

GENERATIVE RELATIONAL ECONOMICS

VOLUME I

Foundations, Constitution, and Ontology
of Generative Relational Economics

FOUNDATIONS • CONSTITUTION • ONTOLOGY

WANHONG HUANG

GENERATIVE RELATIONAL ECONOMICS

Seven-Volume Treatise

Volume I

**Foundations, Constitution, and Ontology
of Generative Relational Economics**

Chapters 1–4

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Series Structure

Generative Relational Economics is organized as a seven-volume treatise. Chapter numbering remains continuous across the series.

Volume I. *Foundations, Constitution, and Ontology of Generative Relational Economics* (Chapters 1–4)

Volume II. *Epistemology, Research Praxis, and Relational Inquiry* (Chapters 5–7)

Volume III. *Generative Relational Inquiry and Integrated Research Design* (Chapters 8–9)

Volume IV. *Application-Dominant Praxis, Intervention, and Economic Architecture* (Chapters 10–12)

Volume V. *Allocation, Value, Spacetime, Power, and Epistemic Economy* (Chapters 13–17)

Volume VI. *Artificial Intelligence, Domains, and Economic Order* (Chapters 18–21)

Volume VII. *Research Programme, Disciplinary Interfaces, Limits, and Open Development* (Chapters 22–25)

The seven-volume division is a physical and editorial organization of the same continuous manuscript. Existing chapter identities, section numbering, notation, bibliography records, and conceptual architecture are preserved. The additional physical volume allows the edition to remain within the publisher's 1,050-page ceiling without compressing the typography or splitting chapters.

Preface

This book develops *Generative Relational Economics* (GRE) as an open research programme for studying economic life through relations, generative processes, historical transformation, heterogeneous forms of value, and the conditions under which present arrangements alter future possibilities. Its point of departure is economic, but the questions that must be answered before a relational-generative economics can be stated coherently are broader. A theory of economic relations requires a view of what kinds of realities may be treated as analytically real; claims about those realities require an epistemology; empirical work requires a research praxis and methodology; and economic intervention requires an account of decision and action under incomplete knowledge. The book therefore develops a limited set of broader Generative Relational (GR) foundations before returning to substantive economics.

The resulting architecture should not be read as a claim that economics contains ontology, epistemology, history, law, governance, aesthetics, or the other domains with which it interacts. The opposite discipline governs the project. A domain remains defined by its principal problem-space while retaining explicit interfaces with neighboring domains. GRE draws historical insight from generative relational approaches to history, governance insight from neighboring work on generative relational governance, and normative and aesthetic resources where economic questions require them. Those interfaces remain interfaces. They do not dissolve the boundaries among disciplines.

The central economic concern is the generation and transformation of relational possibilities. Conventional allocation questions remain important, but an allocation does more than change holdings. It may stabilize or weaken relations, generate capacities, alter access, reshape institutions, change the pathways through which heterogeneous values circulate, and modify what later actors are able to do. GRE therefore follows resources beyond the administrative recipient and asks how economic interventions enter relational structures and how those structures develop through time.

This orientation also changes the treatment of value. The book does not assume that all values can be placed in a single common metric. Material, capability, relational, epistemic, institutional, future, and other forms of value may interact without becoming fully commensurable. Their conversion is therefore an economic problem in its own right. GRE asks what happens at conversion interfaces, which actors can define or control those interfaces, what is lost or generated in conversion, how value circulates and returns, and how power and justice appear when heterogeneous values move through unequal relational systems.

Historical time is equally central. Economic processes operate across different temporal scales. Transactions, prices, attention, organizational routines, institutions, trust structures, infrastructures, and intergenerational capacities need not change at comparable rates. The book consequently treats trajectories, delayed generation, path dependence, multiple timescales, and

cross-scale coupling as economic objects rather than as secondary complications. Formal descriptions such as dynamical systems, networks, fields, geometry, category-theoretic structures, or spacetime-like representations are used where they clarify such problems. They remain analytical representations whose scope must be justified locally; they do not establish the ultimate ontology of social or economic reality.

The book also treats research itself as praxis. Historical, interpretive, qualitative, quantitative, empirical, formal, and computational methods provide partially irreducible modes of access to relational-generative systems. Their relation is therefore neither a hierarchy nor a simple synthesis. They can expose one another's blind spots, constrain one another's overreach, and generate revisions of concepts and theories. Research-dominant praxis and application-dominant praxis are likewise related configurations rather than separate worlds. Research contains decisions and interventions; application contains inquiry and learning. Their principal tensions differ, and either may transform into the other as the practical situation changes.

Artificial intelligence makes several of these questions more urgent. Large asymmetries in productive and epistemic capability may persist even where material output becomes abundant. Such asymmetries raise economic questions about ownership, dependence, participation, access, value capture, research orientation, and the relation between productive contribution and social membership. GRE approaches these questions without assuming that capability equality is either possible or desirable. The relevant issue is how heterogeneous capabilities enter relations and how those relations convert asymmetry into power, exclusion, participation, or new generative possibilities.

The programme offered here is deliberately revisable. Earlier GR formulations, including earlier historical and formal proposals, are treated as intellectual resources rather than canonical premises. A useful distinction may later fail in another domain; a formal analogy may lack empirical warrant; a theory may require a narrower scope; an apparently general GR structure may turn out to be economics-specific. Revision is therefore part of the framework's normal development rather than an exceptional repair.

For the same reason, GRE is presented in dialogue with existing economics rather than as a replacement for it. Neoclassical, Marxian, Keynesian, institutional, evolutionary, complexity, feminist and care, capability, ecological, commons, relational, and other traditions have developed objects, mechanisms, methods, and normative distinctions that GRE can learn from. A relational language may sometimes make translation among these traditions possible. Translation does not imply theoretical identity. Some disagreements should remain visible because they concern different ontologies, values, methods, scales, or historical commitments.

The book is consequently best read as an architecture for continuing inquiry. It makes substantive claims, proposes hypotheses, develops conceptual distinctions, and offers formal and methodological resources, while marking open problems and places where counterevidence would require revision. Its intended endpoint is not a closed economic system. It is a research programme capable of entering new relations, being altered by them, and preserving enough of its own history for later readers to understand how those alterations occurred.

Standing of the Work

This volume is a book-length statement of Generative Relational Economics as a developing research programme. Its standing is stronger than that of a preliminary note and weaker than that of a closed theoretical system. The distinction matters because the chapters contain several kinds of intellectual object whose evidential and argumentative status differs.

A *claim* is a proposition for which the book supplies an argument at the level required by its local purpose. A *proposal* identifies a conceptual or theoretical structure offered for further assessment. A *hypothesis* states a mechanism or relation whose standing ultimately depends on empirical, historical, or formal investigation beyond the argument that motivates it. A *heuristic* organizes inquiry without asserting that the represented structure literally constitutes the world. A *formal representation* specifies a mathematical or structural language under explicit assumptions. These categories should remain distinct throughout the manuscript.

The broader GR material in the book has a similarly limited standing. GRE is the principal domain. General ontological, epistemological, research-practical, and application-practical foundations are developed only to the degree required to construct GRE. The volume does not claim to provide a completed Generative Relational Theory across all disciplines. A more general theory would require sustained comparison across independently developed domains, including cases in which concepts useful in economics fail, change meaning, or become unnecessary elsewhere.

Ontological suspension provides the default discipline for that reason. Relational reality and manifestational reality are treated as analytically meaningful without requiring a final metaphysical settlement for every object under study. Formal language may sharpen a relational description, but formal usefulness does not by itself establish ontological identity. A field representation, a network, a dynamical system, a category-theoretic mapping, or a spacetime-like model earns its place through the question it helps answer and the evidence or interpretation to which it can be connected.

The historical standing of the programme is equally important. Earlier GR and GRH formulations are open to correction. The present book may retain an earlier distinction, weaken it, change its status from ontology to heuristic, or set it aside. Such changes should remain reconstructable rather than being hidden by retrospective rewriting. The research programme therefore values provenance, versioned concepts, preservation of negative results, and future re-epistemization.

GRE also declines several forms of premature closure. It assumes no single universal metric of value, no predetermined historical endpoint, no universal formalism, and no methodological monopoly. Generativity itself is not treated as automatically good. A process can generate capacities, relations, or options while also producing domination, extraction, exclusion, or

harm. Normative evaluation therefore remains an independent task informed by, rather than mechanically derived from, generative description.

The volume's relationship to existing economics is dialogical. Existing theories can correct GRE, delimit its scope, or supply better explanations for particular problems. GRE can also provide a comparative relational language through which theories that foreground different objects or scales may encounter one another. The success of such translation must be assessed case by case. Failed translation is itself informative because it identifies theoretical specificity that a common language should not erase.

The same discipline governs application. The book develops application-dominant praxis because economic actors often must decide before knowledge is complete. Decisions remain epistemically regulated, historically situated, normatively contestable, and revisable where reversal is possible. Practical closure is therefore distinguished from epistemic closure. Acting under uncertainty does not convert uncertainty into knowledge; it establishes a provisional commitment whose consequences become part of the next epistemic situation.

The work should therefore be evaluated at several levels: the coherence of its conceptual distinctions, the adequacy of its reconstructions, the quality of its dialogue with existing theories, the warrant of its formal representations, the empirical tractability of its hypotheses, and the practical usefulness of the questions it makes available. No single success at one level secures the others. The open research programme begins from that plurality of burdens.

Guide to the Book

The book is organized into eight Parts. The sequence is cumulative, although individual chapters can be read independently when a reader already accepts the foundations on which they rely.

Part I: Foundations and Constitution of Generative Relational Economics. The opening Part reconstructs the historical conditions under which GRE becomes necessary and possible, surveys the intellectual resources from which it can be constructed, and defines GRE as an emerging economic research programme. The emphasis is disciplinary: the Part explains the problem-space before introducing the broader GR foundations required later.

Part II: Ontology and Epistemology. The second Part develops the ontological view and epistemology used by the remainder of the book. Ontological suspension, relational reality, manifestational reality, representation, evidence, and the limits of inverse inference establish the conditions under which later economic claims can be made without converting analytical representations into final metaphysical commitments.

Part III: Research Praxis and Methodology. The third Part treats research as a historically situated form of praxis. It develops methodological pluralism across historical, interpretive, qualitative, quantitative, empirical, formal, and computational inquiry; then it develops methods for relational inquiry, generative relational inquiry, and integrated research design. Readers primarily interested in empirical or formal GRE can use this Part as the methodological gateway to the substantive economic chapters.

Part IV: Application-Dominant Praxis and Methodology. The fourth Part shifts the principal practical tension from understanding toward decision and intervention under incomplete knowledge. It develops action spaces, practical judgment, risk, reversibility, participation, responsibility, adaptive intervention, and the methodological instruments used for decision and institutional change. Research and application remain coupled throughout.

Part V: Foundations of Substantive Generative Relational Economics. The fifth Part returns fully to the economic domain. It develops the relational architecture of economic systems, allocation as relational intervention, generative and heterogeneous value, and generative spacetime. This Part contains the main conceptual machinery for following resources and values through relational structures across time and scale.

Part VI: Power, Knowledge, and Artificial Intelligence. The sixth Part develops several major consequences of substantive GRE. Power and justice are examined through asymmetry, conversion, capture, participation, and generative opportunity. The epistemic economy extends the analysis to knowledge abundance, attention, curiosity, aesthetic judgment, and research orientation. The final chapter of the Part examines artificial intelligence under radical capability and knowledge asymmetry.

Part VII: Domains and Economic Synthesis. The seventh Part examines selected domains in which GRE can be tested, translated, and limited. The purpose is not to absorb education, research institutions, humanitarian practice, communities, commons, ecology, or other domains into economics. Domain work identifies where GRE is useful, where neighboring theories are required, and where apparently general concepts become domain-specific. The Part concludes with a synthesis of the economic orders made thinkable by GRE.

Part VIII: Dialogue, Research Programme, and Disciplinary Return. The final Part turns the framework back toward economics as a discipline. Existing economic traditions are reconstructed in relational dialogue without ranking or forced unification. The book then states a GRE research programme, identifies interfaces with neighboring GR domains, records limits and open problems, and closes with GRE's standing as an open and historically revisable programme rather than a finished canon.

Readers can therefore enter the book at different points. A reader interested in foundations should begin with Parts I and II. A methodological reader can move from Chapter 6 through Chapter 11. A reader primarily interested in GRE's economic contribution can begin with Part V and return to the earlier foundations as needed. Readers concerned with AI, epistemic economy, power, or justice may begin in Part VI, while Part VIII provides the most direct account of GRE's relationship to existing economics and its future research agenda.

Cross-references are used to keep these entry points possible without pretending that the chapters are independent. Concepts are introduced where they first become structurally necessary, and later chapters should reuse rather than silently redefine them. Where a concept changes status or scope, the revision should be stated explicitly.

AI Assistance Statement

Artificial intelligence has been used as an assistive research and writing instrument in the development of this book. Its uses include structural planning, language revision, comparison of alternative organizations, code generation for manuscript tooling, compilation support, exploration of formal representations, and assistance in maintaining consistency across a long and evolving project.

AI assistance does not function as an evidential authority. External references are subject to a pre-verification rule: a source must be checked against an authoritative or reliable online record and against the claim it is intended to support before the citation is inserted into the manuscript. Bibliographic verification, claim selection, theoretical commitments, normative judgments, and responsibility for the final text remain with the author.

The use of AI is also treated as part of the book's substantive research problem. Abundant generation of prose, models, hypotheses, and technically difficult questions does not eliminate the need for research judgment. Problem selection, historical sensitivity, relational interpretation, aesthetic judgment, normative responsibility, and decisions about theoretical significance remain distinct tasks even when generative capacity is extensively automated.

Because the project is developed through iterative human–AI interaction, intermediate drafts may contain exploratory formulations that are later revised or abandoned. The standing of the published text is determined by the final human-reviewed manuscript rather than by any individual intermediate generation. Revision histories and project materials are preserved where useful so that the development of the programme remains reconstructable.

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Chapter 1

Historical Conditions of the Contemporary Economy

This chapter establishes the historical ground from which Generative Relational Economics (GRE) becomes intelligible as a contemporary economic research programme. Its role within Part I is preparatory and diagnostic. Before the book reconstructs the intellectual lineages of GRE in Chapter 2 or states its disciplinary constitution in Chapter 3, the present chapter asks what historical transformations make a relational and generative reconsideration of economic life increasingly salient. The objective is therefore to locate GRE within a changing material, institutional, epistemic, and technical environment. The chapter treats economic categories, economic subjects, and economic objects as historically stabilized formations whose analytical usefulness depends on the conditions under which they are produced, recognized, and governed.

The discussion follows a historical-material orientation without reducing economic thought to a mechanical reflection of productive conditions. Economic concepts emerge within relations among productive forces, institutions, law, administrative practice, scientific techniques, political norms, and historically specific problems of coordination and allocation. Categories such as labor, capital, property, firm, household, scarcity, and allocation acquired particular analytical force because modern economic orders made corresponding subjects, resources, and transactions increasingly legible and actionable. Entity-centered and allocation-centered approaches therefore appear in this chapter as historically successful abstractions with identifiable scope conditions. Their historical success forms part of the explanation for GRE's emergence, because a new framework has to account for the achievements of inherited abstractions as well as the situations in which those abstractions become strained.

The chapter develops its argument through three connected movements. Sections 1–7 reconstruct the historical formation of economic categories, economic problematics, modern institutional entities, allocation mechanisms, and differentiated sources of economic power. Sections 8–18 then follow the expansion of relational production through organizational interdependence, transnational networks, digital mediation, artificial intelligence, changing forms of scarcity, capability asymmetry, symbolic abundance, and the destabilization of inherited economic subject positions. This middle movement gradually shifts the analytical focus from entities considered

in relative isolation toward relations that constitute subjects, distribute capacities, and alter future possibilities. Sections 19–27 examine the scientific, computational, evidential, political, legal, and institutional conditions that make richer relational and generative analysis increasingly feasible, while also identifying the epistemic and governance limits that accompany this expansion of analytical capacity. Sections 28–29 synthesize these developments into an account of the historical opening, possibilities, and limits of GRE.

A central distinction throughout the chapter concerns the difference between relational importance and generative importance. Economic life has always depended on relations. The contemporary issue is that more of what matters economically is becoming difficult to understand through recipient-level states, isolated transactions, or stable entity boundaries alone. Relations can organize access, recognition, dependence, knowledge, authority, and productive coordination; they can also transform the capacities of the participants and the conditions under which later relations become possible. Generative analysis begins when the object of inquiry includes these downstream transformations: the production of new subjects, capabilities, constraints, institutional forms, option spaces, and transformation rules. GRE therefore enters the chapter gradually, after the historical and institutional conditions that motivate this extension have been reconstructed.

The same historical transformations that enlarge the relevance of relational and generative analysis also enlarge the risks of overclaiming. Digital infrastructures increase observability while creating new possibilities for surveillance and classification. Computational capacity enables larger and more heterogeneous models while increasing dependence on representation, parameterization, and model selection. Artificial intelligence expands productive and analytical capacity while intensifying questions concerning concentration, epistemic dependence, subjecthood, and the conversion of capability asymmetry into economic power. Political participation, human-rights recognition, capability-oriented development, commons institutions, and environmental or intergenerational concerns broaden the range of economically relevant relations and values, while preserving normative plurality. The chapter therefore treats technical possibility, evidential possibility, institutional possibility, and normative justification as distinct dimensions.

The resulting historical claim is modest in form and substantial in consequence. GRE is situated within a period in which relational and generative processes have become increasingly consequential for production, allocation, subject formation, value creation, knowledge, and power; while contemporary analytical infrastructures make those processes more accessible to systematic inquiry. This conjunction supplies neither a proof of GRE nor a prediction that economics must converge toward it. It establishes a problem-space in which GRE can be developed, compared with existing theories, tested against evidence, and revised through later inquiry. The next chapter turns from these historical conditions to the intellectual lineages and theoretical resources through which such a programme becomes conceptually possible.

1.1 Material Conditions of Economic Thought

This section establishes the historical-material premise of the chapter. Its role is to explain how economic categories, analytical objects, and preferred abstractions acquire their scope within historically specific social orders. The objective is narrower than a general philosophy of economic knowledge: the discussion identifies material, institutional, and epistemic conditions that make particular forms of economic reasoning possible, useful, and credible at particular moments. The argument proceeds in five stages. It first treats economic categories as historical formations; it then considers how productive capacities alter the practical and epistemic environment of inquiry, how relations of production become stabilized through institutions, how abstraction depends on historically available techniques of representation, and how the objects recognized by economics can change with these conditions. The method is historical and interpretive. Several established traditions are used as partial resources for specifying the problem, while the chapter keeps their stronger ontological and teleological commitments open for later examination.

The guiding position is that economic thought develops within the same world it seeks to describe. Changes in production, administration, law, measurement, communication, and institutional organization therefore have a double relevance: they alter economic life, and they alter the evidence, categories, and representations through which economic life becomes intelligible. Marx's materialist formulation is important for the first dimension because it connects productive forces, relations of production, and forms of social consciousness while locating legal and political forms within a wider material configuration (Marx 1859). Historical studies of quantification and statistics are important for the second dimension because they show that objectivity, classification, and measurement acquire authority through specific institutional settings and practical demands (Porter 1995; Desrosières 1998). GRE takes these contributions as reasons to historicize its own concepts. A theory that treats institutions, subjects, and values as generated within relations should also expect its categories to bear traces of the historical conditions under which they became thinkable.

1.1.1 Economic Categories as Historical Formations

The first analytical task is to distinguish the recurrence of an economic phenomenon from the historical stability of the category used to describe it. Exchange, provisioning, obligation, accumulation, scarcity, and coordination occur across very different social formations. Their recurrence leaves open whether the same analytical category has the same extension, institutional support, or causal role in each setting. A category such as labor, property, market, capital, household, or economy becomes analytically determinate through a historically specific configuration of practices, institutions, legal forms, measurement procedures, and relations among participants. Historical ontology provides a useful philosophical vocabulary for this point because concepts and objects can emerge together with new styles of reasoning and new practices of classification (Hacking 2002). The implication for GRE is methodological: historical inquiry concerns the formation and stabilization of an economic object together with the vocabulary and practices through which that object becomes describable.

Marx's critique of political economy offers an early and influential formulation of this historical specificity. In the 1859 Preface, relations of production are linked to a

definite stage in the development of material productive forces, and legal and political forms are treated as historically connected with that economic structure (Marx 1859). The relevance here lies in the mode of inquiry. Stage claims and teleological implications associated with later readings of historical materialism remain separate questions. Economic categories acquire their content within determinate social relations. Capital, for example, is analytically different from a generic stock of useful objects because the category refers to a structured relation among property, production, labor, exchange, and accumulation. The same discipline applies to categories that appear more neutral. A household, a firm, a worker, or a market becomes an analytical unit through institutional and representational practices that determine which relations are treated as internal, external, relevant, or invisible.

Polanyi's historical account strengthens this point from a different direction. His analysis of nineteenth-century market society treats the expansion of market relations as part of a historically specific reorganization of economic and social relations (Polanyi 1944). This perspective matters for GRE because it shifts attention from the mere presence of exchange to the organization of exchange within a wider relational order. A market category may be analytically adequate in one domain and much less adequate when generalized across activities organized by reciprocity, household provision, public obligation, care, or other institutional forms. Historical specificity therefore constrains both the object under analysis and the permissible range of abstraction.

The historical character of categories also applies to the category of "the economy" itself. Mitchell reconstructs the modern understanding of the economy as a bounded totality of production, distribution, and consumption as a product of a mid-twentieth-century transformation in economic representation (Mitchell 1998). This example is important because changes in economic theory can accompany changes in the scale and boundary of the object itself. Once a national economy is represented as an integrated totality, questions about aggregate output, demand, employment, growth, and management become newly central, while many relations remain outside the principal frame. The formation of an economic category can therefore be an epistemic gain and a selective construction of visibility at the same time.

GRE adopts this historical stance while preserving standards of analytical adequacy. Categories can be more or less adequate to the relations they are used to analyze, and historically formed categories can still identify durable mechanisms or recurrent structures. The relevant discipline is to separate analytical usefulness from presumed timelessness. A category earns its place through the work it performs in a specified relational and historical domain, and its continued use remains open to revision when the domain, evidence, or relations change.

1.1.2 Productive Forces and Forms of Economic Knowledge

The second analytical task is to identify how transformations in productive capacity alter the environment in which economic knowledge is produced. Productive forces are used here in a broad historical sense that includes material techniques, energy systems, transport, communication, computational capacity, organizational techniques, and the skills through which production can be coordinated. Their development changes the practical problems that demand explanation and the epistemic possibilities available for explaining them. GRE treats the relation between produc-

tive capacity and theory as historically mediated and contingent. Marx's formulation remains useful because it directs attention to the relation between changing productive capacities and changing relations of production while leaving room for more specific mechanisms through which knowledge responds (Marx 1859).

Changes in productive capacity can affect economic knowledge through several channels. New forms of production can generate new contractual relations, organizational units, and coordination problems. Changes in transport and communication can enlarge the spatial scale at which economic activity is coordinated. Changes in recording and computation can alter temporal resolution, making processes observable continuously or at shorter intervals. Productive development can also create new evidential infrastructures. Accounting systems, censuses, surveys, standardized classifications, and computational records participate in determining which economic differences can be aggregated, compared, and acted upon.

The history of quantification makes this point especially clear. Porter argues that the authority of quantitative objectivity developed partly in response to institutional demands for impersonal and standardized judgment across settings such as government, business, engineering, and social inquiry (Porter 1995). Desrosières reconstructs statistical reasoning through the history of classification, coding, aggregation, correlation, and modeling, emphasizing the conventions through which heterogeneous cases become comparable (Desrosières 1998). These histories place measurement inside the institutional history of economic knowledge. Measurement practices can become part of economic reality because decisions, eligibility, budgets, targets, and expectations are organized around the quantities they produce.

This observation is central to the historical possibility of GRE. Earlier economic thought analyzed relations with the conceptual and technical resources then available. Contemporary computation changes the tractability of relational questions by making large networks, longitudinal records, higher-order interactions, and multi-scale simulations technically accessible. A relation-centered or generative analysis therefore has a historical condition of possibility in the development of computational and evidential infrastructures, while its concepts retain analytical content beyond the infrastructures that support their investigation. Contemporary productive forces enlarge the possibility of GRE by making certain relational and generative questions more systematically researchable than under earlier technical conditions.

The same development creates new epistemic risks. Expanding measurement can encourage the identification of an object with its measurable manifestation. A productive system may become legible through variables that are administratively stable while remaining partial descriptions of its relational structure. Large computational representations can intensify this tendency by creating an appearance of completeness through scale. GRE therefore treats technical capacity as an expansion of possible inquiry accompanied by a stronger requirement to distinguish relational reality, manifestation, and representation. Productive forces transform both the reach of economic knowledge and the forms of error that economic knowledge can institutionalize.

1.1.3 Relations of Production and Institutional Form

The third analytical task is to connect economic relations with the institutional forms that stabilize them. Relations of production concern organized positions in produc-

tion, access to resources, authority over decisions, claims on output, and the conditions under which participants enter, remain within, or leave a productive arrangement. These relations become durable through legal, organizational, administrative, cultural, and infrastructural forms. Institutional form therefore participates in constituting the economic relation and the terms under which that relation can be recognized.

The materialist tradition provides one route into this problem by linking property relations and relations of production with stages of productive development (Marx 1859). Polanyi provides another by showing that market society depended on institutional transformations that reorganized the relation between economic exchange and wider social life (Polanyi 1944). Read together while preserving their differences, these approaches support a modest claim useful to GRE: productive activity is mediated by historically specific institutional arrangements, and changes in those arrangements can transform the economic meaning of otherwise similar acts. The transfer of an object, the performance of labor, or the provision of care can occupy different economic positions depending on property rules, contractual status, household organization, public provision, professional classification, and institutional recognition.

Institutional form also affects the scale at which economic entities appear coherent. A corporation can be treated as a unit in accounting, law, taxation, and contract because multiple internal relations are condensed into a recognized organizational person. A household can appear as a consumption unit, a care relation, a property-sharing arrangement, or an internally differentiated organization depending on the institutional and analytical frame. The same nominal entity can therefore support multiple relational descriptions. GRE later develops this point as a problem of economic architecture; its historical implication belongs here because the apparent stability of entities is partly an achievement of institutional form.

The relation between institution and economic knowledge is recursive. Institutions stabilize categories, and categories feed back into institutions. Once an administrative system recognizes a class of worker, firm, asset, household, industry, or transaction, the category can organize reporting, eligibility, taxation, regulation, contracting, and comparison. Desrosières' history of statistical classification is relevant because classification and encoding are practical operations that help create standardized populations for analysis (Desrosières 1998). Hacking's historical ontology supplies a broader philosophical formulation: classifications and styles of reasoning can participate in the historical emergence of the objects to which they refer (Hacking 2002). In economic life, institutional categories can therefore become causally effective while remaining partial representations of the relational realities they organize.

GRE approaches institutional form through two linked concerns. Stabilization concerns the rules, classifications, infrastructures, and expectations that make a relation durable enough to function as an economic object. Transformation concerns changes in those supports that alter the relation itself. This dual focus treats institutions as historically generated relational arrangements that condition later economic action while remaining open to reproduction, contestation, and change.

1.1.4 Economic Abstraction under Historical Constraints

The fourth analytical task concerns abstraction. Abstraction is constitutive of economic inquiry because comparison, aggregation, and explanation require some dif-

ferences to be suppressed. The historical question concerns which abstractions become credible, operational, and institutionally consequential under particular conditions, together with the relations that disappear when those abstractions are generalized beyond their domain of adequacy.

Quantification provides a clear example. A numerical category can coordinate judgment across distance by replacing local variation with standardized comparison. Porter emphasizes that quantitative objectivity gained authority partly because it could support impersonal forms of decision under institutional conditions in which reliance on individual discretion was difficult or contested (Porter 1995). Desrosières shows that statistical reasoning depends on conventions of equivalence through which heterogeneous cases are classified and made comparable (Desrosières 1998). These accounts reveal abstraction as an institutional achievement. A statistical aggregate becomes useful because differences judged irrelevant to a task have been suppressed in a repeatable way.

Economic abstraction is constrained by the historical availability of such operations. A national aggregate presupposes classifications, territorial boundaries, reporting systems, institutional capacities, and conventions through which dispersed activities can be treated as commensurable. Mitchell's account of the emergence of "the economy" demonstrates how representation helped establish a national economic totality as an object of expertise and intervention (Mitchell 1998). The abstraction made aggregate economic management thinkable, and the gain depended on a selective boundary around the relations represented. Every successful abstraction therefore establishes an analytical field together with a remainder.

For GRE, the remainder has methodological importance. Entity-centered accounting can be highly effective for questions concerning ownership, liability, taxation, or the direct recipient of a transfer. The same abstraction can be insufficient when the research question concerns how a transfer changes trust, dependence, coordination, knowledge, or future relational capacity. A graph representation may reveal connectivity while suppressing legal meaning; an ethnographic reconstruction may recover meaning while offering weak estimates of prevalence; a macroeconomic aggregate may represent total activity while hiding the distribution of relational conditions that generated it. The appropriate response is explicit specification of the abstraction's object, excluded differences, and historical conditions of usability.

This perspective also changes the interpretation of theoretical disagreement. Two economic theories can appear to conflict because they abstract at different scales, stabilize different objects, or preserve different relations. A theory centered on individual choice and a theory centered on institutions may produce incompatible descriptions when each is treated as complete, while still identifying real structures at different levels. GRE later develops translation among theories as a distinct research programme. The material point established here is prior: abstraction is historically conditioned, and theoretical categories should be evaluated partly by the relations they preserve and the relations they suppress.

1.1.5 Transformation of Economic Objects across Historical Periods

The final analytical task draws the preceding arguments together into a historical view of changing economic objects. Economic history includes changes in quantities

and institutions, and it also includes changes in what can appear as an economic object in the first place. New forms of production, administration, measurement, and political organization can stabilize entities and aggregates absent from earlier analytical languages or differently organized within them. Hacking's account of historically emergent concepts and objects provides a general philosophical frame for this possibility (Hacking 2002). Mitchell's reconstruction of the twentieth-century emergence of "the economy" provides a specifically economic example in which a new bounded object of macroeconomic representation became available to expertise and intervention (Mitchell 1998).

This transformation concerns relational visibility and institutional coordination. Activities later assembled into a national economy existed before the aggregate became a dominant object of analysis. The historical change lay in the representational and institutional configuration through which those activities could be organized as one object, measured through common categories, and treated as a target of coordinated intervention. A similar caution applies to newer objects. Data, attention, platform intermediation, algorithmic labor, knowledge infrastructures, and artificial productive capacity can become increasingly salient to economics because productive relations and measurement systems make their economic effects more visible and more consequential. Their appearance as economic objects therefore reflects both underlying changes in relations and changes in the apparatus through which those relations are represented.

The historical transformation of objects has two consequences for GRE. First, the field should expect its own object list to remain open. Relations, capacities, constraints, value forms, and generative possibilities that are analytically peripheral today may become central under different productive and institutional conditions. Second, economic theory should preserve the historical provenance of its categories. A concept developed for industrial wage labor, territorially organized markets, or nationally bounded accounting may continue to be useful under digital and transnational conditions, yet its range of adequacy requires renewed examination when the relations denoted by the term change. Historical continuity of terminology can conceal transformation in the underlying relational structure.

The historical-material argument developed in this section therefore establishes a limited premise: economic categories and objects are historically conditioned, and transformations in productive forces, institutional relations, and representational capacities can change both the economy and the forms of knowledge through which it becomes intelligible. The subsequent sections examine how modern entity-centered economic structures were historically stabilized, how digitalization and artificial intelligence strain some inherited abstractions, and why contemporary scientific and computational conditions create a specific opening for relational and generative economic analysis.

1.2 Genealogy of Economic Problematics

This section reconstructs a selective genealogy of the problems that have organized modern economic inquiry. Its role is to show how the center of economic analysis has shifted as productive arrangements, institutions, and techniques of representation changed. The objective is analytical rather than encyclopedic: the discussion follows

five recurring problem-fields—wealth and exchange, production and division of labor, labor and capital, allocation and welfare, and information and institutions—and examines how each made particular economic relations visible while placing others in the background. The method is genealogical and comparative. Canonical works are used as indicators of changing problem-spaces, without treating the history of economics as a linear succession in which one problematic simply replaces another. Earlier questions persist, are reformulated, and often return inside later frameworks with altered meanings.

A genealogy of problematics differs from a chronology of doctrines. Chronology asks which theory came first and which school followed. Genealogy asks what had to become practically consequential and analytically representable for a particular question to acquire disciplinary centrality. The relevant movement is therefore one of changing emphasis. Wealth remains relevant after production becomes central; production remains relevant after allocation is formalized; allocation remains relevant when information and institutions enter the analysis. What changes is the configuration of problems through which economic reality is rendered intelligible. This section prepares the later historical argument by showing that modern economics was repeatedly reorganized around newly salient relations rather than by a single permanent definition of its subject matter.

1.2.1 Wealth and Exchange

The first problematic considered here concerns the production, circulation, and composition of wealth. In early modern political economy, wealth was inseparable from questions of trade, money, revenue, taxation, and the conditions under which national production could expand. Adam Smith's *An Inquiry into the Nature and Causes of the Wealth of Nations* makes the scale of this problematic explicit in its title and organization. The opening books move from the productive powers of labor through division of labor, money, prices, wages, profits, and rent before extending the analysis to accumulation, trade, public revenue, and state expenditure (Smith 1776). The object called wealth was therefore already relationally distributed across production, exchange, class incomes, public institutions, and international commerce.

Exchange acquired analytical importance because it offered a visible interface among otherwise heterogeneous activities. Money prices, market transactions, and trade flows provided forms in which dispersed production could be compared and coordinated. Smith's analysis of money and market exchange did not reduce social wealth to circulation alone, yet exchange supplied a tractable surface on which value, price, and distribution could be investigated. The practical importance of expanding markets reinforced this analytical role. Exchange connected local productive activity to wider systems of demand, specialization, taxation, and accumulation, making the relation between individual transactions and national prosperity a durable economic question.

Ricardo's *On the Principles of Political Economy and Taxation* sharpened this problematic by organizing analysis around value, rent, wages, profits, foreign trade, taxation, machinery, and the distribution of the social product (Ricardo 1817). The book's structure reveals a significant shift in emphasis. Wealth and exchange remain central, yet their analysis increasingly depends on the distributional relations among classes and on the conditions of production that determine rents, wages, and profits.

A transaction can no longer be understood solely as an exchange between two owners; it participates in a wider distributional structure whose effects become visible only when production and class positions are included.

For GRE, the significance of this early problematic lies in the relation between visibility and abstraction. Exchange produces highly legible manifestations: prices, quantities, payments, debts, and transfers. These manifestations can be recorded, compared, and aggregated. They therefore provide a powerful analytical interface with economic reality. The same visibility can privilege relations that culminate in exchange over relations whose effects are indirect, delayed, or institutionally unpriced. Care, trust, knowledge formation, environmental reproduction, and the maintenance of social capacities may condition exchange while appearing only weakly within the transaction itself. The genealogy of wealth and exchange thus supplies an early example of a recurring theme in this book: analytically successful manifestations can organize a field of inquiry while leaving part of the generative structure outside the dominant representation.

1.2.2 Production and Division of Labor

The production problematic shifts attention from the circulation of finished goods toward the organization of productive activity. Smith's treatment of the division of labor is a canonical expression of this move. He attributes major improvements in the productive powers of labor to specialization and links the extent of specialization to the extent of the market (Smith 1776). Productivity, on this account, is already relational in a straightforward sense: the output of an individual worker depends on an organized division of tasks, the circulation of intermediate outputs, accumulated skills, tools, and a market large enough to sustain specialization.

The analytical importance of division of labor extends beyond the familiar claim that specialization raises productivity. It changes the unit through which productive capacity is understood. A worker's output cannot be read only from individual effort or skill because productivity is partly constituted by the position occupied within a differentiated productive arrangement. The pin factory is analytically important precisely because the productive effect appears at the level of coordination among tasks. Individual capacities matter, yet their economic effect depends on sequencing, complementarity, repetition, tools, supervision, and the relation between the workshop and its market.

This transformation also introduces dependence as an economic fact. Greater specialization increases productive power while making participants more reliant on activities performed elsewhere in the system. The same relation that raises output can narrow self-sufficiency. A productive order therefore generates capacities and dependencies together. Classical political economy did not need the later language of networks or relational fields to identify this structure; division of labor made interdependence visible through the organization of production itself.

The problem of coordination follows immediately. Once production is divided, economic analysis must explain how differentiated activities become mutually compatible. Market exchange supplies one answer, managerial organization another, custom and institution others. The division of labor therefore sits at an intersection between production and coordination. It makes clear that an economy cannot be represented only as a collection of independent producers because the productivity of each par-

ticipant depends on relations that organize the activity of others.

GRE later develops this point in stronger form by asking which relations generate capacities that cannot be assigned to any isolated participant. The present historical section makes a more limited claim. The rise of the production problematic already shifted economic inquiry toward arrangements in which outcomes are properties of organized relations. This prepared the ground for later theories of the firm, industrial organization, networks, institutions, and collective productive capacity.

1.2.3 Labor, Capital, and Industrial Production

Industrialization deepened the production problematic by stabilizing labor and capital as central analytical categories. Ricardo's analysis of wages, profits, and rent placed distribution among classes close to the center of political economy (Ricardo 1817). Marx's *Capital* subsequently reorganized the field around the production process of capital, including the purchase of labor-power, the labor process, surplus value, cooperation, manufacture, machinery, and modern industry (Marx 1867). The economic object under investigation became increasingly processual: capital was analyzed through accumulation and reproduction, while labor appeared both as human activity and as a socially organized relation within production.

The shift matters because industrial production makes the economic effect of institutional position difficult to ignore. The worker and the owner enter production with different claims over productive assets, different forms of dependence, and different capacities to appropriate the resulting output. These positions are sustained by property, contract, labor markets, organizational authority, and the material concentration of productive means. Industrial economic analysis therefore cannot remain at the level of exchange among formally equivalent owners. The exchange of a wage for labor-power is embedded within a productive structure that determines what each party can contribute, control, and claim.

Marx's analysis is especially important for the genealogy pursued here because it treats production relations as constitutive of the economic process rather than as external conditions surrounding exchange. Cooperation and machinery do more than raise a given worker's productivity. They reorganize the labor process, concentrate control, alter skill requirements, and transform the relation between workers and the means of production (Marx 1867). Industrial production consequently generates new economic capacities together with new asymmetries. The productive effect of machinery belongs to a configuration involving capital investment, technical knowledge, labor organization, ownership, and markets; its distributional effects depend on the relations through which that configuration is governed.

This industrial problematic also strengthens the importance of reproduction through time. Capital must be maintained and accumulated; labor capacity must be reproduced; firms and institutions must persist; technical systems require replacement, learning, and coordination. Economic analysis therefore acquires an increasingly temporal object. Current output depends on inherited productive structures, and current investment changes the conditions under which later production occurs. The distinction between a present allocation and a future productive capacity begins to matter even before generativity is made explicit as a theoretical category.

GRE does not inherit any single classical or Marxian theory of value, class, or historical development as a complete account. The genealogical lesson is narrower and

more durable. Industrial political economy made visible that economic outcomes arise within structured relations among labor, capital, technology, ownership, and organization. Those relations generate capacities and asymmetries that persist beyond the individual transaction. Later sections of this chapter examine how modern institutions stabilized these relations into recognizable economic subjects such as worker, owner, household, firm, and corporation.

1.2.4 Allocation, Distribution, and Welfare

The allocation problematic reorganizes economic inquiry around choice among alternative uses of scarce means, the distribution of resulting goods and incomes, and the evaluation of economic arrangements. Marshall's *Principles of Economics* retains the older language of production, distribution, exchange, and consumption while developing a more unified analysis around demand, supply, value, and marginal adjustment (Marshall 1890). His treatment illustrates a transition in which economic reasoning increasingly abstracts from the full historical structure of production in order to analyze choice and adjustment within a specified field of alternatives.

Robbins later gave the scarcity formulation a particularly influential methodological expression by defining the economic aspect of conduct in terms of ends and scarce means with alternative uses (Robbins 1932). The significance of this formulation for the present genealogy lies in its portability. Once the economic problem is specified through scarcity and alternative use, the same analytical grammar can travel across households, firms, public budgets, time allocation, and other domains. The gain is considerable: heterogeneous substantive problems can be represented through a common structure of constrained choice. The corresponding methodological question concerns what must already be specified before the allocation problem can be solved—the relevant ends, available means, feasible alternatives, boundaries of the decision, and the units whose welfare or claims enter the analysis.

Welfare economics made these evaluative conditions more explicit. Pigou's *The Economics of Welfare* links economic welfare to the national dividend and examines situations in which private and social net products diverge, thereby making the relation between decentralized economic activity and social evaluation a central problem (Pigou 1920). Allocation consequently becomes more than the placement of scarce resources. It becomes a question about the criteria under which one arrangement is judged preferable to another and about the institutional conditions under which private decisions produce socially consequential effects.

This movement supplied economics with powerful tools for policy analysis because it made trade-offs expressible within comparatively standardized frameworks. Budgets could be allocated, marginal changes compared, and welfare effects discussed with greater analytical discipline. The abstraction also encouraged a recipient-centered representation of policy: resources are assigned to persons, households, firms, sectors, or jurisdictions, and evaluation asks how outcomes change for those units. Under many administrative conditions this is both necessary and effective. Legal responsibility, taxation, eligibility, accounting, and payment systems all require identifiable recipients.

The GRE problem begins where the consequences of allocation exceed the recipient representation. A transfer to a person can change household dependence, trust, mobility, bargaining power, or participation. Funding to an organization can alter

internal authority, external alliances, knowledge flows, and future access to institutions. Infrastructure expenditure can generate option spaces for actors who were not direct recipients. These effects do not invalidate allocation analysis; they reveal an additional layer in which allocation acts through relational structure. The historical importance of the allocation problematic is therefore twofold. It created a highly general language for disciplined choice under scarcity, and it made increasingly visible the need to specify which consequences and relations enter the evaluative frame.

1.2.5 Information, Institutions, and Coordination

Twentieth-century economic inquiry increasingly treated information, organization, and institutions as central to coordination. Hayek's analysis of dispersed knowledge reformulated the coordination problem by emphasizing that the information required for economic adjustment is distributed across participants and is never available in fully concentrated form to a single decision-maker (Hayek 1945). The economic problem thereby acquires an epistemic dimension: coordination depends on how locally held and frequently changing knowledge enters practical adjustment.

Coase's theory of the firm introduced a complementary organizational question. If market exchange coordinates activity through prices, the existence of firms requires an account of why some transactions are organized through authority and internal direction. Coase's answer directs attention to the costs of using the price mechanism and to the boundary between market and organization (Coase 1937). The firm becomes more than a production function or legal owner of assets; it becomes an institutional arrangement that coordinates relations differently from a sequence of market contracts.

Institutional economics extends this shift by treating rules, norms, enforcement, and organizational arrangements as constitutive of economic performance. North characterizes institutions as humanly devised constraints that structure interaction and argues that institutional change shapes economic performance through time (North 1990). This moves the coordination problematic beyond the instantaneous matching of decentralized choices. Economic action occurs within rule systems that shape incentives, transaction costs, expectations, learning, and the feasible forms of organization. History enters because institutional arrangements persist, change incrementally, and condition later choices.

The convergence of information and institutional problems expands the range of relations that economics must represent. Coordination depends on prices, yet also on authority, rules, conventions, trust, expertise, legal recognition, and infrastructures through which information can move. Different arrangements solve different coordination problems and distribute knowledge, discretion, and power differently. A price system can aggregate some dispersed information while leaving organizational knowledge local; a firm can coordinate complex tasks while concentrating authority; an institution can reduce uncertainty while stabilizing rules that later become costly to change.

This expanded problematic provides an important bridge toward GRE. The genealogy traced across this section shows successive enlargements of the economic field: from wealth and exchange, to organized production, to industrial relations among labor and capital, to allocation and welfare, and then to information, institutions, and coordination. The sequence is cumulative rather than substitutive. Contemporary

economic life contains all of these problematics simultaneously, and each preserves analytical strengths developed under different historical conditions.

The implication for GRE is methodological and historical. A generative relational approach should enter this accumulated field as another language of inquiry rather than as a declaration that earlier economics studied the wrong objects. Its distinctive question concerns what becomes visible when relations are examined for the capacities, constraints, subjects, values, and future possibilities they generate. That question arises from the tensions internal to the inherited problematics themselves: exchange depends on production; production depends on coordination; allocation changes relations; institutions shape feasible action; and information is distributed through structures that themselves evolve. The remaining sections of Chapter 1 reconstruct the historical order in which these relations became increasingly consequential and increasingly difficult to treat as fixed background conditions.

1.3 Industrial Modernity and the Modern Economic Order

This section reconstructs the institutional architecture that made the modern economic order simultaneously productive, administratively legible, and analytically tractable. Its role in the chapter is to connect the genealogy of economic problematics developed in Section 1.2 with the later construction of recognizable economic subjects and entities. The objective is to identify the historical configuration in which industrial production, wage labor, property, firms, markets, and states became mutually reinforcing components of economic organization. The discussion proceeds through five dimensions: material production and scarcity, wage labor and social reproduction, property and productive assets, firms and administrative organization, and the coordination of market and state. The method is historical and institutional. The section does not treat industrial modernity as a single globally uniform stage; it uses the term for a family of arrangements whose concrete forms varied across jurisdictions and periods while sharing several recurrent organizational features.

The central analytical point is that the modern economic order stabilized relations that could increasingly be represented through identifiable entities, contracts, accounts, incomes, assets, and administrative categories. Industrial production concentrated productive means and coordinated differentiated labor. Wage relations connected participation in production to monetary income. Property regimes stabilized claims over productive assets. Firms organized activities internally through authority and administration. States supplied legal, fiscal, infrastructural, and statistical conditions within which markets could operate at expanding scales. These arrangements did more than support production. They helped determine which economic subjects became visible, which claims could be administered, and which flows could be represented as movement among recognized units. The later entity-centered architecture of allocation emerged from this institutional history rather than from a purely methodological preference.

1.3.1 Industrial Production and Material Scarcity

Industrial production altered the relation between productive capacity and material organization by concentrating machinery, energy, fixed capital, labor, and technical knowledge within increasingly coordinated processes. Marx's analysis of machinery and modern industry treats mechanized production as a reorganization of the labor process rather than as a simple addition of more productive tools (Marx 1867). The relevant historical development for GRE is the growing dependence of output on combinations of assets and relations whose productive effect could not be assigned to isolated participants. Machinery required capital investment, maintenance, energy, technical knowledge, supplies, coordinated labor, and access to markets. Industrial capacity therefore existed in organized configurations before it appeared in the output attributed to a firm, sector, or worker.

Material scarcity remained a central organizing condition within this order. Productive assets, energy, land, raw materials, transport capacity, working time, and financial means could not be expanded without cost or delay. Industrial organization responded by concentrating resources, improving throughput, extending specialization, and creating institutions capable of coordinating larger stocks and flows. The economic importance of scarcity consequently attached not only to final consumption goods but also to access to the productive conditions through which future goods could be generated. A machine, factory site, transport connection, patent, or stock of working capital mattered because it conditioned later production. The industrial order therefore strengthened the distinction between current possession and productive capacity.

Scarcity also became increasingly mediated by infrastructure. Railways, ports, warehouses, energy systems, urban utilities, and communication networks changed the effective availability of resources by altering distance, timing, reliability, and scale. A material resource could be physically present while remaining economically inaccessible because transport, finance, legal permission, or organizational coordination was absent. Conversely, infrastructure could transform distant resources into practically available inputs. The economic meaning of scarcity was therefore relational even where the scarce object was material: availability depended on the configuration connecting the resource to those capable of using it.

This configuration helps explain why industrial economics could profitably abstract toward measurable inputs and outputs. Factories, inventories, wages, investment, prices, and physical production created comparatively legible interfaces with economic activity. Accounting and administrative practices could attach costs and claims to recognizable organizational units. The resulting abstractions were historically powerful because they corresponded to material arrangements in which production was increasingly concentrated, standardized, and measured. Their usefulness did not require every generative relation to be visible. It required enough stability that productive resources, organizations, and recipients could be treated as identifiable over the horizon relevant to management and policy.

The GRE significance of industrial materiality lies in this combination of concentration and relational dependence. Industrial production made entities such as factories and firms appear increasingly substantial while simultaneously deepening the relations on which their productive capacities depended. The entity and the relational configuration developed together. Later economic analysis inherited the entity be-

cause it was legally and administratively useful; GRE returns to the surrounding configuration because the capacity attributed to the entity was generated through it.

1.3.2 Wage Labor and Social Reproduction

Wage labor supplied one of the principal institutional links between productive participation and access to livelihood in industrial economies. Marx's treatment of labor-power makes this relation explicit by distinguishing the worker's capacity to labor from the labor performed within production and by connecting the reproduction of labor-power to the means of subsistence required for its continued availability (Marx 1867). The analytical importance of the wage relation extends beyond the wage as a price. It connects production, income, household provisioning, time discipline, mobility, bargaining position, and future participation in the labor process.

Polanyi's account of market society provides a complementary historical perspective by emphasizing the institutional transformation involved when labor, land, and money are organized through market mechanisms (Polanyi 1944). Labor is especially revealing because the object transacted in a labor market remains inseparable from the person whose activity is organized. The labor relation therefore couples a market contract to domains that exceed the transaction itself: health, family life, residence, education, social membership, and the reproduction of the capacity to work. The wage can be recorded as a payment to an individual worker, while the conditions that make labor possible are distributed across households, communities, public institutions, and infrastructures.

This distributed structure gives social reproduction a direct economic relevance. Industrial production requires renewed labor capacity across days and generations. Food, housing, care, education, health, socialization, and periods outside paid employment contribute to that reproduction through arrangements whose institutional forms vary historically. Some are purchased in markets, some are provided within households, some are organized publicly, and some are sustained through community relations. The wage relation becomes especially consequential when access to these conditions depends heavily on employment income. Employment then mediates more than contribution to production; it mediates access to a wider field of material and institutional resources.

The resulting architecture stabilizes the worker as an economic subject. Payroll systems, labor contracts, taxation, social insurance, workplace rules, and household budgets can all identify the worker as a recipient of income and bearer of obligations. This administrative clarity is historically significant. It permits production costs to be assigned, income to be taxed, entitlements to be calculated, and labor supply to be represented in aggregate. The same clarity places part of the reproductive structure outside the immediate representation. A wage record identifies the payment while saying relatively little about the household relations, care arrangements, commuting infrastructure, education, health, or social supports through which the worker remains capable of participation.

For GRE, the wage relation is therefore an early example of a relation whose economic effects propagate beyond the nominal parties to a contract. Changes in wages, employment security, working time, or workplace authority can alter household dependence, geographic mobility, care burdens, learning opportunities, and future bargaining power. The historical prominence of wage labor helped make the individual

worker a practical unit of economic administration, yet the capacity represented by that worker was reproduced through a wider relational system. The distinction between recipient and generative conditions later becomes central to GRE's treatment of allocation and value.

1.3.3 Property and Productive Assets

Property regimes stabilized claims over productive assets and thereby shaped who could decide how resources were used, who could exclude others, who could transfer claims, and who could receive returns generated through production. North's institutional analysis treats property rights and other formal rules as part of the institutional structure that shapes incentives and economic performance through time (North 1990). For the present argument, the important point is that a productive asset becomes economically consequential through a relation among material control, legal recognition, organizational use, and expectations concerning future returns.

Industrial production increased the importance of this stabilization because productive means became increasingly durable, specialized, and costly. Ownership of land, machinery, buildings, inventories, and financial claims could organize access to productive opportunities over horizons much longer than a single transaction. Property therefore linked present legal claims to future streams of decision-making and income. A productive asset was valuable partly because it could be inserted into an institutional environment in which exclusion, transfer, contracting, financing, and enforcement were sufficiently reliable for long-horizon organization.

The relation between property and productive capacity also clarifies why ownership and control deserve analytical separation. A legal owner may delegate operational control to managers; creditors may constrain decisions without owning the asset; regulators may determine permissible uses; workers may possess indispensable knowledge; suppliers and platforms may control access to complementary infrastructure. Industrial organization consequently produces layered claims around the same productive object. Ownership remains economically important, yet its practical effect is mediated through a configuration of rights, contracts, dependencies, and institutional authorities.

Property also contributes to the stabilization of economic boundaries. Assets can be assigned to persons, firms, households, public bodies, or other recognized entities. Accounting systems can record acquisition, depreciation, liabilities, and returns relative to those boundaries. Contracts can specify transfers across them. This improves administrative legibility and supports the representation of economic activity as flows among units with identifiable holdings. The boundary is institutionally real because claims and obligations are enforced through it, even when the productive process itself crosses that boundary through labor relations, supply chains, shared infrastructure, finance, and knowledge flows.

GRE later develops a relational account of ownership, control, access, and allocation in greater detail. At this historical stage, the relevant result is that property helped make productive resources administratively attachable to entities while organizing the relations through which those resources could generate future value. The institutional success of entity-centered representation therefore rested on relational arrangements that stabilized entities sufficiently for ownership, contracting, and accounting to operate.

1.3.4 Firms and Administrative Organizations

The industrial firm gave durable organizational form to coordination that could not be represented adequately as a sequence of isolated exchanges. Coase's analysis begins from precisely this problem: market exchange coordinates through the price mechanism, while the firm coordinates some activities through internal direction because using markets also entails costs (Coase 1937). The firm therefore marks an institutional boundary across which the dominant mode of coordination changes. Prices remain important outside and within the organization, yet authority, routines, roles, schedules, budgets, technical standards, and managerial judgment coordinate many productive relations internally.

This organizational form expanded the range of activities that could be planned across time. Capital investment, hiring, training, procurement, production sequencing, inventory, quality control, sales, and finance could be coordinated through administrative structures that persisted beyond individual contracts. The firm became an economic subject because law, accounting, taxation, and organizational practice treated it as a continuing unit capable of owning assets, entering contracts, receiving revenue, bearing liabilities, and employing workers. Its continuity depended on relations among participants, yet the organization could be represented as an entity for many practical purposes.

Administrative organization also transformed information. A large productive process requires knowledge to be distributed among specialized roles while remaining coordinated sufficiently for collective action. Records, reports, budgets, plans, technical specifications, and chains of authority create channels through which local knowledge is translated into organizational decisions. Some knowledge remains tacit or local, and some is formalized into procedures and indicators. The organization therefore does not merely collect information; it structures which information can travel, who is authorized to interpret it, and which representations acquire decision-making force.

This point links the firm to the broader genealogy of coordination developed in Section 1.2. Hayek's account of dispersed knowledge emphasizes the difficulty of concentrating the information relevant to economic adjustment (Hayek 1945). The firm does not eliminate that difficulty. It creates another coordination regime in which some decisions are internalized, some knowledge is formalized, and some authority is concentrated. Market and organization consequently represent different relational arrangements for coordinating heterogeneous knowledge and activity rather than mutually exclusive forms of economic order.

The GRE relevance of the firm lies in the contrast between entity manifestation and relational constitution. The firm is sufficiently stable to sign a contract, own an asset, receive funding, report profit, and appear as a node in administrative data. At the same time, its capacities depend on internal authority, cooperation, knowledge flows, routines, worker relations, supplier relations, finance, law, and infrastructure. Treating the firm as an entity is therefore often operationally indispensable. Treating the entity as analytically self-sufficient obscures the relations that generate its capacities and determine how an intervention directed at the firm propagates through the surrounding system.

1.3.5 State, Market, and Economic Coordination

Industrial modernity joined market coordination to a dense institutional architecture of law, public authority, infrastructure, taxation, monetary organization, administration, and social provision. Polanyi's historical account is especially useful here because it treats market society as institutionally produced and politically sustained rather than as the spontaneous expansion of exchange alone (Polanyi 1944). North similarly places economic performance within rule systems that structure incentives and reduce or redistribute uncertainty (North 1990). The modern market therefore operates through institutional conditions that define property, contract, legal personality, money, enforcement, and permissible forms of organization.

The state participates in this order through several analytically distinct roles. It recognizes and enforces legal claims; raises and spends revenue; builds and regulates infrastructure; produces statistics and administrative classifications; supplies or finances services; defines corporate, labor, and property forms; and intervenes in crises. These activities vary widely across historical periods and political systems. Their common relevance lies in the production of conditions under which dispersed economic actors can coordinate over scales that exceed local relations. State capacity can enlarge markets by standardizing rules, currencies, transport, information, and enforcement even when many transactions remain privately organized.

Market coordination addresses a different dimension of the same problem. Hayek's account of the price system emphasizes its capacity to communicate information relevant to adjustment when knowledge is dispersed among many participants (Hayek 1945). Prices can coordinate decentralized decisions without requiring a central actor to possess all local knowledge. Their informational economy is powerful precisely because the system does not attempt to reproduce every relation or circumstance in a complete representation. A price condenses some conditions into a signal useful for action while leaving many causal and normative dimensions outside the signal.

The institutional and market dimensions of coordination therefore operate through different forms of selective representation. Law translates heterogeneous social relations into rights, duties, persons, and claims. Administration translates them into categories, records, eligibility conditions, and budgets. Markets translate some dispersed conditions into prices and contracts. Firms translate productive complexity into organizational roles, accounts, and plans. Each representation supports coordination by reducing complexity, and each leaves a remainder that can become economically consequential when conditions change.

This selective structure is the historical bridge to the next sections of the chapter. Industrial modernity did not merely produce more goods or larger organizations. It stabilized a recognizable architecture of workers, owners, households, firms, assets, contracts, markets, and states. These units became economically real through persistent relations and institutionally powerful manifestations. They could be taxed, regulated, funded, counted, contracted with, and made responsible. The resulting order made entity-centered economic analysis unusually effective because economic administration itself increasingly operated through entities.

The same historical achievement establishes the limit that GRE later addresses. Coordination through entity boundaries and compressed representations works best when the relevant entities remain sufficiently stable and when the consequences of action can be assigned within the chosen boundary and horizon. As production be-

comes more networked, knowledge-intensive, transnational, platform-mediated, and dependent on distributed infrastructures, those conditions become less secure. The next sections therefore examine how modern economic subject positions and institutional entities were constructed before turning to the contemporary transformations that place increasing pressure on the architecture industrial modernity stabilized.

1.4 Historical Formation of the Economic Subject

This section reconstructs the historical formation of the principal subject positions through which modern economic life became administratively and analytically intelligible. Its role in the chapter is to move from the institutional architecture of industrial modernity to the actors that this architecture made recognizable as bearers of labor, property, consumption, responsibility, and organizational capacity. The objective is to show that the worker, owner, consumer, household, firm, and corporation acquired economic salience through historically specific relations and institutions rather than entering economic analysis as timeless units. The discussion proceeds through five subject positions and uses a historical-institutional method: each position is examined through the relations that stabilize it, the capacities and claims attached to it, and the forms of representation through which economic analysis and administration can act upon it.

The term *economic subject* is used here in a deliberately limited sense. It designates a configuration that can occupy an economically consequential position, enter recognized relations, receive or control resources, bear claims or obligations, and become a unit of observation or intervention. The term therefore concerns economic standing rather than a complete theory of personhood or agency. A biological person may occupy several economic subject positions at once; an organization may acquire a durable economic position despite lacking the experiential properties associated with a human subject. This distinction permits the historical analysis to remain compatible with the ontological restraint developed later in the book.

Industrial modernity strengthened the stability of several such positions simultaneously. Wage labor made the worker legible through employment and remuneration. Property institutions stabilized the owner as a bearer of enforceable claims. Expanding markets and demand analysis strengthened the consumer as a distinct economic role. Household organization linked income, care, consumption, and reproduction. Firms and corporations condensed collective productive relations into continuing organizational subjects. These positions overlap in practice, yet their differentiation made modern economic administration unusually capable of assigning income, liability, entitlement, taxation, and policy effects to recognizable units.

1.4.1 Worker as Economic Subject

The worker became a particularly consequential economic subject through the institutional expansion of wage labor. Industrial production required large numbers of people to enter continuing relations in which labor capacity could be contracted, scheduled, supervised, remunerated, and coordinated with machinery and organizational routines. Marx's analysis of labor-power and the industrial labor process treats this relation as constitutive of capitalist production: productive activity is organized

through a relation between those who control productive assets and those who sell labor-power within the production process (Marx 1867). Polanyi later emphasized the historical specificity of treating labor as if it were a commodity available to market coordination, while insisting that labor remains inseparable from the lives of the persons who supply it (Polanyi 1944).

The economic importance of the worker position lies partly in the forms of legibility that wage labor makes possible. Employment attaches income to a recognizable relation between worker and employer. Hours, wages, occupations, contracts, payrolls, and employment status create administrative traces through which labor can be taxed, regulated, insured, compared, and statistically represented. The worker can therefore appear as a unit of production and as a recipient of income at the same time. This dual standing helped make employment one of the principal institutional bridges between productive contribution and access to material resources in modern economies.

The worker position also illustrates the difference between an economic subject and the whole person occupying that position. A person who appears in an employment relation as a worker may simultaneously be a household member, caregiver, consumer, owner of some assets, citizen, borrower, learner, or participant in a professional community. Economic administration frequently selects one of these relations because a particular institution requires a determinate role. Payroll systems need an employee; labor law needs parties to an employment relation; national accounts need categories of compensation and production. The resulting representation is operationally powerful precisely because it suppresses dimensions that are irrelevant to the immediate administrative task.

The relational constitution of the worker remains visible even within this compressed representation. Productive capacity depends on education, health, transport, care, technical infrastructure, organizational knowledge, legal protection, bargaining arrangements, and access to employment. The wage received by one worker may support several household members; a change in scheduling may alter care relations; a change in technology may reallocate authority and skill inside the workplace. The worker is therefore economically real as a stabilized subject position, while the capacities attached to that position remain generated and sustained through a wider relational field.

This historical construction becomes especially important later in the chapter when artificial intelligence and automation place pressure on employment as a mechanism of economic recognition and allocation. The relevant historical point at this stage is narrower. Modern institutions made the worker sufficiently stable and legible to serve simultaneously as a productive subject, an income recipient, a bearer of labor rights, and an object of economic measurement. That stabilization was an institutional achievement with a history, and its future transformation is therefore also historically possible.

1.4.2 Owner as Economic Subject

The owner position formed around enforceable claims to assets, resources, and the income streams associated with them. Property institutions identify a subject that may exclude others from specified uses, transfer claims, pledge assets, authorize access, and receive returns. The economic owner is therefore constituted through a relation

among the claimant, the asset, other potential users, and the institutions that recognize and enforce the claim. North's institutional analysis is relevant because property and contracting arrangements operate within rule systems that structure incentives, expectations, and the security of exchange over time (North 1990).

Industrial development increased the importance of ownership by expanding the scale and durability of productive assets. Land, machinery, factories, inventories, financial claims, intellectual resources, and later corporate securities could be assigned to recognized owners and represented through accounts, registries, contracts, and balance sheets. Ownership thereby became a major interface between present control and future income. The owner could appear in economic analysis as a recipient of profit, rent, interest, or capital gain even when the productive process generating those returns depended on many relations extending beyond the owner's direct activity.

The position is internally differentiated. Ownership may coexist with delegated management, creditor claims, regulatory constraints, contractual commitments, shared ownership, or limited rights of use. An owner may hold legal title while another actor exercises operational control; several owners may share claims to the same organization; a lender may constrain asset use without becoming owner. These arrangements show that ownership is a structured bundle of recognized relations rather than a simple physical connection between a person and a thing. The stability of the subject position comes from institutional recognition of those relations and from the capacity to reproduce them through transfer, enforcement, and accounting.

Ownership also shapes the distribution of economic possibility. A productive asset can support future borrowing, investment, bargaining, mobility, inheritance, and access to organizational opportunities. The economic consequence of ownership therefore exceeds the current income attached to the asset. It can alter the owner's future action space while simultaneously affecting the access of others. This temporal dimension becomes central later in GRE's analysis of generative value, capability, and option-space transformation.

The owner position consequently provides an early example of a subject whose economic significance is relational and generative even when conventional representation is entity-centered. Administrative systems may record that an asset belongs to a named owner, and this representation is often indispensable. The effects of that ownership emerge through relations of exclusion, access, finance, production, inheritance, and institutional recognition. Section 1.5 develops the legal and administrative construction that makes these ownership relations increasingly durable and governable.

1.4.3 Consumer as Economic Subject

The consumer became a distinct economic subject as demand, choice, and the allocation of expenditure acquired greater analytical and practical importance. Marshall's synthesis of demand, supply, wants, value, and marginal adjustment gives consumption a systematic place within a unified account of economic coordination (Marshall 1890). The consumer in this framework appears as a chooser whose demands help organize production through market exchange. Later scarcity-centered formulations extended the same analytical grammar by representing economic conduct through the allocation of scarce means among alternative ends (Robbins 1932).

The rise of the consumer position depended on more than an intellectual shift in economic theory. Expanding markets, standardized goods, monetary income, retail infrastructures, advertising, credit, transport, and mass production increased the practical importance of household expenditure and individualized purchasing decisions. Prices and product categories made heterogeneous goods comparable within budgets, while market institutions provided repeated occasions on which persons could be addressed primarily through their role as buyers. The consumer therefore became both an analytical unit and an institutional target for pricing, marketing, credit, taxation, regulation, and later consumer protection.

This subject position has a characteristic abstraction. The consumer is represented through preferences, purchasing power, observed choices, or welfare effects, while the relations that formed those preferences and capacities may remain outside the immediate model. Income depends on labor, ownership, transfers, or household relations; access depends on infrastructure and geography; preferences may be shaped by culture, information, social position, and commercial representation; credit can move purchasing power across time. A demand curve or expenditure record captures an economically meaningful manifestation while leaving many of its generative conditions unresolved.

The distinction becomes more important when consumption itself generates relations. Repeated purchases can sustain platforms and distribution networks; credit creates durable obligations; subscription models establish continuing dependence; digital consumption produces data that can be converted into commercial knowledge; consumption inside households redistributes access among members. These effects do not eliminate the analytical usefulness of the consumer. They reveal that the consumer is one stabilized position within a larger relational process.

The historical formation of the consumer therefore complements the formation of the worker and owner. Industrial modernity increasingly organized persons through several differentiated roles: contribution could be represented through work, command over assets through ownership, and access to goods through consumption. Economic policy could then act upon each role through different instruments. The later GRE problem is to understand how these roles interact, how they generate one another's capacities, and how contemporary digital systems increasingly blur their boundaries.

1.4.4 Household as Economic Subject

The household occupies a distinctive position because it joins economic subjecthood to a relational configuration that is visibly composite. Modern economic analysis and administration frequently treat the household as a unit of income, expenditure, taxation, welfare, housing, saving, and consumption. At the same time, the household contains relations of care, dependence, authority, contribution, inheritance, and intergenerational support that cannot be inferred from aggregate household resources alone. The household therefore makes especially clear how an entity-level representation can be administratively necessary while remaining analytically incomplete.

Industrial wage labor strengthened the household's role as a bridge between production and social reproduction. Wages and other incomes enter the household through members occupying positions in labor, ownership, or public transfer systems. Food, shelter, care, education, health, and time are then organized through

internal relations that reproduce capacities required for future participation in economic and social life. Polanyi's account of market society is useful for locating this process historically because the expansion of labor markets placed livelihoods under market dependence while social institutions continued to mediate the reproduction of persons and communities (Polanyi 1944).

The household also became a practical allocation unit. Taxes, benefits, housing policy, social insurance, surveys, and consumption statistics frequently require a boundary within which income and need can be aggregated. Such aggregation enables public administration to compare households and distribute resources at scale. The boundary acquires causal force because eligibility rules, tax liabilities, benefits, and legal responsibilities may depend on who counts as a member. Economic subjecthood is therefore partly generated by the institutional act of recognizing a household and assigning consequences to its boundary.

Aggregation can also conceal internal asymmetry. Two households with the same measured income may distribute time, care, consumption, control, and risk very differently. A transfer formally received by one member may alter bargaining relations among several members. Unpaid care can sustain labor-market participation without appearing as wage income. Intergenerational transfers can expand the future options of some members while limiting those of others. These possibilities show why the household is an important bridge from entity-centered economics toward relational analysis: the entity is empirically real and administratively consequential, yet the distribution of capacities within it depends on internal relations.

GRE therefore has reason to retain the household as an economic subject while refusing to treat its boundary as self-explanatory. Later chapters can ask how resources entering a household propagate through internal relations, how care and dependence generate capabilities, and how household membership affects access to institutions. The historical point developed here is that modern economic order increasingly stabilized the household as a recognizable recipient and decision unit, creating a powerful administrative representation whose relational interior remains economically consequential.

1.4.5 Firm and Corporation as Collective Economic Subjects

The firm and corporation extend economic subjecthood beyond the individual and household by stabilizing a collective organization as a continuing participant in economic relations. Coase's analysis of the firm identifies an organizational domain in which coordination occurs through internal direction rather than through a sequence of market exchanges, thereby making the boundary of the firm an economic problem in its own right (Coase 1937). The corporation adds greater durability through institutional forms that allow assets, contracts, liabilities, roles, and organizational purposes to persist across changes in particular participants.

Collective economic subjecthood depends on the capacity to act through organized relations. A firm can hire workers, purchase inputs, own or control assets, borrow, sell outputs, enter contracts, maintain accounts, and make investment decisions because internal authority and procedures translate distributed activity into organizational action. No single participant needs to perform every function. The organization acquires practical continuity through roles, routines, records, governance structures, and external recognition. Its economic agency is therefore generated through

coordination among relations that are distributed across many persons and institutional interfaces.

The collective subject also produces a distinctive form of representation. Revenue, cost, profit, debt, assets, employment, and output can be assigned to the organizational boundary even though the processes generating these quantities extend through workers, suppliers, creditors, customers, regulators, infrastructures, and knowledge networks. Accounting and legal systems make the organization sufficiently coherent to appear as one unit in contracts, taxation, statistics, investment, and policy. The unit is therefore neither fictitious in the ordinary sense nor analytically exhaustive. It is a stabilized manifestation of a more complex relational configuration.

This distinction matters for economic intervention. A subsidy paid to a firm may alter wages, investment, bargaining power, supplier dependence, market position, knowledge accumulation, or shareholder returns. A liability imposed on a corporation may be redistributed internally through prices, employment, contracting, or investment decisions. Entity-level policy therefore operates through collective subjects whose responses are generated by internal and external relations. The organization can remain the correct administrative recipient while relational analysis is required to understand the consequences of intervention.

The historical formation of the firm and corporation closes the section because it reveals the general pattern most clearly. Modern economic subject positions became powerful through institutional stabilization, selective representation, and repeated practical use. Worker, owner, consumer, household, firm, and corporation are heterogeneous kinds of subject, yet all can become economically real through durable participation in recognized relations. Section 1.5 turns from these subject positions to the legal, contractual, accounting, statistical, and administrative mechanisms that construct the entities through which modern economic systems allocate rights, resources, obligations, and responsibility.

1.5 Institutional Construction of Economic Entities

This section examines the institutional processes through which heterogeneous persons, organizations, assets, activities, and relations become recognizable as bounded economic entities. Its role in the chapter is to connect the historically formed economic subjects of Section 1.4 to the administrative architecture that permits modern economies to assign ownership, liability, income, taxation, reporting, eligibility, and responsibility to identifiable units. The objective is to show how legal personality, property, contract, accounting, statistics, and institutional membership jointly stabilize economic boundaries without requiring those boundaries to coincide with every relation that generates the entity's capacities. The discussion proceeds through five institutional mechanisms and uses a historical-institutional method: each mechanism is treated as a practical technology of recognition that makes an economic unit durable enough to enter law, administration, measurement, and allocation.

The term *economic entity* refers here to a recognized unit to which economically consequential attributes can be attached. Such attributes include assets, liabilities, income, expenses, rights, obligations, tax status, employment, eligibility, and reporting responsibility. This use remains compatible with the ontological restraint of GRE.

Institutional recognition can make an entity relationally and causally consequential without settling the ultimate ontology of the person, organization, or collective concerned. The relevant historical achievement is the stabilization of boundaries that permit repeated action upon a unit across time.

Modern economic coordination depends heavily on this achievement. Credit requires a debtor whose obligations can be identified. Property requires a bearer of enforceable claims. Contracts require parties. Accounting requires a reporting boundary. Statistics require units that can be classified and aggregated. Public administration requires membership criteria that determine who enters a category, receives a transfer, pays a tax, or bears a duty. These mechanisms operate differently, yet together they transform fluid relational configurations into operationally persistent entities. The resulting compression makes large-scale economic coordination possible while creating a recurrent analytical tension between the recognized unit and the wider relations on which its capacities depend.

1.5.1 Legal Personality

Legal personality supplies one of the strongest mechanisms for stabilizing an economic entity through time. Organizational law provides standardized legal forms through which an enterprise can hold assets, enter agreements, incur liabilities, and persist across changes in the individuals who participate in it. Hansmann and Kraakman's analysis of organizational law emphasizes asset partitioning: organizational law can separate a pool of entity assets from the personal assets and creditors of owners or managers, thereby creating a durable structure of claims around the organization (Hansmann and Kraakman 2000). This separation supports the practical treatment of the organization as a continuing economic unit.

The significance of legal personality for GRE lies in its capacity to stabilize relations into a recognizable locus of responsibility. A corporation, association, trust, or other recognized organization may contain many internal relations and participate in many external ones, yet legal form gives selected relations a persistent boundary. Contracts can be entered in the entity's name. Assets can remain attached to the organization when shareholders, managers, or employees change. Creditors can direct claims toward specified pools of assets. Courts and regulators can address the organization as a continuing bearer of rights and duties. Legal personality therefore creates temporal continuity that exceeds the continuity of any individual participant.

This institutional continuity should be distinguished from the complete economic reality of the organization. The legal entity identifies a powerful boundary, yet productive capacity may depend on workers, suppliers, public infrastructure, household reproduction, financing networks, tacit knowledge, and social trust that extend beyond that boundary. The legal unit nonetheless remains economically consequential because claims, liabilities, and decision authority are routed through it. Entity-centered analysis gains much of its practical force from this institutionally produced concentration of responsibility.

The relation between legal and economic entityhood becomes especially clear in systems of national accounting. The System of National Accounts treats institutional units as fundamental economic units capable of owning assets, incurring liabilities, engaging in transactions, and taking economic decisions on their own behalf (European Commission et al. 2009). Legal responsibility and accounting capacity are

therefore closely connected to the statistical constitution of the economy. The institutional unit is useful because economic flows can be attributed to a recognizable bearer across repeated transactions and accounting periods.

Legal personality also demonstrates that economic entities can be generated through institutional recognition. The organization does not become economically significant merely because a legal label is attached to it; the label works because it reorganizes relations of ownership, liability, contracting, and enforcement. The legal form is therefore performative in an economically specific sense: recognition creates durable channels through which resources, obligations, and claims can circulate. Later GRE chapters return to this point when examining how institutional recognition can generate capacities and constraints beyond the immediate legal relation.

1.5.2 Property and Contract

Property and contract deepen entity stabilization by attaching resources and obligations to recognized parties. Property identifies who may hold, transfer, exclude, pledge, or authorize uses of an asset within a given institutional order. Contract identifies parties whose commitments can be interpreted, enforced, and carried forward through time. Together they create a relational grammar in which economically consequential claims can be assigned to named units and transferred among them.

North's account of institutions is relevant because property and contracting operate through rule systems that structure incentives, reduce some forms of uncertainty, and make repeated exchange more predictable (North 1990). Coase's analysis of the firm similarly shows that contracting and market exchange have costs and that organizations emerge partly through alternative arrangements for coordinating transactions (Coase 1937). These traditions differ in focus, yet both demonstrate that exchange depends on institutional structures that define who can commit, what can be transferred, and how agreements are sustained.

Property contributes to entity formation by linking a recognized subject to a durable set of claims over resources. Organizational law can intensify this effect through asset partitioning. Hansmann and Kraakman show that the ability to shield entity assets from the personal creditors of owners or managers supports the construction of large-scale organizations whose assets can remain committed to organizational purposes (Hansmann and Kraakman 2000). The entity thereby acquires a resource base whose continuity is institutionally protected.

Contract contributes a complementary temporal structure. An agreement links present recognition to future performance. Parties can coordinate production, finance, labor, supply, insurance, and exchange across time because obligations have a recognized bearer and an enforceable form. Contractual relations therefore extend the temporal horizon of economic organization. They also connect entity boundaries: one firm's obligation becomes another firm's claim, one household's debt becomes another unit's asset, and one employment contract links a worker position to an organizational position.

The resulting architecture makes economic activity legible as relations among entities with identifiable holdings and commitments. This architecture is analytically powerful because many economically important questions genuinely concern the distribution and transfer of recognized claims. The same architecture also compresses

relational complexity. A contract records selected obligations, while leaving many background relations unstated. Property identifies a recognized claimant, while the asset's productive use may depend on wider infrastructures and collective conditions. GRE therefore treats property and contract as real institutional structures whose analytical boundaries remain narrower than the total field of relations sustaining economic activity.

1.5.3 Accounting and Organizational Boundaries

Accounting converts organizational continuity into a recurring representational boundary. Assets, liabilities, equity, income, and expenses are recorded relative to a reporting entity, allowing economic activity to be summarized across a period and compared across periods. The reporting boundary makes a heterogeneous organizational process appear as a unit with a balance sheet, flows, and a calculable financial position. This representation supports investment, lending, taxation, governance, and organizational decision-making.

The IFRS Conceptual Framework makes the constructed character of this boundary explicit. A reporting entity can be a single legal entity, a portion of an entity, or a group of entities, and the reporting boundary therefore need not coincide exactly with legal personality (IFRS Foundation 2018). Consolidated accounts may represent a parent and its subsidiaries as one reporting entity even though several legal entities remain in existence. Combined accounts can likewise gather economic activities across organizational units when the reporting purpose requires a wider boundary.

This flexibility reveals an important methodological point for GRE. Economic entityhood is partly representation-dependent because different institutional practices may draw different boundaries around the same relational field. Legal personality, managerial control, accounting consolidation, statistical sectoring, and productive coordination can produce overlapping rather than identical entities. A corporate group may be many legal persons, one consolidated reporting entity, several operational divisions, and part of a wider supply network at the same time. Each boundary serves a different analytical and institutional function.

Accounting nonetheless gives these boundaries substantial causal force. Budgets, performance measures, debt covenants, taxation, capital allocation, and managerial evaluation are frequently organized around reported units. Once a reporting boundary is stabilized, internal and external flows are classified differently depending on which side of the boundary they occur. A transfer between subsidiaries may disappear in consolidated reporting while remaining visible in the accounts of each subsidiary. The representational boundary therefore changes which economic relations appear as internal coordination and which appear as transactions between entities.

This point provides a direct bridge from institutional construction to later GRE analysis. The entity represented in accounts is neither arbitrary nor exhaustive. It is selected for an institutional purpose, sustained through conventions and control relations, and capable of shaping decisions once established. Accounting therefore participates in the economic reality it represents: it defines operational units, channels attention, and conditions how resources are compared and allocated. The relational question is consequently not only whether the accounts are accurate, but also which relations become internal, external, visible, or invisible under the chosen boundary.

1.5.4 Statistics and Administrative Legibility

Statistical systems extend entity construction from organizations to entire economies. Large-scale administration requires units that can be counted, classified, compared, and aggregated. Households, corporations, government units, workers, industries, sectors, residents, and non-residents become statistical categories through definitions that specify membership and delimit the observations that belong together. Desrosières' history of statistical reasoning shows that classification and quantification depend on conventions that make heterogeneous cases comparable, while Porter emphasizes the institutional role of standardized quantitative procedures in producing impersonal forms of judgment (Desrosières 1998; Porter 1995).

The System of National Accounts provides a particularly clear example. It organizes macroeconomic accounting around institutional units and sectors, treating units capable of owning assets, incurring liabilities, entering transactions, and making economic decisions as the building blocks of the statistical economy (European Commission et al. 2009). Corporations, government units, nonprofit institutions, and households are then grouped according to functions and institutional characteristics. This statistical architecture permits production, income, saving, investment, assets, and liabilities to be aggregated into coherent macroeconomic accounts.

Administrative legibility emerges through similar operations. Tax systems define taxable persons and entities. Social insurance systems define contributors and beneficiaries. Business registries identify organizations. Labor statistics classify employment status and occupation. Regulatory systems distinguish sectors, ownership forms, and reporting obligations. Each system draws a boundary around the unit relevant to its task and attaches standardized attributes to that unit. The economy becomes governable partly because actors and activities can be entered into interoperable categories.

These classifications have practical consequences. Eligibility, tax liability, regulatory burden, access to programs, statistical visibility, and policy targeting can depend on categorical membership. The category therefore becomes more than a passive description. Hacking's historical work on classification is useful for understanding how classificatory practices can participate in the formation of the objects and kinds they describe (Hacking 2002). In economic administration, classification can alter incentives, organizational forms, reporting behavior, and the distribution of resources.

GRE inherits both the analytical power and the caution implied by this history. Statistical units are indispensable for large-scale comparison and coordination. Their usefulness depends on abstraction: a household or corporation must be treated as sufficiently coherent for aggregation to work. The same abstraction can conceal internal relations, boundary disputes, informal activity, cross-border structures, and dependencies that do not fit the chosen classification. Administrative legibility therefore increases the capacity to act on an economy while narrowing the dimensions that remain visible within the administrative representation.

1.5.5 Economic Recognition and Institutional Membership

Economic recognition completes the institutional construction of entities by determining which units count as members of particular economic categories and which rights, duties, resources, and observations follow from that membership. Recognition occurs

through law, registration, accounting, statistics, employment, taxation, licensing, residence, organizational affiliation, and many other institutional practices. The resulting membership conditions establish who is visible to a system and in what capacity.

Institutional membership is rarely singular. A person may simultaneously be recognized as worker, taxpayer, household member, shareholder, resident, borrower, student, beneficiary, and citizen. An organization may be recognized as employer, corporation, taxpayer, regulated firm, statistical unit, contractor, or recipient of public support. Each membership relation attaches a different set of capacities and obligations. Economic subjecthood therefore becomes layered through multiple institutional recognitions rather than exhausted by one universal status.

The SNA illustrates this layering at the macroeconomic level. Institutional units are assigned to sectors and to residence categories so that transactions and balances can be organized consistently (European Commission et al. 2009). The classification is analytically productive because it creates stable membership rules for statistical aggregation. Similar logics operate in administrative systems: participation in a program or regulatory regime depends on satisfying criteria that determine whether an actor belongs inside or outside the relevant category.

Recognition can also generate economic capacity. Registration may permit an organization to open accounts, contract, receive funds, employ workers, or incur debt. Employment status may provide access to wages, insurance, pensions, or legal protections. Residence may determine access to public services or tax obligations. Institutional membership thus changes the action space available to an actor. North's treatment of institutions as constraints structuring interaction helps clarify why recognized status can alter incentives and feasible conduct (North 1990).

The generative consequence is important for the chapters that follow. An entity becomes economically durable when several systems converge in recognizing it: law attaches rights and duties, accounting draws a reporting boundary, statistics assign a category, administration records membership, and counterparties organize expectations around the resulting unit. These recognitions reinforce one another and make the entity increasingly actionable. Once stabilized, the entity can receive resources, bear obligations, appear in models, and become the target of intervention.

This institutional success explains much of the historical power of entity-centered economics. Modern economies created entities that were genuinely useful for administration because institutional systems repeatedly acted through them. The limit appears when economic effects propagate through relations that cross the recognized boundary or when important participants remain weakly recognized by the institutions that allocate resources and visibility. Section 1.6 therefore turns from the construction of entities to the historical logic of allocating scarce resources through administratively identifiable recipients.

1.6 Entity-Centered Allocation in Historical Context

The institutional construction of economic entities described in Section 1.5 made a particular form of allocation historically practical: resources could be assigned to recipients represented as persons, households, firms, corporations, public bodies, or other administratively identifiable units. This section examines the historical conditions under which recipient-centered allocation became a powerful economic ab-

straction. Its objective is explanatory rather than dismissive. The analysis proceeds through five steps: the formation of administrative recipients, the relation between material scarcity and allocation, the role of employment in connecting productive participation to livelihood, the relation between competitive capability and resource claims, and the limits that appear when evaluation stops at the recipient boundary. The method is historical and institutional. Entity-centered allocation is treated as an achievement of modern economic organization whose usefulness depends on the social and administrative conditions that made recipients sufficiently stable, comparable, and actionable.

1.6.1 Administrative Recipients

Allocation requires a recipient that an institution can identify before resources can be transferred, taxed, credited, insured, subsidized, or otherwise assigned. Modern economic administration therefore depends on categories that answer a practical question of membership: which unit is entitled, liable, responsible, or eligible within a given scheme. The institutional units of national accounting provide one explicit example. The System of National Accounts organizes production, income, saving, assets, and liabilities around units capable of owning assets, incurring liabilities, making economic decisions, and entering transactions (European Commission et al. 2009). Similar recipient structures appear in taxation, social insurance, business registration, corporate finance, public procurement, and household-based benefit systems.

The administrative recipient is consequently a historically stabilized interface between a relational economy and an allocative act. A transfer rarely reaches an abstract individual in isolation. It reaches a legally or administratively recognized unit whose identity has already been produced through registration, residence, employment, ownership, household membership, organizational status, or another institutional relation. The recipient category compresses these relations into a unit upon which an administrative system can act.

This compression yields substantial practical advantages. A public authority can assign a benefit to a registered household without reconstructing every relation within the household. A bank can lend to a corporation whose legal and accounting boundaries are sufficiently stabilized for liability and repayment to be represented. A firm can pay wages to an employee whose contractual status identifies both the payer and the recipient. Large-scale allocation becomes feasible because institutional systems can repeatedly address the same kinds of units without reproducing the whole relational history that makes those units possible.

Recipient construction also standardizes accountability. An allocation can be recorded as having been made to a defined unit; the unit can be asked to report, repay, comply, or demonstrate eligibility. The reporting-entity logic discussed in the preceding section illustrates how flexible such units can be: accounting may construct a reporting boundary around one legal entity, part of an entity, or several entities when the institutional purpose requires it (IFRS Foundation 2018). Administrative allocation operates through the same general principle. The actionable unit is selected according to the function of the allocative regime.

The success of this architecture explains why recipient-centered analysis became deeply embedded in economic reasoning. Once recipients are legally, statistically, and administratively stabilized, flows among them can be represented with excep-

tional clarity. Income is received by households, investment is made by firms, taxes are collected from persons and organizations, transfers are paid to beneficiaries, and assets are assigned to owners. The representation is institutionally grounded rather than merely convenient. Modern economies developed extensive infrastructures that made entity-level flows real objects of administration.

1.6.2 Scarce Resources and Allocation

The allocative significance of stable recipients increased under conditions in which material resources, income, productive assets, public budgets, and institutional opportunities were treated as scarce relative to competing claims. Robbins' influential formulation of economics around scarce means with alternative uses made this structure explicit at the disciplinary level (Robbins 1932). Scarcity does not by itself determine who should receive a resource, yet it creates the recurrent requirement to choose among possible uses and recipients.

Entity-centered allocation offered a tractable response to that requirement. Once a scarce resource could be represented as a quantity and potential recipients could be represented as discrete units, allocation could be organized through prices, wages, contracts, budgets, eligibility rules, credit decisions, taxation, transfers, or administrative assignment. The institutional problem acquired a common form even when the mechanisms differed: a bounded quantity was distributed among recognized claimants.

This form was especially compatible with the accounting and statistical infrastructures of industrial modernity. Monetary valuation allowed heterogeneous resources to enter common ledgers; property rules identified control; organizational accounts located assets and liabilities; state statistics aggregated households and firms; and administrative records linked claims to recognized recipients. Allocation could therefore be represented through flows that entered and left defined units. The entity-centered picture matched the operational needs of institutions that had to decide, record, compare, and audit distributions at scale.

Welfare economics extended the allocative problem from private choice to the evaluation of social arrangements. Pigou's analysis of economic welfare connected economic assessment to the national dividend and to divergences between private and social net product (Pigou 1920). Whatever normative criterion is adopted, such analysis presupposes some representation of who receives benefits and bears costs. Recipient categories thereby enter both administrative action and evaluative reasoning.

The historical importance of this architecture should be separated from a claim of timeless necessity. Material scarcity remains economically consequential, and recipient-level distribution remains indispensable in many domains. A household requires income, a firm requires financing, and a public program requires rules for eligibility. The historical question concerns the scope of the abstraction. Recipient-centered allocation became powerful because the major resources and institutions of modern economic organization could often be represented through identifiable owners, workers, firms, taxpayers, and beneficiaries. The same abstraction becomes less complete when the economic consequence of an allocation depends heavily on relations that extend beyond the recipient unit.

1.6.3 Employment and Access to Livelihood

Employment became one of the central institutional relations connecting productive participation to command over resources. Under wage labor, the employment relation links the contribution of labor to a monetary claim that can be exercised elsewhere in the economy. Marx's analysis of labor-power and the wage relation places this institutional form within the production process of capital, while Polanyi's historical account emphasizes the broader social transformation involved in organizing labor through markets (Marx 1867; Polanyi 1944). The importance of employment for allocation follows from its position between production and livelihood.

For the worker, wage income supplies purchasing power. For the firm, employment identifies a recognized contributor within an organizational structure and a recurrent claim on organizational resources. For public administration, employment status can become an observable category used in taxation, insurance, pensions, labor regulation, and statistical classification. The employment relation therefore coordinates several institutional systems at once. Productive participation, monetary income, legal status, organizational membership, and administrative recognition become partially coupled through one relation.

This coupling makes employment more than a production arrangement. In societies where access to many goods and services is mediated by monetary income, labor-market position influences the practical ability to secure housing, food, mobility, education, care, and other conditions of life. The strength of the connection varies across welfare regimes, households, property structures, and public institutions, yet the general architecture remains significant: employment often provides a major route through which productive participation is converted into an individual or household resource claim.

The recipient-centered form is visible in the way the wage appears. A complex production process involving technologies, infrastructures, organizations, legal protections, accumulated knowledge, suppliers, customers, and public institutions results in a payment assigned to an identifiable worker. The wage is real and materially consequential, while the recipient unit abstracts from the wider relations that made the productive process possible. The same structure appears on the employer side, where revenues and profits are attributed to legally and organizationally bounded entities even when production depends on extended relational networks.

Employment therefore helped stabilize a broader social expectation: participation in production could function as a legitimate basis for access to income. This expectation never exhausted the sources of livelihood, since property income, household transfers, public provision, informal production, inheritance, and many other mechanisms also mattered. Its analytical significance lies in how effectively it connected three institutional domains that might otherwise remain separate: production, recognition, and allocation. Later sections will examine why artificial intelligence and changing productive capabilities place pressure on this historically powerful connection.

1.6.4 Competitive Capability and Resource Claims

Market allocation frequently connects resource claims to capabilities that can be exercised within recognized exchange and production relations. Labor earns income

when a worker's capacities can be supplied under an employment relation; property generates claims when an owner controls an asset that can be leased, sold, financed, or used productively; firms obtain revenue when organizational capacities produce goods or services that counterparties purchase. Competitive capability therefore matters because institutions convert certain capacities into claims over resources.

The conversion is mediated rather than automatic. A capability has economic consequence only within a structure that recognizes, prices, contracts, or otherwise enables its exercise. The same skill may command a high wage in one labor market and little income in another. An asset may generate revenue under one property regime and remain economically inactive under another. Organizational knowledge may become valuable when complemented by finance, infrastructure, legal permission, and market access. Resource claims consequently depend on the relation among capability, institution, and opportunity rather than on capability considered in isolation.

Sen's entitlement analysis offers a particularly clear formulation of the distinction between aggregate availability and a person's command over resources. His analysis of famine shifts attention from total food supply toward the legally available means through which persons can command food, including production possibilities, trade opportunities, and state entitlements (Sen 1981). The argument is narrower than a general theory of allocation, yet its structural lesson is important here: the existence of a resource in an economy does not establish an actor's effective claim upon it. Claims are mediated by ownership, exchange, production, public provision, and other institutional relations.

This perspective clarifies the historical connection between competitive capability and allocation. Markets can translate productive or exchange capabilities into monetary claims when institutions recognize the relevant relations. The resulting claims can then be exercised against other resources. A worker's labor capacity, a firm's organizational capacity, an owner's asset, or a creditor's contractual right enters an allocative system through a different institutional channel, yet each channel links a recognized position to a claim.

The architecture also generates asymmetry. Differences in productive capability, asset ownership, bargaining position, institutional recognition, and access to markets can become differences in resource command. Once resource command changes, it can alter future capabilities by affecting education, health, mobility, technology, finance, networks, and institutional access. Recipient-centered allocation therefore contains a dynamic dimension even when the immediate transaction is represented as a transfer between fixed entities. Present claims influence the conditions from which future claims can be made.

The historical relevance of this mechanism becomes especially important when capabilities change rapidly. If productive capacity is increasingly concentrated in artificial systems, platforms, capital-intensive infrastructures, or organizations that control them, the inherited connection between individual productive contribution and resource claims may weaken. Chapter 1 develops this problem later. The present point is preparatory: modern allocation systems often rely on institutional pathways that translate recognized capabilities and positions into claims, and those pathways have histories rather than universal form.

1.6.5 Historical Limits of Recipient-Centered Evaluation

Recipient-centered evaluation is strongest when the principal question concerns the immediate distribution of a resource among identifiable units. It can show who received income, credit, property, benefits, or public expenditure; it can compare quantities across households or firms; and it can support accountability for decisions made under scarcity. These capacities remain indispensable. The limitation emerges when the evaluative object extends from receipt to the relational and generative consequences of receipt.

The first limit concerns internal structure. Two households receiving the same transfer may contain different dependency relations, care obligations, decision structures, and access conditions. Two firms receiving the same investment may organize labor, knowledge, ownership, and external suppliers differently. A recipient-level measure records the transfer accurately while leaving the internal relational configuration unresolved. The resulting abstraction is often appropriate for administration, although it cannot by itself establish how the resource changes relations within the recipient unit.

The second limit concerns external structure. A resource assigned to one entity may alter other actors through prices, employment, bargaining, supply relations, debt, care obligations, network access, or institutional precedent. These effects cross the administrative boundary used to record the allocation. The same nominal transfer can therefore generate different economic consequences depending on the recipient's position within wider relational configurations.

The third limit concerns effective command. Sen's entitlement analysis demonstrates, in an especially stark domain, that aggregate resource availability does not determine who can command the resource (Sen 1981). Recipient-centered evaluation can likewise become incomplete when formal receipt and effective access diverge. A formally allocated resource may be unusable without complementary infrastructure, knowledge, legal status, time, mobility, or relational support. The allocative event and the realized capability can therefore differ substantially.

The fourth limit concerns temporal extension. Immediate receipt is an event; its consequences may unfold through a trajectory. An educational grant can alter later capabilities and networks. Credit can enable production while also creating dependence. Infrastructure can change future market access. A transfer to an organization can reshape internal authority or external bargaining power. Evaluating only the first recipient and the first period captures a real part of the process while omitting the later relations generated by the allocation.

These limits establish the historical transition that motivates GRE without retroactively invalidating entity-centered economics. Modern law, accounting, statistics, markets, and public administration created stable recipients because large-scale allocation required them. Economic theory developed abstractions that corresponded closely to this institutional architecture. The contemporary challenge arises as increasingly important economic effects depend on networks, platforms, knowledge infrastructures, institutional access, heterogeneous capabilities, and long-horizon transformations that cross recipient boundaries.

Recipient-centered allocation therefore remains a valid analytical layer within a wider relational account. GRE's later allocation theory will retain the administrative recipient while asking additional questions about the relations through which

resources become usable, the configurations altered by transfer, and the future capacities and constraints generated afterward. Before that theory can be developed, Chapter 1 must first reconstruct how capital, labor, and knowledge became historically differentiated sources of economic power. Section 1.7 takes up that task.

1.7 Capital, Labor, Knowledge, and Economic Power

The preceding sections reconstructed the institutional conditions that made economic subjects legible and recipient-centered allocation administratively tractable. This section turns to the historically differentiated capacities through which economic subjects could command resources, participate in production, and influence the conditions of later action. Its objective is to clarify how capital, labor, and knowledge became distinct yet convertible sources of economic advantage and how their institutional conversion contributed to economic power. The discussion proceeds through five steps: capital as productive control, labor as the material basis of social reproduction, knowledge as a productive resource whose scarcity differs from that of material goods, expertise as an institutionally organized hierarchy of epistemic capability, and the conversion among capability, resources, and power. The method is historical and relational. Each source of advantage is treated through the relations that make it effective rather than as an isolated substance possessed independently of institutions, organizations, and other economic subjects.

1.7.1 Capital and Productive Control

Capital acquired historical significance through more than the accumulation of valuable objects. Productive assets become economically consequential when ownership, finance, organization, and law permit their holders to determine how production is initiated, combined, expanded, or withheld. The distinction matters because the same physical object can occupy very different economic positions according to who controls it, what claims are attached to it, and which organizational relations it enables. A machine incorporated into a firm, a parcel of land pledged as collateral, and a financial claim that can be mobilized for investment all participate in productive control through different institutional arrangements.

Marx's analysis of capital emphasized this relational dimension by locating capital within a production process in which money, means of production, and purchased labor-power are organized toward the production of surplus value (Marx 1867). Whatever theoretical commitments are adopted regarding value, the historical insight is broader: control over productive assets can organize the labor of others, determine access to productive opportunities, and shape the technical form of production. Capital therefore carries a capacity to structure relations in addition to representing stored wealth.

Modern organizational law strengthened this capacity by creating durable arrangements through which assets could be partitioned, committed to organizational purposes, and insulated from some claims against owners or managers (Hansmann and Kraakman 2000). Productive control could thereby persist beyond the lifespan or immediate decisions of particular individuals. Corporations, banks, partnerships, and other organizational forms stabilized pools of assets and claims that could hire labor,

purchase technology, enter contracts, and accumulate further resources. Capital increasingly operated through organizations rather than through isolated proprietors alone.

Financial institutions added another layer. Access to credit allows claims on future income to be converted into present productive capacity, while collateral and creditworthiness determine which subjects can perform that conversion on favorable terms. Productive control can consequently expand without prior possession of the full material resources required for production. The institutional ability to mobilize claims, pledge assets, and coordinate investment becomes part of the effective content of capital.

This historical structure created a recursive advantage. Control over productive assets can generate income; income can be retained or invested; investment can expand productive capacity; expanded capacity can strengthen bargaining position and access to finance. The recursion is neither automatic nor uniform, because markets, crises, regulation, competition, technological change, and collective organization can interrupt it. The important point for the present chapter is structural: capital can reproduce its economic effectiveness through institutional channels that connect present control to future control.

Economic power begins to appear within this recursion. At this stage, the term refers provisionally to an actor's capacity to influence access to productive conditions, the organization of production, or the feasible economic actions of other participants. A firm controlling essential infrastructure, a lender controlling access to finance, or an owner controlling a productive asset can affect choices available to subjects who depend on those conditions. Later chapters develop a fuller theory of power. The historical task here is to identify the material and institutional channels through which productive control became one of its recurrent economic sources.

1.7.2 Labor and Material Reproduction

Labor occupies a different position because productive activity is inseparable from the reproduction of the persons and households that perform it. Wage labor links these domains by converting participation in production into income through which food, shelter, care, mobility, education, and other conditions of continued life are acquired. The employment relation therefore connects the organization of production to the material reproduction of economic subjects.

Marx's treatment of labor-power made this connection explicit by distinguishing labor from the capacity to labor and by locating the reproduction of labor-power within the material conditions required for its continued availability (Marx 1867). Polanyi's historical account likewise emphasized the social transformation involved in subjecting labor to market organization, since labor is inseparable from the human beings whose lives are affected by the conditions under which it is bought and sold (Polanyi 1944). These traditions differ in theory and purpose, yet both illuminate the historical dependence of wage labor on arrangements extending beyond the immediate labor contract.

The worker's productive capacity depends on relations that precede the employment encounter. Health, education, care, household support, transportation, legal status, social networks, and public infrastructure all condition whether labor can be offered and under what terms. The wage relation makes only part of this supporting

structure visible in monetary form. A firm pays for labor according to institutional and market conventions, while many conditions that reproduce labor are provided by households, communities, public institutions, or earlier investments whose contribution is not represented in the wage itself.

Labor also generates capacities that can outlast particular employment relations. Skills are learned through practice; workers acquire knowledge of technologies, organizations, clients, procedures, and collective routines; occupational communities transmit standards and techniques. Employment can therefore reproduce and transform productive capability at the same time that it uses it. The distribution of learning opportunities becomes economically important because work positions differ in the degree to which they expand future capability.

The relation between labor and power follows from this dual character. A worker may depend on employment for livelihood while an organization depends on workers for productive continuity. The relative strength of these dependencies varies with labor-market conditions, legal protections, skill scarcity, collective organization, ownership structure, mobility, and the availability of alternatives. Labor power in the ordinary political-economic sense and productive capability in the present historical reconstruction meet at this point: the capacity to work becomes economically consequential through institutions that determine who can withhold, replace, coordinate, or reorganize that capacity.

This perspective also clarifies why labor cannot be reduced to a quantity of effort. Labor is situated within a relational infrastructure of reproduction and learning. Its economic effect depends on technical systems, organizational coordination, access to tools and information, household conditions, and institutional recognition. The material reproduction of labor and the productive use of labor are therefore connected moments of one economic architecture. That architecture becomes especially important once knowledge and expertise begin to account for a larger share of differentiated productive capability.

1.7.3 Knowledge as a Scarce Productive Resource

Knowledge entered modern economic analysis through several routes that gradually made its productive importance more explicit. Industrial production had long depended on skill, scientific knowledge, technical design, and accumulated experience. During the twentieth century, economic theory increasingly represented education, training, information, and innovation as objects of investment and coordination in their own right. This development expanded the concept of productive resources beyond physical assets while also revealing that knowledge obeys a different scarcity structure from many material goods.

Human-capital analysis provided one influential formulation. Becker treated education and on-the-job training as investments that affect earnings, employment, and productivity, thereby representing acquired knowledge and skill as economically consequential capacities rather than as external cultural attributes (Becker 1964). This framework made differences in training and education analytically comparable with other forms of investment, while leaving open broader questions about the institutions through which learning is provided and recognized.

Hayek approached knowledge from the problem of coordination. His argument centered on the dispersion of incomplete and frequently local knowledge across sep-

arate individuals, emphasizing that economically relevant information is rarely concentrated in one mind or institution (Hayek 1945). Knowledge scarcity in this sense concerns location and access as much as aggregate quantity. A system may contain the relevant knowledge while no participant possesses a complete representation of it.

Arrow's analysis of invention introduced another important distinction. Information generated through inventive activity has economic properties that complicate ordinary commodity treatment, including uncertainty about its production and difficulties surrounding appropriation once information becomes available (Arrow 1962). The result is a productive resource whose cost of creation, cost of transmission, and cost of repeated use can differ sharply. A technical insight may require substantial investment to produce while becoming inexpensive to reproduce after codification. Knowledge can therefore be scarce at one stage and abundant at another.

These observations support a more differentiated historical account of knowledge scarcity. Scarcity may arise in discovery, acquisition, verification, interpretation, certification, access, or the ability to apply knowledge effectively. Codified information can circulate widely while the capacity to understand or operationalize it remains concentrated. Scientific knowledge can be publicly available while access to laboratories, data, compute, professional networks, or institutional authority remains restricted. The economically relevant unit is consequently broader than a stock of information.

Knowledge also has cumulative properties. Earlier discoveries provide inputs to later discoveries; education increases the ability to acquire further knowledge; organizations develop routines that preserve experience; scientific communities build infrastructures through which findings can be criticized and extended. These cumulative relations can generate increasing advantages for subjects already positioned within rich knowledge environments. The historical scarcity of knowledge therefore concerns both the content known and the relations through which further knowing becomes possible.

This distinction prepares an important transition in Chapter 1. Industrial modernity treated many forms of expertise as scarce because advanced knowledge required long training, specialized institutions, and limited access to technical infrastructures. Contemporary artificial intelligence alters parts of this scarcity structure by reducing the cost of producing certain symbolic and cognitive outputs. Section 1.11 develops that transformation. The present section first establishes the earlier architecture in which knowledge scarcity supported differentiated expertise and economic hierarchy.

1.7.4 Expertise and Epistemic Hierarchy

Expertise is knowledge placed within an institutional relation of recognized competence. An individual may know something without occupying an expert position, while an expert position usually depends on certification, organizational role, professional reputation, demonstrated performance, or another mechanism through which others are authorized to rely on that knowledge. Epistemic hierarchy arises when these recognition structures distribute unequal authority to interpret information, define problems, evaluate evidence, or make decisions whose consequences extend to other participants.

The economic significance of expertise follows from its connection to scarce productive and coordinative tasks. When training is costly and specialist knowledge is unevenly distributed, expertise can affect wages, occupational access, organizational authority, and bargaining position. Human-capital analysis captures part of this structure by linking education and training to productivity and earnings (Becker 1964). The wider institutional structure includes professional licensing, educational credentials, technical standards, internal promotion systems, and reputational mechanisms that determine which capabilities receive economic recognition.

Expertise also creates organizational dependence. Complex production requires decisions about design, maintenance, finance, medicine, law, logistics, software, research, and many other specialized domains. Organizations therefore allocate decision rights partly according to recognized competence. The resulting hierarchy can be productive because it concentrates responsibility where relevant knowledge is expected to be available. At the same time, dependence on specialized judgment creates asymmetry between those who possess or are recognized as possessing relevant knowledge and those who must act on their conclusions.

Hayek's account of dispersed knowledge places an important limit on epistemic hierarchy. Local participants often possess situational knowledge unavailable to centralized experts, and coordination problems arise when institutions fail to transmit or respond to such distributed information (Hayek 1945). The tension is structural. Specialized expertise may be indispensable for tasks requiring deep technical knowledge, while economic systems also depend on dispersed, contextual, and practical knowledge that cannot be fully centralized.

The hierarchy of expertise is consequently shaped by both knowledge and recognition. Credentials can signal capability, yet they also determine access to occupations and decision arenas. Organizational roles can place experts close to resources and strategic information, which in turn expands their opportunities for further learning. Research institutions can accumulate instruments, data, and networks that make future knowledge production easier. Epistemic advantage can therefore become institutionally self-reinforcing even when the underlying knowledge remains contestable or distributed.

This structure matters for GRE because economic power can arise through control over interpretation as well as control over material resources. Subjects able to classify risk, certify quality, authorize technical claims, design information systems, or define admissible evidence can shape which actions appear feasible to others. Later chapters examine epistemic power more directly. The historical point here is that modern economies increasingly organized productive differentiation around recognized knowledge, thereby adding an epistemic dimension to the older relations of capital and labor.

1.7.5 Conversion among Capability, Resources, and Power

Capital, labor, and knowledge become most consequential when their economic effects are examined through conversion. Productive capability can generate income; income can purchase education, tools, mobility, or access; knowledge can attract finance; ownership can purchase expertise; organizational position can provide information; and institutional recognition can convert a capability into an authorized claim on resources. Economic advantage therefore develops through pathways that

translate one form of capacity or resource into another.

The conversion from capability to resources is institutionally mediated. Becker's human-capital framework links acquired education and training to earnings and productivity, yet the strength of that link depends on labor markets, credentials, organizational demand, discrimination, bargaining arrangements, and other institutions (Becker 1964). A capability that lacks recognition, market demand, legal permission, or access to complementary resources may generate little income. Productive capacity and resource command therefore remain analytically distinct.

The reverse conversion is equally important. Income and wealth can finance training, relocation, health, experimentation, equipment, and time for learning. Capital can purchase access to expertise and technical infrastructure. Organizational resources can support research whose results create further capability. Resource inequality can consequently become capability inequality through cumulative investment, while capability inequality can become resource inequality through differentiated returns. These conversions create feedback across time.

Sen's entitlement analysis provides a related insight from a different problem-space: aggregate availability of resources does not determine what particular persons can command, because access depends on the entitlement relations through which resources are obtained (Sen 1981). The same principle applies more broadly to capability conversion. Possessing a useful skill does not by itself establish access to the assets, institutions, markets, or rights required to exercise it. Resources become effective through relations, and capabilities become economically consequential through conversion structures.

Power enters when these conversions affect the feasible actions of others or the rules governing access. Control over capital can determine who receives finance; recognized expertise can determine which claims are accepted; organizational authority can allocate productive opportunities; ownership can restrict access to infrastructure; labor scarcity can strengthen the capacity to bargain or withhold participation. Economic power therefore often emerges through control of conversion points rather than through possession of a single resource considered in isolation.

The conversion structure also helps explain persistence. An actor with capital may purchase knowledge, hire labor, and expand organizational capacity. An actor with recognized expertise may gain income and authority, then use those resources to acquire further credentials, networks, or productive assets. A worker in a position rich in learning opportunities may accumulate capabilities that widen future options. Conversely, subjects lacking access to key conversion interfaces may experience cumulative disadvantage even when they possess valuable capacities. Historical inequality can therefore reproduce itself through unequal conversion conditions.

This synthesis provides the bridge to the next stage of Chapter 1. Capital, labor, and knowledge are distinct sources of productive capacity, yet their economic effects depend on relations that connect subjects across organizations, infrastructures, institutions, and markets. As production becomes more interdependent, the relevant unit of analysis increasingly extends beyond the isolated owner, worker, or expert. Section 1.8 develops this expansion by examining relational production through division of labor, organizations, production networks, knowledge infrastructures, and transnational economic relations.

1.8 Expansion of Relational Production

The preceding sections reconstructed the modern economic subject and the institutional mechanisms through which capital, labor, and knowledge became recognizable sources of productive capability and economic power. This section changes the scale of analysis. Its role is to show how production increasingly depended on relational configurations that extended beyond any single worker, owner, firm, or administrative recipient. The objective is to identify the historical forms through which productive activity became distributed across interdependent tasks, organizations, supply relations, knowledge infrastructures, and multiple territorial scales. The discussion proceeds from division of labor to organizations, production networks, scientific and knowledge infrastructures, and transnational relations. The method is historical and relational: each form of production is examined through the dependencies, coordination mechanisms, and infrastructures that make distributed activity productive as a configuration.

1.8.1 Division of Labor and Interdependence

The division of labor offers one of the clearest historical routes from entity-centered description toward relational production. Smith treated specialization as a source of increased productive power because repeated tasks permit greater dexterity, reduce time lost in switching activities, and encourage the development of specialized machinery (Smith 1776). The resulting productivity, however, belongs to a configuration of differentiated activities rather than to any isolated worker. Specialization increases output by making each participant more dependent on the complementary work of others.

This dependence changes the economic meaning of productive capability. A highly specialized worker may possess a narrow and valuable skill while being unable to produce a finished good independently. A specialized machine may be extremely productive within one production sequence while having little use outside it. A firm may excel at one stage of production while relying on logistics, suppliers, finance, standards, infrastructure, and downstream distribution. Productive capability therefore becomes increasingly positional: its value depends on how a capacity is connected to other capacities within an organized sequence.

The relation between specialization and interdependence is historically important because it expands the coordination problem at the same time that it expands productive capacity. Tasks must be sequenced, inputs must arrive at appropriate times, specifications must be compatible, and failures in one component can propagate to others. Market prices can coordinate some of these relations, while organizations, contracts, standards, routines, and long-term exchange relationships coordinate others. Hayek's account of dispersed knowledge captures one dimension of this problem by emphasizing that economically relevant knowledge is distributed across participants and cannot be fully concentrated in a single mind or office (Hayek 1945).

Interdependence also makes attribution more difficult. An observed output can often be assigned legally or administratively to a firm, yet the productive conditions of that output may include workers trained elsewhere, infrastructure financed publicly, suppliers operating under long-standing technical standards, scientific knowledge produced in universities, and demand coordinated through institutions beyond

the firm. The administrative unit remains useful for accounting and responsibility, while the productive process exceeds it.

Granovetter's analysis of embeddedness sharpened this point by arguing that economic action is situated within ongoing structures of social relations rather than adequately represented by atomized actors alone (Granovetter 1985). For the historical argument developed here, the significance lies in the unit of explanation. Productive outcomes increasingly depend on the pattern of relations among specialized actors, and the stability, trust, information, and expectations carried by those relations can affect what the participants are able to accomplish.

Relational production therefore begins with a simple historical observation: specialization makes productive capacity increasingly distributed. The more extensive the division of labor, the less adequate it becomes to identify production solely with the attributes of a nominal producer. The relevant productive object begins to include the configuration through which differentiated capacities are connected.

1.8.2 Organizations as Relational Structures

Organizations provide one institutional response to the coordination demands generated by specialization. Section 1.5 examined the legal and accounting mechanisms that stabilize organizations as recognizable entities. The present subsection examines their internal productive structure. An organization can act as an economic unit because relations among roles, authority, information, assets, routines, and responsibilities are sufficiently stabilized to sustain coordinated action over time.

Coase's analysis of the firm framed the organizational question through the costs of using the price mechanism and the circumstances under which coordination is brought inside the firm (Coase 1937). That formulation remains important because it makes organizational boundaries economically consequential. Yet the boundary does not eliminate relational complexity. It reorganizes it. Activities that might otherwise be coordinated through repeated market transactions become connected through employment, managerial authority, internal procedures, budgeting, technical standards, and shared infrastructure.

The internal productive capability of a firm is consequently distributed across relations among positions. A design team depends on manufacturing knowledge; manufacturing depends on procurement and maintenance; sales depends on production and logistics; finance depends on information generated throughout the organization. The formal organization chart captures part of this architecture, while informal relations, professional communities, accumulated routines, trust, and tacit knowledge often carry coordination that the formal chart does not specify.

Network forms of organization make the relational character of production even more visible. Powell describes network forms as organized through reciprocal patterns of communication and exchange that differ from both discrete market transactions and hierarchical command (Powell 1990). Such arrangements can support collaboration where participants remain organizationally distinct yet require continuing coordination, mutual adjustment, and information exchange. Productive organization therefore admits more than a binary choice between market and hierarchy.

This plurality matters for economic analysis because the same nominal set of assets and workers can perform differently under different relational arrangements. A tightly centralized organization, a federated organization, a long-term alliance, and a

project network distribute authority, information, learning, and risk differently. Productive capability is consequently partly a property of organizational architecture. Reorganization can alter output without changing the physical assets or formal skills initially available, because the relations through which those resources are combined have changed.

Organizations also accumulate relational memory. Routines preserve solutions to recurrent problems; reputations shape expectations; shared standards reduce coordination costs; informal communication channels accelerate problem solving; and prior collaboration changes the ease with which new collaboration can occur. These features make organizational history productive. Present capability depends partly on relations generated through earlier activity.

The firm remains a legitimate unit of economic analysis, especially where legal responsibility, financial reporting, and contractual control are concerned. Relational analysis adds a second description: the firm is also a stabilized configuration of internal and external relations whose productive capacity depends on how those relations are maintained and transformed. This dual description becomes increasingly necessary once production extends across organizational boundaries.

1.8.3 Production Networks and Supply Chains

Production networks extend relational production beyond the boundaries of a single organization. Modern goods and services are frequently produced through sequences in which design, components, assembly, logistics, finance, certification, distribution, and after-sales support are distributed among legally distinct organizations. The resulting system cannot be understood only by adding the attributes of participating firms, because the pattern of dependence among them affects coordination, bargaining, learning, vulnerability, and the distribution of returns.

Supply relations differ in depth. Some transactions are relatively standardized and can be shifted among suppliers with limited reorganization. Others require dedicated equipment, jointly developed specifications, long-term learning, quality assurance, shared information systems, or repeated adaptation. The economic relation between buyer and supplier therefore ranges from relatively impersonal exchange to durable interdependence. These differences affect how productive knowledge moves and how risks are distributed across the network.

The global value-chain literature provides a developed account of such variation. Gereffi, Humphrey, and Sturgeon identify governance patterns ranging from market relations to modular, relational, captive, and hierarchical forms, with differences shaped by transaction complexity, codifiability, and supplier capabilities (Gereffi et al. 2005). Their typology is valuable here because it shows that formally separate firms can stand in relations with very different degrees of coordination and power asymmetry. A contractual boundary therefore provides limited information about the substantive structure of production.

Network position can also affect access to opportunity. A firm connected to technically demanding customers may receive information, standards, and incentives that support learning, while a supplier confined to narrowly specified tasks may have fewer opportunities to develop independent capabilities. The productive consequences of a relation can therefore extend beyond the immediate exchange. Repeated transactions may generate new competencies, lock in specialized investments,

deepen dependence, or alter the set of future partners available to each participant.

This perspective clarifies why disruptions propagate. A production network can appear decentralized because ownership is distributed among many firms, while remaining operationally concentrated around a small number of critical nodes, standards, logistics routes, or technological interfaces. Failure at one point can interrupt production elsewhere even when downstream firms remain financially solvent and legally intact. The vulnerability belongs to the relational configuration through which production is organized.

Relational production also complicates the attribution of value creation. Final prices and accounting systems assign revenues to identifiable organizations, but productive contribution may be dispersed across suppliers, infrastructure providers, workers, knowledge institutions, and complementary technologies. The question of how value generated through a network is recognized, converted, and distributed will become central in later GRE chapters. At this historical stage, the important development is the expansion of production beyond the boundaries used to identify economic recipients and owners.

Supply chains therefore provide a concrete transition from entity-centered production to relational architecture. Firms remain real and consequential economic subjects, yet their productive capacities are conditioned by positions within networks of dependence, learning, standards, and exchange. The unit of production increasingly spans relations among organizations.

1.8.4 Scientific and Knowledge Infrastructures

Knowledge-intensive production makes the relational basis of productive capacity especially visible because usable knowledge depends on infrastructures that no single organization normally creates by itself. Universities, laboratories, professional associations, journals, standards bodies, databases, patent institutions, training systems, public research agencies, and technical communities contribute to the production, verification, transmission, and preservation of knowledge. Firms and workers draw on these infrastructures even when the resulting commercial output is attributed to a particular organization.

Arrow's analysis of invention emphasized uncertainty and the distinctive appropriation problems surrounding information production (Arrow 1962). These features help explain why knowledge production has repeatedly relied on institutional forms that differ from ordinary commodity exchange. Public funding, professional norms, publication systems, intellectual-property regimes, collaborative research, and organizational secrecy create different arrangements for balancing dissemination, appropriation, and continued investment.

The productive importance of knowledge infrastructures extends beyond the stock of published information. Scientific and technical work depends on instruments, methods, repositories, standards, peer communities, credibility systems, and trained personnel able to interpret results. A published finding may be widely accessible while the capability to reproduce, evaluate, or apply it remains concentrated in institutions possessing complementary infrastructure. Knowledge abundance at the level of symbols can therefore coexist with scarcity at the level of effective participation.

Interorganizational collaboration provides one mechanism through which such capabilities are distributed. Powell, Koput, and Smith-Doerr's study of biotechnology

located important innovation processes within networks of learning that crossed organizational boundaries (Powell et al. 1996). The broader lesson is not specific to biotechnology. Where relevant knowledge is dispersed and rapidly developing, productive capability can depend on access to relations through which organizations learn from one another, recruit expertise, interpret developments, and combine complementary resources.

Knowledge infrastructures are also cumulative. Training institutions reproduce specialist communities; standards allow artifacts produced in different places to interoperate; archives and databases preserve earlier results; professional criticism filters claims; and shared technical vocabularies reduce the cost of future coordination. These infrastructures are products of earlier relations and conditions for later production. Their economic contribution is therefore temporally extended and difficult to assign to a single transaction.

This structure matters for the historical emergence of GRE because it weakens the correspondence between ownership of an output and generation of the conditions that made the output possible. A firm may own a patent or sell a product while depending on publicly financed science, professional standards, prior open knowledge, supplier learning, and collective technical infrastructures. The administrative attribution of revenue can remain precise even when the generative history of capability is distributed.

Knowledge-intensive production thus expands the economic object from information possessed by an actor to an infrastructure of relations through which knowing becomes possible, credible, applicable, and renewable. Later chapters will examine the implications for knowledge capital, epistemic economy, and generative return. The present section establishes the historical condition: productive knowledge increasingly operates through relational infrastructures whose boundaries exceed the firms that commercialize their outputs.

1.8.5 Transnational and Multiscalar Economic Relations

The expansion of relational production eventually exceeds both organizational and territorial boundaries. Production can be coordinated through relations among workers, firms, financial institutions, public authorities, standards bodies, logistics systems, and knowledge institutions located in different jurisdictions. The resulting architecture is multiscalar: local workplaces operate within organizations; organizations operate within production networks; networks depend on national institutions and transnational infrastructures; and changes at one scale can alter feasible actions at another.

This multiscalar structure changes the meaning of economic location. A plant is physically situated in one place while depending on financing, intellectual property, technical standards, intermediate inputs, software, demand, and managerial decisions distributed across other places. A worker's employment conditions can be affected by procurement decisions made elsewhere. A supplier's upgrading opportunities can depend on standards imposed by lead firms or regulatory regimes outside its jurisdiction. Territorial location therefore remains important while becoming only one coordinate of economic position.

Global value-chain analysis again illustrates the point. Governance patterns within transnational production can distribute coordination and power asymmetri-

cally even where production is legally fragmented across independent firms (Gereffi et al. 2005). The economic significance of a firm consequently depends partly on its relation to lead firms, standards, technologies, logistics channels, and markets that operate at larger scales.

Multiscalar production also connects different institutional tempos. Employment law, industrial capacity, infrastructure, financial conditions, and technical standards change at different rates. A rapid shift in procurement or finance can therefore encounter much slower changes in worker skills, transport systems, regulatory institutions, or regional productive structures. The historical consequences of production cannot always be understood on the timescale of the transaction that initiated them. This observation prepares the later GRE treatment of generative spacetime and fast-slow economic dynamics.

The expansion across scales also changes the distribution of responsibility. Economic benefits and harms may be generated through chains of relations in which no single participant controls the whole configuration. Lead firms may influence specifications without directly employing workers who implement them; investors may alter financing conditions without managing production; states may regulate entities within their jurisdiction while key dependencies lie elsewhere. Legal and administrative responsibility remains essential, yet causal and generative responsibility can extend across a wider relational field.

Section 1.9 develops globalization as a distinct historical transformation of these relations, including transnational production, capital flows, distributed labor, institutional interdependence, and economic relations beyond territorial boundaries. The present section establishes the prior analytical shift. Once productive activity is distributed across interdependent tasks, organizations, networks, knowledge infrastructures, and scales, the economy becomes increasingly difficult to represent as a collection of independently productive entities connected only by exchange. Relational production becomes part of the historical architecture of economic life.

1.9 Globalization and the Extension of Economic Relations

The preceding section showed how productive activity expanded from specialized tasks and organizations into interorganizational networks and knowledge infrastructures. This section extends the historical scale once more. Its role is to reconstruct globalization as an enlargement and densification of economic relations across territorial, organizational, and jurisdictional boundaries. The objective is to identify how production, capital, labor, institutions, and claims upon value became increasingly transnational while remaining embedded in unequal capacities, legal regimes, and historically specific forms of coordination. The discussion proceeds through transnational production, global capital flows, distributed labor and unequal exchange, global institutional interdependence, and economic relations whose operative structure exceeds a single territorial container. The method is historical and relational: globalization is treated as a reorganization of connections among economic actors and institutions rather than as a simple increase in the volume of international transactions.

1.9.1 Transnational Production

Transnational production extends the relational structure of production across territorial jurisdictions. A finished good, service, or technological system may combine design in one location, components from several others, assembly elsewhere, financing through another jurisdiction, and distribution through globally coordinated logistics. The productive object presented to a final buyer can therefore be the terminal manifestation of a geographically dispersed system of relations among firms, workers, infrastructures, standards, and institutions.

Global value-chain analysis made this architecture analytically visible by distinguishing different governance forms through which lead firms and suppliers coordinate complex transactions. Gereffi, Humphrey, and Sturgeon show that transaction complexity, the codifiability of information, and supplier capabilities help shape governance arrangements ranging from relatively market-like relations to more captive and hierarchical forms (Gereffi et al. 2005). Their framework is useful here because it shows that geographic dispersion does not imply organizational dispersion in the same degree. Production can be territorially distributed while coordination, specification, intellectual property, market access, or strategic decision-making remains highly concentrated.

This distinction changes the meaning of location. A factory is located in a territory, yet its productive role may be defined by relationships extending far beyond that territory. Its output may depend on imported components, standards specified by a distant lead firm, credit provided through international financial networks, software maintained elsewhere, and demand originating in multiple markets. The economic significance of the local unit therefore cannot be inferred from territorial location alone. Position within a transnational production structure affects bargaining power, learning opportunities, vulnerability to substitution, and the share of downstream value that can be retained.

Transnational production also separates several forms of economic control that industrial organization had often joined within the same firm or national economy. Ownership may be located in one jurisdiction, production in another, technical authority in a third organizational center, and consumption across many territories. Contractual relations can coordinate these distributed elements without bringing them under a single legal person. The resulting architecture combines entity-level responsibility with relational dependence across entities.

The historical importance of this arrangement lies in the enlargement of the relevant economic system. A national economy remains a meaningful institutional and statistical object, yet many productive processes acquire conditions of reproduction that extend beyond national boundaries. Input availability, logistics, exchange rates, standards, foreign demand, and decisions by transnational firms can alter domestic production without originating within the domestic institutional field. Globalization therefore expands the set of relations that must be considered when explaining how a nominally local economic capability is generated and sustained.

This expansion does not erase territory. Infrastructure, labor law, taxation, education, energy systems, political authority, and physical logistics continue to be territorially organized to substantial degrees. Transnational production instead layers cross-border coordination upon territorial institutions. The result is a multiscalar productive architecture in which local, national, regional, and global relations jointly

condition what any single economic actor can do.

1.9.2 Global Capital Flows

Global capital flows extend economic relations through claims on assets, liabilities, income streams, and future payments. Cross-border finance allows savings generated in one jurisdiction to support investment in another, firms to raise funds from foreign investors, states to issue debt internationally, and households or institutions to hold claims on assets located elsewhere. The relevant relation is therefore partly financial and partly temporal: present resources are connected to expectations about future returns across institutional and territorial boundaries.

The expansion of gross external positions illustrates how strongly these relations can exceed the scale suggested by net flows alone. Lane and Milesi-Ferretti constructed estimates of foreign assets and liabilities for a large set of countries and documented the growing scale and changing composition of international financial positions during the late twentieth century (Lane and Milesi-Ferretti 2006). For relational analysis, the importance of such data lies less in a single aggregate measure than in the multiplication of cross-border creditor, debtor, equity, reserve, and direct-investment relations that bind economic actors to developments outside their immediate jurisdiction.

Financial integration can redistribute both opportunity and exposure. Access to external capital may relax domestic financing constraints, support investment, and diversify risk. The same relational extension can transmit shocks through balance sheets, refinancing conditions, exchange-rate movements, and changing investor expectations. A financial relation that appears as an asset to one actor is simultaneously a liability or obligation within another balance sheet. Changes in one part of the system can therefore alter the conditions faced by actors connected through portfolios, credit lines, collateral structures, or payment systems.

Capital mobility also changes the relation between economic activity and institutional jurisdiction. Productive facilities remain materially situated, while claims on their earnings can circulate through financial centers and legal vehicles far from the site of production. Ownership, control, risk bearing, and income receipt can thus become geographically separated. These separations complicate any analysis that equates the location of productive activity with the location of economic benefit or decision power.

The same architecture creates asymmetry among participants. Actors with access to deep financial markets, reserve currencies, diversified portfolios, sophisticated intermediaries, or favorable legal jurisdictions can often manage cross-border exposure differently from actors dependent on a narrow set of external creditors or volatile financing channels. Global capital flows consequently create a relational field in which mobility itself becomes unequally distributed capability. The ability to enter, exit, hedge, refinance, or relocate a claim may matter as much as the nominal size of the resource being moved.

For GRE, the historical lesson is preparatory. Capital becomes increasingly intelligible as a set of mobile claims embedded in institutional relations, rather than only as a stock attached to a territorial owner. The later analysis of power, value circulation, and conversion will require this distinction because financial mobility can transform resources, obligations, and bargaining positions across scales without any

corresponding movement of the underlying productive activity.

1.9.3 Distributed Labor and Unequal Exchange

The globalization of production distributes labor across economies characterized by different wage structures, productivity levels, bargaining institutions, currencies, social protections, and positions within international production networks. This distribution generates a long-standing problem in political economy: similar productive interdependence can coexist with markedly unequal compensation, bargaining power, and capacity to appropriate the gains associated with international exchange.

The structuralist tradition formulated an early version of this problem through the center–periphery distinction. Prebisch’s analysis of Latin American development emphasized asymmetries in productivity, industrial structure, and terms of trade between industrial centers and primary-exporting peripheral economies (Prebisch 1950). The analytical significance of this tradition lies in its insistence that participation in international exchange occurs from historically differentiated productive positions. Exchange connects economies whose capacities to innovate, set prices, absorb shocks, and alter the composition of production may differ substantially.

Theories of unequal exchange developed the argument in a more explicitly distributive direction. Emmanuel linked international exchange to persistent differences in wages and to the international organization of production, arguing that trade can reproduce transfers of value between differently positioned economies (Emmanuel 1972). This is a contested theoretical tradition, and the present chapter does not adopt its full value-theoretic apparatus. Its relevance to the historical argument is narrower: globalization made it increasingly necessary to ask how the distribution of labor across jurisdictions interacts with price formation, wage differentials, ownership, and the allocation of returns across the production process.

Global production networks sharpen the question because the physical contribution of labor and the capacity to command downstream returns can be institutionally separated. Workers and suppliers may perform indispensable stages of production while lead firms control design, standards, branding, finance, intellectual property, market access, or final distribution. The governance patterns identified in global value-chain research provide one way to describe these asymmetries without presupposing a single theory of value (Gereffi et al. 2005). Different positions in the chain carry different opportunities for learning, upgrading, substitution, and bargaining.

The term *unequal exchange* therefore names more than one possible mechanism and should be used carefully. Terms-of-trade dynamics, wage differentials, ownership structures, market concentration, technological dependence, currency hierarchy, and contractual governance can each contribute to unequal distributions of gains. Their relative importance is an empirical and theoretical question. A relational framework gains little by compressing them prematurely into one explanation.

The more durable insight is that labor mobility, capital mobility, and value appropriation need not move together. Capital and contractual authority can cross borders with relative ease in some settings, while workers remain subject to migration law, local labor institutions, family obligations, language, and other forms of territorial embeddedness. The resulting asymmetry can alter bargaining positions across the global production system. Globalization therefore expands productive interdependence while also creating new sites at which differences in mobility, institutional

protection, and control shape distribution.

This historical problem prepares a later GRE question concerning heterogeneous value and conversion. Labor performed in different institutional settings becomes comparable through prices, contracts, accounting systems, and exchange rates, yet those mechanisms of commensuration may also conceal relations that produced the observed distribution. Section 1.9 remains at the historical level; later chapters will return to the normative and power-theoretic consequences of such conversion structures.

1.9.4 Global Institutional Interdependence

Globalization depends on institutions that make cross-border relations sufficiently stable to support repeated economic activity. Trade agreements, customs rules, financial regulation, payment systems, accounting standards, investment regimes, central-bank arrangements, dispute procedures, technical standards, and private certification systems all contribute to the conditions under which transnational exchange can occur. Economic integration is therefore institutionally produced as well as commercially enacted.

Institutional interdependence creates a layered structure of authority. A firm operating transnationally may face domestic corporate law, foreign labor and environmental regulation, international trade rules, sectoral standards, contractual obligations, financial-market requirements, and private platform or certification rules at the same time. These rule systems differ in source and enforceability, yet jointly shape the feasible actions of the firm. The economic relation is consequently embedded in overlapping jurisdictions rather than contained by one institutional order.

This layering also reveals a persistent tension between economic reach and political jurisdiction. Rodrik emphasizes that deep international economic integration encounters constraints created by national jurisdiction and political organization (Rodrik 2000). The point is especially useful for relational analysis because the relevant boundaries do not coincide: production networks, capital claims, information flows, and market relations may extend globally while taxation, social protection, electoral accountability, and many regulatory capacities remain organized primarily through territorial states.

Institutional interdependence therefore changes the consequences of domestic decisions. A regulatory change in one major market can alter production standards elsewhere; a monetary or financial decision can affect external borrowers; a change in customs treatment can reorganize sourcing relations; a shift in certification requirements can redistribute access to markets. The causal chain often crosses several jurisdictions and organizations before reaching the affected actor.

The resulting structure can also redistribute institutional power. Actors capable of setting standards, providing settlement infrastructure, controlling market access, or defining widely adopted contractual forms can shape behavior beyond their formal territorial authority. Smaller jurisdictions and firms may retain legal autonomy while adapting to rules generated elsewhere because access to a larger network depends on compliance. Such influence operates through relational position and dependence rather than through direct command alone.

Global institutional interdependence thus extends the economic field beyond trade volumes. It includes the rule-producing and rule-transmitting relations that allow

transnational production and finance to remain coordinated. These institutional layers will become important later when GRE distinguishes resource ownership from access, capability from effective control, and formal sovereignty from relational dependence.

1.9.5 Economic Relations beyond Territorial Boundaries

The combined development of transnational production, global finance, distributed labor, and institutional interdependence produces economic relations whose operative boundaries differ from territorial boundaries. A production network may span several states; a financial position may connect balance sheets located on different continents; a technical standard may organize firms across many jurisdictions; and an ownership structure may separate the place of production from the place in which claims on its income are legally held.

Territory remains economically consequential because infrastructure, coercive authority, taxation, public services, labor regulation, and political membership are still extensively territorialized. Globalization adds relational structures that cut across these territorial containers. The same actor can therefore occupy several economic spaces simultaneously: a local labor market, a national legal order, a transnational supply chain, an international financial network, and a global market for knowledge or standards.

This multiplicity creates analytical problems for any unit of analysis treated as self-contained. National accounts can describe production and income according to carefully defined territorial and residence conventions, firms can report consolidated entities, and trade statistics can record cross-border transactions. These representations remain indispensable. Their boundaries, however, answer specific administrative and analytical purposes. They do not exhaust the relations through which productive capability, vulnerability, knowledge, risk, and bargaining power are generated.

A relational description therefore supplements territorial accounting with attention to connection, position, dependence, and cross-scale transmission. The relevant questions concern which actors are connected, which infrastructures mediate those connections, which institutions govern them, how easily relations can be substituted, and how effects propagate when one node or jurisdiction changes. Such questions become increasingly important as the same production process is divided among actors whose legal, financial, and political environments differ.

Globalization also changes the meaning of economic distance. Geographic separation can coexist with tightly synchronized production, while neighboring actors can remain weakly connected economically. Contractual standards, transport infrastructure, communication systems, legal compatibility, financial access, and organizational integration can reduce some forms of distance while preserving or enlarging others. Economic proximity becomes partly relational rather than purely spatial.

The historical transition examined in this section therefore prepares the move to digital modernity. Once economic coordination already extends beyond territorial and organizational boundaries, digital infrastructures can intensify mediation, observation, matching, and algorithmic coordination across those relations. Section 1.10 develops that next stage. The globalization considered here establishes the preceding transformation: economic activity becomes increasingly organized through multiscalar relations whose effective boundaries exceed the entities and

territories through which they are administratively represented.

1.10 Digital Modernity and Relational Intermediation

This section locates digital modernity within the historical expansion of relational production developed in Sections 1.8 and 1.9. Its role is to identify how digital infrastructures alter the conditions under which economic relations are formed, observed, coordinated, and concentrated. The objective is to show that digitalization changes more than the speed or scale of existing transactions: it creates new infrastructures of information, inserts platforms between previously more direct relations, increases the frequency and granularity of observation, delegates parts of coordination to algorithmic systems, and changes the returns associated with network position. The discussion proceeds through information as productive infrastructure, platforms as mediators, data-intensive observation, algorithmic coordination, and the concentration dynamics associated with network effects. The method is historical and relational. Digital technologies are treated as institutional and technical arrangements that reorganize connections among economic actors rather than as a separate economy detached from earlier productive structures.

1.10.1 Information as Productive Infrastructure

Digitalization changes the economic role of information by making its storage, processing, replication, transmission, and recombination available at scales and speeds that earlier organizational forms could not sustain. Information has always mattered to production, exchange, administration, and coordination. Digital infrastructures deepen that dependence by embedding information-processing capacities directly into productive systems, logistics, finance, communication, and organizational decision-making.

Goldfarb and Tucker characterize digital economics through reductions in several costs associated with digital activity, including search, replication, transportation of information, tracking, and verification (Goldfarb and Tucker 2019). This formulation is useful for the present historical argument because each cost reduction modifies a relation. Lower search costs alter how buyers, sellers, workers, firms, and information sources find one another. Lower replication and transmission costs change the circulation of symbolic and informational goods. Lower tracking costs expand the observability of interactions. Lower verification costs can reorganize the institutional arrangements through which claims are authenticated.

Information therefore becomes infrastructural in a stronger sense than simply being an input possessed by an organization. Digital production depends on shared protocols, databases, cloud services, communication networks, identifiers, software standards, application interfaces, payment rails, and security systems. These infrastructures establish conditions under which geographically distributed actors can coordinate actions that remain intelligible to one another. A transaction recorded in one system can trigger inventory updates, logistics instructions, payment processes, compliance checks, and subsequent recommendations across several organizational boundaries.

The productive significance of such infrastructure often appears indirectly. A database or protocol may generate little value as an isolated object while enabling a large number of downstream relations. Its economic importance can therefore reside in the range of interactions it makes possible, the compatibility it establishes, and the future actions it renders easier or harder. This is an early instance of a distinction developed later in GRE between possession of a resource and the generative conditions supported by that resource.

Digital infrastructure also changes the temporal structure of coordination. Information that previously arrived through periodic reports can be transmitted at much shorter intervals. Inventory, demand, prices, locations, payments, and user interactions may be updated in near real time. Decisions can consequently respond to changing conditions before slower administrative routines would have registered them. The historical consequence is a tighter coupling between observation and action, a theme that becomes central in the later discussion of data and algorithmic coordination.

The expansion of information infrastructure does not remove the material basis of economic activity. Data centers require energy and equipment; communication networks require physical infrastructure; software systems depend on organizations and trained labor; digital records rely on institutional conventions that make identifiers, permissions, and categories operational. Digital modernity therefore adds a dense informational layer to material production while also making many productive relations increasingly dependent on that layer.

1.10.2 Platforms and Mediated Relations

Platforms reorganize economic relations by becoming durable intermediaries between groups whose interactions were previously arranged through more fragmented markets, organizations, or bilateral channels. Search platforms connect users and information providers; marketplaces connect buyers and sellers; payment systems connect merchants, consumers, and financial institutions; labor platforms connect clients and workers; application ecosystems connect developers, device owners, advertisers, and infrastructure providers. The platform's economic object is therefore frequently a configuration of relations among several participant groups.

The economics of two-sided markets provides an established account of this structure. Rochet and Tirole analyze platforms whose viability depends on bringing multiple sides of a market into participation and on choosing a price structure that reflects interactions across those sides (Rochet and Tirole 2003). Their formulation shows that the platform cannot be understood adequately by examining a single bilateral transaction in isolation. Participation on one side changes the attractiveness and economic possibilities available on another.

Relational mediation gives the platform several forms of influence. It can determine conditions of entry, specify contractual terms, rank or recommend participants, standardize interfaces, collect fees, define permitted forms of interaction, and alter which information is visible to whom. These functions need not be exercised uniformly, and their institutional significance varies across platform types. The common feature is positional: the platform occupies an interface through which other actors reach one another.

This interface position can reorganize the distinction between internal and exter-

nal economic relations. A seller may remain legally independent while depending on a platform for discovery, payment, reputation, and access to demand. A worker may formally contract as an independent provider while task allocation, evaluation, and visibility are mediated by platform rules. A developer may own an application while access to users depends on an operating system, store, or technical interface controlled elsewhere. Legal independence can therefore coexist with substantial relational dependence.

Platforms also transform market boundaries. The relevant market may become partially constituted by technical standards, ranking systems, identity protocols, and participation rules maintained by the intermediary. Changing an interface or recommendation policy can alter demand allocation without changing the underlying legal status of participants. Economic coordination increasingly occurs through modifications to the architecture of mediation itself.

For GRE, the historically significant development is the emergence of intermediaries whose productive role consists partly in organizing relations among others. This does not make the platform external to the economy it mediates. The platform becomes one participant within the relational configuration, while its position gives it unusual capacity to alter the conditions under which other relations form and persist.

1.10.3 Data and Continuous Observation

Digital mediation produces data as a recurrent by-product of economic interaction. Searches, purchases, clicks, payments, movements, communications, ratings, inventories, delivery events, and work activities can generate machine-readable traces as they occur. Economic observation consequently shifts from periodic description toward increasingly granular and high-frequency recording in domains where digital infrastructures are present.

Einav and Levin describe the growing use of large-scale administrative and private-sector data in economics and emphasize that such data can provide granular and increasingly timely views of economic activity (Einav and Levin 2014). Their discussion concerns economic research, yet the same historical transformation extends beyond research. Firms, platforms, governments, and other organizations can use transaction-level or interaction-level data as operational inputs to pricing, logistics, risk assessment, advertising, fraud detection, performance evaluation, and service design.

The reduction of tracking costs identified by Goldfarb and Tucker is especially consequential here (Goldfarb and Tucker 2019). Observation becomes woven into the transaction itself. A purchase records demand; a delivery records location and timing; a recommendation records exposure and response; a digital workflow can record sequence, duration, completion, and evaluation. The distinction between conducting an activity and producing a record of that activity narrows in systems designed around continuous data capture.

This increased observability changes economic power because visibility is distributed unevenly. A platform may observe interactions among many participants while each participant sees only a narrow local portion of the system. A firm operating a digital marketplace can possess information about aggregate demand, search behavior, conversion rates, and seller performance that individual sellers cannot reconstruct independently. Data concentration can therefore produce epistemic

asymmetry even where the underlying transactions involve formally independent parties.

Data also depend on categories. A recorded event becomes usable only after a system defines what counts as a user, transaction, impression, conversion, task, defect, risk, or successful outcome. Continuous observation therefore increases the importance of classification rather than eliminating it. What can be optimized depends on what has been rendered observable, and what is observable depends on technical and institutional decisions embedded in the data infrastructure.

The resulting expansion of evidence has an ambivalent historical character. Granular observation can reveal heterogeneity, improve coordination, detect failures, and make previously opaque processes available for analysis. The same infrastructure can intensify surveillance, concentrate informational advantage, and encourage action toward what is easiest to record. Later chapters examine these epistemic and normative consequences directly. At this stage, the central transformation is that economic relations increasingly generate traces that can feed back into the organization of those relations at short temporal intervals.

1.10.4 Algorithmic Coordination

The accumulation of machine-readable data creates conditions for algorithmic coordination. Rules encoded in software can match participants, rank alternatives, set prices, route deliveries, detect anomalies, recommend actions, schedule labor, allocate attention, and update decisions in response to incoming information. Economic coordination thereby acquires a computational layer operating between observation and action.

Algorithmic coordination differs from simple automation of a fixed task when the system continually mediates relations among multiple actors. A recommendation system affects which producers become visible to which users. A dispatch system allocates work across drivers and locations. A pricing system changes incentives and demand across a marketplace. A ranking system redistributes attention among competing participants. In each case, the algorithm operates upon a relational configuration and can alter that configuration through repeated decisions.

Organizational research has documented this development in the workplace. Kellogg, Valentine, and Christin synthesize research on algorithmic control and identify mechanisms through which employers can use algorithms to direct, evaluate, and discipline work (Kellogg et al. 2020). Their account is relevant beyond labor control because it demonstrates a broader institutional change: observation, classification, recommendation, evaluation, and sanction can be integrated into computational systems that operate repeatedly and at scale.

The economic significance of algorithmic coordination depends on both the rule and the information available to it. A technically sophisticated allocation rule produces little if the relevant state of the system is poorly observed. Conversely, extensive data can have limited operational effect until a decision process translates them into rankings, predictions, or actions. Digital infrastructures therefore join observation and coordination through feedback: records generated by interaction become inputs to later decisions, and later decisions generate new records.

Such feedback can make coordination highly adaptive while also producing path dependence. Ranking based on prior activity can direct attention toward already

visible participants; recommendation based on accumulated behavior can reinforce established patterns; performance metrics can induce workers or firms to adapt toward measured criteria. The resulting economic order is partly generated through repeated interaction between participants and the computational procedures that mediate them.

Algorithmic coordination remains institutionally situated. Objectives, permissible actions, data access, error tolerances, review procedures, and accountability structures are supplied by organizations and legal systems. The algorithm is therefore neither an autonomous economic subject by default nor a neutral technical layer. It is part of an institutional relation through which some actors obtain the capacity to coordinate the actions of others at increased scale and frequency. The later treatment of artificial intelligence will examine what changes when computational systems acquire substantially greater productive and epistemic capabilities.

1.10.5 Network Effects and Digital Concentration

Digital intermediation can generate concentration through the interaction of network effects, accumulated participation, data, standards, and control of interfaces. The mechanism begins from a relational property: the usefulness of some systems depends partly on how many other participants, complementary products, or compatible services are connected to them.

Katz and Shapiro analyze systems markets in which compatibility and network effects make popular products more valuable and influence adoption dynamics, competition, and standardization (Katz and Shapiro 1994). Platform markets add cross-group effects: participation by one side can increase the value of the platform to another side, creating feedback across participant populations (Rochet and Tirole 2003). These mechanisms do not guarantee monopoly, yet they can make installed participation and interface control economically consequential assets.

Concentration can arise through several mutually reinforcing channels. A larger participant base may attract more complementary suppliers; greater activity may generate more data; more data may improve matching or prediction; improved coordination may attract further participation; and wider adoption may increase incentives for complementary products to conform to the platform's standards. The result is a feedback structure in which relational position contributes to future capacity.

This process changes the meaning of capital and competitive advantage. Productive assets remain important, yet control of a widely used interface, identity system, communication network, data repository, technical standard, or application ecosystem can become a durable source of economic power. The value of such an asset may depend less on its isolated technical properties than on the relations already organized through it and the costs participants face when moving elsewhere.

Digital concentration also creates asymmetry between scale and jurisdiction. A platform can mediate relations across many territories while regulation, labor law, taxation, consumer protection, and public accountability remain divided among jurisdictions. The multiscale tension developed in Section 1.9 therefore persists within digital modernity, now combined with technical mediation and high-frequency observation. Concentrated intermediaries can coordinate relations at a scale larger than many institutions responsible for governing their effects.

The historical importance of digital concentration lies in the coupling of relational

centrality with productive and epistemic capability. A central intermediary can influence access, visibility, standards, data collection, and coordination simultaneously. Economic power consequently becomes increasingly difficult to infer from ownership of conventional productive assets alone. Position within a digital relational architecture can itself generate capabilities that reinforce that position.

Digital modernity thus intensifies several tendencies developed across this chapter: production becomes more relational, observation becomes more continuous, coordination becomes more mediated, and economic power becomes increasingly connected to control over interfaces and infrastructures. Section 1.11 turns to artificial intelligence, where these digital conditions support a further transformation in cognitive production, symbolic generation, knowledge production, and comparative productive capability.

1.11 Artificial Intelligence and Productive Transformation

This section identifies the transformation that artificial intelligence introduces into the productive conditions established by digital modernity. Its role is to distinguish the economic significance of contemporary AI from the preceding expansion of information infrastructure and algorithmic coordination. The objective is to show how artificial systems increasingly participate in tasks historically performed through human cognitive labor, generate symbolic outputs at very low marginal cost, enter organized processes of knowledge production, alter comparative productive capability across workers and organizations, and concentrate important forms of productive capacity in the infrastructures that make advanced models possible. The discussion proceeds from cognitive-task automation to symbolic generation, machine-mediated knowledge production, comparative capability, and concentration. The method is historical and economic. Artificial intelligence is treated here through the productive relations it changes rather than through a claim about machine consciousness, intelligence in the philosophical sense, or the ontological status of artificial systems. Those questions remain open and are addressed only where their economic consequences require them.

1.11.1 Automation of Cognitive Production

Earlier waves of mechanization transferred portions of physical production from human labor to machines. Contemporary artificial intelligence extends automation into tasks whose outputs were historically associated with human cognitive labor: drafting, classification, prediction, translation, coding, summarization, pattern recognition, search, recommendation, and parts of analytical work. The economic novelty does not lie in the appearance of automation itself. It lies in the widening range of tasks for which computational systems can produce outputs that enter ordinary organizational workflows.

A task-based perspective provides a useful starting point. Acemoglu and Restrepo distinguish automation from productivity improvement in already assigned tasks by emphasizing changes in the allocation of tasks between labor and capital (Acemoglu and Restrepo 2019). In their framework, automation creates a displacement effect

when capital substitutes for labor in tasks previously performed by workers, while the creation of new tasks can generate a reinstatement effect that expands domains in which labor retains comparative advantage. The framework is deliberately more precise than a binary contrast between “jobs lost” and “jobs created.” Production is decomposed into tasks, and technological change alters who or what can perform them.

Generative AI extends this task reallocation into forms of work whose intermediate products are symbolic. A worker drafting a memorandum, preparing a customer response, writing code, summarizing a document, or producing a first-pass analysis can now combine human judgment with machine-generated candidate outputs. This arrangement does not imply complete substitution. It alters the sequence of production. Human effort can move away from some acts of initial generation toward specification, selection, correction, verification, integration, and responsibility for the final result.

Experimental evidence already demonstrates that this reorganization can be economically consequential in bounded tasks. Noy and Zhang randomly assigned college-educated professionals to complete occupation-specific writing tasks with or without access to ChatGPT and found substantial reductions in completion time together with improvements in evaluated output quality (Noy and Zhang 2023). Brynjolfsson, Li, and Raymond study the staggered introduction of a generative-AI assistant among customer-support workers and report an average productivity increase, with especially large gains among less experienced and lower-skilled workers (Brynjolfsson et al. 2025). The studies concern particular tasks and organizational settings, yet they establish a point needed for the historical argument: systems generating language can already change the productive performance of human workers rather than merely serving as experimental demonstrations outside production.

The resulting transformation is therefore relational. Productive capability no longer resides only in the worker or only in the model. It can arise from a configuration involving the worker, the model, the interface through which prompts and outputs are exchanged, the organization’s proprietary information, evaluation procedures, and the institutional rules determining which outputs may be used. A model that performs impressively in isolation may contribute little where data access, workflow integration, or verification is absent. Conversely, a modest model embedded in a well-designed process may alter productivity substantially. The productive object is increasingly the human-machine arrangement rather than either component taken alone.

This reorganization also changes the meaning of skill. Some skills remain directly productive because the worker performs the task. Others become supervisory or evaluative because the worker judges machine-generated candidates. Still others become more valuable because AI lowers the cost of complementary activities. The historical transition is therefore better understood as a redistribution of productive functions than as the simple removal of human cognition from production. Section 1.13 later examines the allocation consequences when such redistribution creates persistent asymmetries in comparative capability.

1.11.2 Machine-Generated Symbols

Generative models also alter the material conditions of symbolic production. Text, software code, images, audio, structured summaries, translations, synthetic examples, and other representational outputs can be produced at scales and speeds that differ sharply from earlier human-only processes. Digitalization had already lowered the cost of storing, copying, transmitting, and searching symbols. Generative AI lowers the cost of producing new symbolic arrangements in response to instructions and context.

This distinction matters because symbolic production had historically remained constrained by human time even after reproduction became cheap. A digital document can be copied almost without limit, yet drafting the first document still required someone to produce it. Generative systems weaken that bottleneck. Once a model is available, additional candidate texts, images, code fragments, classifications, or reformulations can be generated at low marginal cost relative to the human labor that would have been required to produce each candidate independently.

The resulting abundance should be interpreted carefully. Symbolic output is not identical with meaning, truth, or knowledge. Bender, Gebru, McMillan-Major, and Mitchell emphasize that large language models operate over linguistic form and warn against attributing understanding merely from the fluency of generated text (Bender et al. 2021). Their argument is particularly useful for GRE because it separates an economic fact from an epistemic conclusion. The economic fact is that systems can generate symbols that are usable within many production processes. The epistemic standing of those symbols depends on their relation to evidence, context, interpretation, verification, and subsequent use.

Machine-generated symbols therefore create a new selection problem. When candidate production becomes cheap, the scarce activity can migrate toward specification, evaluation, authentication, and attention. A writer facing one blank page confronts a production problem. A writer facing hundreds of plausible machine-generated drafts confronts a different problem: selecting, interpreting, checking, and integrating among abundant candidates. The productive constraint shifts from generation alone toward orientation and judgment.

The same shift occurs in organizations. Marketing teams can generate many variations of copy; software teams can generate multiple code suggestions; researchers can generate candidate summaries or hypotheses; administrative systems can generate draft classifications and reports. In each case, the volume of symbolic material can expand more quickly than the institutional capacity to evaluate its accuracy, relevance, provenance, or consequences. Symbolic abundance can therefore increase the demand for trustworthy filters even while reducing the direct cost of producing symbols.

This transformation provides the immediate historical background for the representational crisis examined in Section 1.14. Economic institutions depend on symbols: prices, reports, contracts, classifications, credentials, ratings, applications, records, and claims about states of the world. When symbol generation becomes abundant, the old inference from costly production to evidential significance becomes less reliable. The problem moves from whether a representation can be produced toward how its relation to a referent is established and maintained.

1.11.3 Machine-Mediated Knowledge Production

Artificial intelligence enters knowledge production through a more demanding pathway than symbolic generation. Knowledge is an institutional and epistemic achievement: claims must be related to evidence, methods, prior work, standards of justification, and communities capable of criticism and revision. A fluent output becomes economically useful knowledge only when it is incorporated into relations that establish why it should be relied upon.

AI can nevertheless alter those relations materially. Systems can search large information spaces, retrieve and reorganize documents, generate code for analysis, propose candidate explanations, identify patterns, produce simulations, and translate material across technical or linguistic boundaries. These functions can shorten the path between a question and a set of candidate answers. They can also make forms of expertise available to workers who would previously have required longer training, specialized assistance, or access to a more experienced colleague.

The productivity evidence from generative AI illustrates this knowledge-transfer function without establishing that the model itself possesses knowledge in the same sense as a person or institution. Brynjolfsson, Li, and Raymond find especially large gains among less experienced customer-support workers and present evidence consistent with the system disseminating practices associated with stronger workers (Brynjolfsson et al. 2025). The economically important mechanism is relational: information distilled from prior interactions becomes available through the model to workers who did not personally accumulate the same experience.

This possibility changes the historical scarcity of expertise. Expertise traditionally combined knowledge with the time required to learn, practice, encounter rare cases, and gain entry to communities and institutions where such learning occurs. AI can reduce some of these access costs by placing codified or statistically reconstructed regularities into an interface available during performance. The result may narrow capability differences in some tasks, as the heterogeneous productivity effects in experimental and workplace studies suggest (Noy and Zhang 2023; Brynjolfsson et al. 2025).

The transformation remains partial. Tacit knowledge, situated judgment, responsibility, domain-specific interpretation, and the recognition of novel or misleading circumstances may remain difficult to externalize. AI outputs can also be incorrect, weakly grounded, or inappropriate to the local context. The epistemic problem therefore changes rather than disappears. A worker may gain access to a larger candidate knowledge space while simultaneously acquiring a new burden of verification.

Knowledge production also becomes more recursive. Human-generated records train or condition models; models generate outputs that enter human workflows; those workflows produce new records; and later systems may be trained, evaluated, or adapted using traces of the resulting activity. The boundary between knowledge infrastructure and productive activity therefore becomes increasingly porous. What an organization knows can be partly embodied in databases, models, prompts, retrieval systems, evaluation procedures, and the accumulated interaction between artificial systems and human participants.

For GRE, the important historical consequence is that knowledge can become both more abundant and more infrastructurally concentrated at the same time. Access to a general-purpose model can diffuse capabilities widely, while the production, training,

adaptation, and control of the most capable systems may remain concentrated. Section 1.12 examines the corresponding transformation of scarcity, while Section 1.17 later returns to the economic organization of knowledge and epistemic capacity.

1.11.4 Transformation of Comparative Productive Capability

The economic significance of AI becomes sharper when productive capability is treated comparatively rather than absolutely. A worker can become more productive after adopting AI and simultaneously lose relative scarcity if similar or greater capability becomes available to many others at low cost. Conversely, a worker whose domain expertise complements AI effectively may become more productive and more valuable even though the technology performs parts of the underlying task. The relevant transformation concerns the distribution of comparative capability across participants.

Task-based automation already provides the structure for this analysis. When technology performs tasks previously assigned to labor, the task content of production shifts. New tasks, complementary skills, or organizational roles can partly counterbalance displacement (Acemoglu and Restrepo 2019). Generative AI makes this reallocation unusually visible in cognitive and symbolic tasks because the same system can assist drafting, coding, classification, summarization, translation, and other activities across occupations rather than being confined to one narrowly engineered physical process.

Evidence from current deployments suggests that the effect can be heterogeneous across prior capability levels. Noy and Zhang report larger gains among initially weaker performers in professional writing tasks (Noy and Zhang 2023). Brynjolfsson, Li, and Raymond similarly find larger improvements among less experienced and lower-skilled customer-support workers, while effects for the most experienced workers are smaller (Brynjolfsson et al. 2025). These findings do not establish a universal equalizing effect. They demonstrate that AI can change the shape of a productivity distribution rather than simply shifting every participant upward by the same amount.

This transformation can alter the economic value of accumulated experience. Some experience is encoded in routines that a model can reproduce or make available to newcomers. Other experience becomes more valuable because it supports verification, problem framing, exception handling, or judgment in cases where machine output is unreliable. Comparative advantage therefore moves within the task structure. A capability that once differentiated an expert may become common, while a previously secondary capability becomes the new bottleneck.

The same logic applies at the organizational level. Firms differ in proprietary data, complementary software, workflow design, managerial capacity, domain expertise, computing infrastructure, and the ability to redesign production around new tools. Access to the same general-purpose model can therefore yield different productive effects. AI capability is not a scalar resource added uniformly to every organization; it enters a pre-existing relational architecture and combines with other capacities.

Comparative productive capability also has distributive consequences because modern institutions connect productive contribution to wages, profit, bargaining position, investment, access, and organizational authority. A technology that changes comparative capability can therefore alter resource claims even before aggregate

output changes dramatically. The later sections on scarcity, allocation, and subjecthood examine the resulting tension: an economic order historically organized around comparative productive necessity encounters artificial systems capable of performing an expanding range of tasks at potentially much lower replication cost.

1.11.5 Concentration of Artificial Productive Capacity

The diffusion of AI-generated outputs coexists with concentration in the infrastructure that produces frontier artificial capability. This combination is historically important. A service can be accessible to millions of users while the training, deployment, and strategic control of the underlying systems remain located in a relatively small number of organizations and technical infrastructures.

The Stanford AI Index documents this concentration at the frontier. Its 2026 report states that industry produced more than 90 percent of notable AI models in 2025 and records rapid growth in global AI compute capacity together with substantial concentration in advanced hardware and hyperscale infrastructure (Stanford Institute for Human-Centered Artificial Intelligence 2026). These observations do not imply that useful AI is available only from a few firms. Open-weight models, smaller systems, local adaptation, and falling inference costs can diffuse access widely. The relevant distinction is between diffusion of use and control over the resources required to create or operate the most capable systems.

Artificial productive capacity depends on several complementary layers: specialized chips, data centers, energy, network infrastructure, model architectures, training data, engineering talent, capital, and organizational experience in large-scale deployment. Bottlenecks at any layer can shape who can develop frontier systems. The productive asset is therefore not the model file alone. It is a relation among computational, financial, informational, organizational, and infrastructural capacities.

Concentration at these interfaces can create economic leverage beyond conventional ownership of a single productive asset. An organization controlling model access can influence prices, usage conditions, permissible applications, data retention, technical compatibility, and the pace at which downstream users receive new capabilities. Cloud providers and hardware suppliers can shape the cost and feasibility of model development. Organizations possessing proprietary data or distribution networks can combine those assets with models in ways that new entrants cannot easily reproduce.

The structure is therefore double-sided. AI can decentralize capability by allowing a small organization or individual worker to perform tasks that previously required a larger team or specialized expert. The same technological system can centralize upstream productive power by increasing dependence on compute, model providers, data infrastructure, and technical standards. Decentralized use and centralized capacity are compatible because they occur at different layers of the productive architecture.

This layered concentration complicates conventional measures of economic power. Ownership of factories, machinery, or financial assets remains relevant, yet control of artificial productive capacity may depend on infrastructure positions that organize access for many downstream actors. A user can possess no share of the model provider while becoming deeply dependent on the provider's interface. A firm can own its data while lacking the compute or model capability needed to extract comparable produc-

tive value from them. Relational position becomes increasingly important to effective command.

Artificial intelligence therefore intensifies the historical tendencies developed in Sections 1.7 through 1.10: knowledge becomes a productive resource, production becomes distributed across networks, digital interfaces mediate access, and informational advantage can become economic power. AI adds the capacity to generate cognitive and symbolic outputs at scale and to reorganize comparative capability. The next section turns to the resulting transformation of scarcity: abundance in some forms of production can coexist with new scarcities in attention, trust, institutional access, infrastructure, and meaningful opportunities to participate in generative economic relations.

1.12 Transformation of Economic Scarcity

This section consolidates the productive changes described in Sections 1.10 and 1.11 into a historical account of changing scarcity. Its role is to clarify that technical abundance in one domain can redistribute scarcity across the wider economic system. The objective is to distinguish continuing material scarcity from the rapid expansion of symbolic and codified informational output, then identify the growing importance of attention, trust, institutional access, and opportunities for consequential participation. The discussion proceeds from material constraints to symbolic abundance, qualified knowledge abundance, emergent relational scarcities, and generative opportunities. The method is historical and economic. Scarcity is treated as a relation between available means, institutional arrangements, technological capacities, and the uses through which those means become consequential; no claim is made that contemporary economies have entered a general condition of abundance.

1.12.1 Material Scarcity

Material scarcity remains a constitutive condition of economic organization. The digitalization of information and the automation of cognitive tasks alter the cost structure of production, yet they continue to depend on energy, land, physical infrastructure, computing equipment, logistics, human time, and access to productive assets. The historical transformation therefore concerns the composition and location of scarcity as much as its aggregate level. A task can become cheap in one dimension while becoming more dependent on scarce complementary resources in another.

The classical economic language of scarce means retains its relevance here. Robbins's influential formulation treated economics as concerned with human behavior under conditions in which means are scarce relative to alternative uses (Robbins 1932). Contemporary digital production changes which means are scarce and which alternatives compete for them. Storage and replication costs can fall sharply while advanced computation, energy, specialized hardware, skilled maintenance, and infrastructure access become more economically consequential. The relevant scarcity therefore shifts across the production system rather than simply receding.

Artificial intelligence makes this redistribution especially visible. Frontier systems can generate symbolic outputs at very low marginal cost once a model has been trained and deployed, yet the capacity to build and operate such systems remains

materially intensive. The 2026 AI Index documents continued growth in the scale and concentration of advanced AI compute and infrastructure, alongside broader diffusion of downstream use (Stanford Institute for Human-Centered Artificial Intelligence 2026). The coexistence of cheap generated output and concentrated upstream capacity illustrates the central point: abundance at the output interface can rest on scarcity and concentration in the infrastructure that makes the output possible.

Material scarcity also persists through bottlenecks that lie outside the immediate production process. A digitally abundant service may still depend on limited transmission capacity, electricity supply, physical distribution, regulatory permission, or geographic access. Similarly, an organization may possess abundant information while lacking the personnel, time, or institutional authority required to act upon it. The economic significance of scarcity therefore depends on the relations linking resources to use. A resource can be physically present and economically unavailable when the institutional or relational conditions of access are absent.

This historical persistence of material constraint prevents a simple narrative in which digital technology replaces scarcity with abundance. The more precise development is a differentiation of scarcity. Some forms of production become increasingly reproducible and automatable, while other inputs become relatively more decisive because they remain difficult to reproduce, difficult to access, or concentrated in a small number of institutional locations. This differentiation prepares the analysis of symbolic abundance, where the cost of producing representations falls much faster than the cost of interpreting, validating, and acting upon them.

1.12.2 Symbolic Abundance

Symbolic production has undergone one of the sharpest scarcity transformations in the contemporary economy. Digital technologies reduced the costs of copying, transmitting, searching, and storing information, while generative AI extends the cost reduction to the production of new symbolic arrangements. Goldfarb and Tucker characterize digital technologies through reductions in several economic costs associated with search, replication, transportation, tracking, and verification (Goldfarb and Tucker 2019). Generative systems add another layer by lowering the cost of producing candidate texts, images, software code, classifications, and other representations.

The economic consequence is a rapid expansion in the supply of symbols relative to the human time required to inspect them. Section 1.11 distinguished this expansion from knowledge production in the stronger epistemic sense. That distinction remains essential. Bender and colleagues caution against inferring understanding from fluent language output and thereby provide a useful boundary between symbolic competence and epistemic warrant (Bender et al. 2021). Symbolic abundance therefore describes an observable productive condition: representations can be generated at scales that no longer require proportional human authorship. It does not establish that truth, justification, or understanding have become correspondingly abundant.

This shift alters the location of economic effort. When symbolic generation is expensive, production itself absorbs time and skill. When candidate production becomes cheap, selection, comparison, verification, interpretation, provenance assessment, and integration become relatively more important. The scarcity problem moves downstream. An organization may be able to generate hundreds of reports,

designs, or strategic options while lacking the attention required to evaluate them. A researcher may generate many plausible hypotheses while still facing the harder task of determining which ones merit sustained inquiry. A consumer may face abundant recommendations while remaining uncertain which sources deserve trust.

Symbolic abundance also changes the strategic value of visibility. When publication or generation costs fall, the ability to enter an informational environment no longer guarantees that an output will be noticed. Search ranking, platform position, reputational signals, institutional endorsement, and network location become increasingly important in determining which symbols reach consequential audiences. The problem of scarcity therefore reappears through channels of selection and recognition.

The expansion of machine-generated symbols further increases the importance of provenance. When many outputs can be produced rapidly and with similar stylistic plausibility, the economic value of knowing where a representation came from, which process produced it, and what evidential relations support it can rise. Section 1.14 develops this issue as a representational crisis. The present section records the prior economic condition: production of symbols can become abundant faster than the institutional capacity to authenticate, rank, and absorb them.

1.12.3 Knowledge Abundance

Knowledge abundance requires a more qualified interpretation than symbolic abundance. Modern economies possess unprecedented capacities to store, reproduce, retrieve, and recombine codified knowledge. Digital networks make scientific articles, technical documentation, educational materials, software, data, and institutional records available across distances at costs far below those of earlier print and archival systems. Artificial intelligence can further reduce the effort required to search, summarize, translate, and reorganize such materials. These developments expand the effective availability of codified knowledge even when the production of justified knowledge remains demanding.

The economic properties of information help explain this transformation. Arrow's analysis of invention emphasized that information differs from ordinary commodities because its production involves uncertainty and its use can be difficult to appropriate exclusively once the information exists (Arrow 1962). Digital reproduction strengthens the practical significance of this distinction by making many informational objects cheap to copy and distribute. The marginal cost of another reader, user, or software instance can become very small relative to the original cost of discovery, design, or verification.

Expanded availability, however, does not eliminate the dispersed and situated character of economically relevant knowledge. Hayek's analysis of knowledge in society emphasized that knowledge of particular circumstances remains distributed among many actors and cannot be treated as if it were centrally given (Hayek 1945). Contemporary data systems and AI can aggregate and mediate some of this knowledge, yet they do so through representations, classifications, and institutional access arrangements. Tacit knowledge, local judgment, practical familiarity, and context-sensitive interpretation remain difficult to detach from the relations in which they are formed.

The phrase *knowledge abundance* therefore refers here to an expansion in the acces-

sible stock and recombining of codified knowledge rather than to a disappearance of epistemic scarcity. Several complementary scarcities can intensify as codified material proliferates. Verification remains costly. Provenance must be established. Contradictory sources require adjudication. Questions must be selected. Relevance must be judged relative to a concrete problem. The scarce activity increasingly concerns orientation within a large possibility space of available information and candidate explanations.

AI-mediated work illustrates this redistribution. Brynjolfsson, Li, and Raymond find evidence consistent with generative AI helping less experienced workers access and apply patterns embodied in the practices of more experienced workers (Brynjolfsson et al. 2025). Such diffusion can reduce certain knowledge asymmetries inside an organization. At the same time, the organizational value of the system depends on who can access the tool, what proprietary knowledge it can retrieve, how its outputs are checked, and which institutional processes accept those outputs as actionable. The scarcity of codified know-how can decline while the scarcity of trustworthy interpretation, authorized access, and responsibility for judgment becomes more salient.

This distinction is important for GRE because an economy with abundant informational artifacts can still distribute epistemic capability very unequally. Access to a large corpus differs from the capacity to formulate worthwhile questions, discriminate among explanations, connect knowledge to a local situation, or persuade an institution to act. The later analysis of epistemic economy will treat these differences directly. At the historical level, the relevant transition is already visible: economic scarcity moves from possession of information alone toward the relations that make information interpretable, credible, and practically consequential.

1.12.4 Attention, Trust, and Institutional Access

As symbolic and informational supply expands, several relational conditions become more economically scarce. Attention is the clearest case. Simon's analysis of information-rich organizations argued that an abundance of information creates a scarcity of the attention required to receive and process it (Simon 1971). The proposition becomes increasingly important in digital environments where both human and machine systems can produce outputs continuously. The cost of producing another message may approach zero while the time available to read, interpret, compare, and act upon messages remains bounded.

Attention scarcity is relational because visibility depends on competition among claims upon finite recipients. A document can exist without being read, a recommendation can be generated without being considered, and an opportunity can be technically available without entering the decision horizon of the relevant actor. Search systems, ranking algorithms, professional reputation, institutional position, and social networks therefore influence which signals obtain scarce attention. Abundance in production can increase the economic value of selection mechanisms.

Trust becomes consequential through a related mechanism. Economic relations frequently involve commitments whose quality cannot be fully established before action. Arrow's discussion of gifts and exchanges emphasized the pervasive role of trust in commercial and social transactions (Arrow 1972). In information-rich environments, the number of potential counterparties, claims, and representations can

expand faster than the capacity to verify each one independently. Trust, reputation, certification, and institutional assurance then perform a filtering function. Their economic importance grows when direct verification is expensive relative to the abundance of available claims.

Trust should not be treated here as a homogeneous stock. It is generated and sustained within particular relations, histories, institutions, and repeated practices. Trust in a person, trust in a profession, trust in a platform, and trust in a public institution arise under different conditions and can fail in different ways. The scarcity relevant to economic coordination is therefore the limited availability of credible relations through which actors can rely on information, promises, identities, and standards without reproducing the entire verification process themselves.

Institutional access forms a third scarcity. Institutions organize entry to resources, credentials, markets, finance, scientific communities, legal protections, and decision procedures. North's institutional analysis emphasizes that rules and organizations structure incentives and transaction possibilities rather than merely recording choices after they occur (North 1990). In a digital economy, information about an opportunity can be abundant while actual access to the institution controlling that opportunity remains constrained. Knowing that a funding programme exists differs from being eligible to apply; knowing that a model exists differs from having compute access; knowing that a scientific field exists differs from possessing the credentials, language, networks, or institutional affiliation through which participation becomes possible.

The capability perspective provides a useful bridge from resource possession to effective opportunity. Sen's account of development as freedom emphasizes substantive opportunities and the institutional conditions through which people are able to pursue valued ways of living (Sen 1999). For the present historical argument, the important point is analytical: equal information or nominal resources can coexist with unequal effective access because conversion depends on social, institutional, and personal conditions. Scarcity can therefore reside in the relation between a subject and an institution even when the informational description of the opportunity is widely available.

Attention, trust, and institutional access share a common structural feature. They mediate the conversion of abundant possibilities into consequential action. Symbolic abundance produces many candidate claims; attention determines which are considered; trust influences which are treated as credible; institutional access affects which can be acted upon. Their growing importance marks a transformation in scarcity from possession alone toward relational gateways.

1.12.5 Generative Opportunities and Meaningful Participation

The final scarcity considered in this section concerns opportunities to participate in relations that can generate further capacities, knowledge, projects, recognition, and future options. The term *generative opportunity* is used here in a preliminary sense. It denotes access to a relational configuration in which participation can contribute to outcomes that extend beyond immediate consumption or transfer. Examples include entry to a research community, participation in an organization where skills can develop, access to collaborators and infrastructure, involvement in a public institution, or membership in a network through which new projects become possible. The full

theory of generative value and generative opportunity is developed later in the book; the present section identifies the historical conditions that make the category increasingly relevant.

This perspective extends the analysis of scarcity beyond the ownership of goods. A person may possess material resources and still lack access to relations in which those resources can be converted into capability. A worker may possess skill yet lack organizational entry. A researcher may possess knowledge yet lack collaborators, infrastructure, or recognition. A community may possess local knowledge yet lack institutional channels through which that knowledge can alter decisions. In each case, scarcity resides in a missing relation or a constrained pathway of conversion.

Sen's capability approach provides an important precedent for shifting attention from resources to substantive opportunity (Sen 1999). GRE carries the question further into the structure of relations that generate later possibilities. The distinction is analytical rather than competitive: capabilities concern what a person is effectively able to do or be, while generative opportunities direct attention to the relational processes through which new capacities and future option spaces may emerge. The two can overlap, and their exact relation remains an open theoretical problem for later chapters.

Artificial intelligence intensifies the relevance of this issue because productive abundance can weaken the historical link between human participation and material necessity. If machines can perform a growing range of cognitive and symbolic tasks, economic inclusion cannot be understood only through the scarcity of labor required for production. Access to livelihood remains crucial, yet another problem becomes visible: whether people possess opportunities to participate in relations where their judgment, curiosity, care, creativity, or responsibility can become consequential. Section 1.15 examines the resulting pressure on the modern economic subject, and Section 1.17 develops relational and generative conditions of subjecthood more directly.

Meaningful participation is therefore introduced here as an economic object whose scarcity cannot be inferred from unemployment statistics or income measures alone. Its empirical specification requires caution. Meaningfulness varies across persons and contexts, and GRE does not assume a single universal content. The economically relevant issue is whether institutional arrangements provide plural pathways through which participants can enter, sustain, and transform consequential relations. Scarcity appears where such pathways are narrow, heavily gated, or concentrated among actors already possessing relational advantage.

The transformation of scarcity described across this section can now be stated in historical terms. Material scarcity persists, while digitalization and AI produce relative abundance in selected symbolic and informational domains. This abundance raises the importance of attention, trust, institutional access, and generative opportunity as mediating scarcities. Economic analysis organized only around the possession and allocation of material goods therefore captures a declining share of the constraints that determine who can convert resources into consequential participation. Section 1.13 turns next to allocation under radical capability asymmetry, where these new scarcities interact with increasingly unequal productive capacities.

1.13 Allocation under Radical Capability Asymmetry

This section examines a historical allocation problem created when productive capability becomes highly unequal across human and artificial participants. Its role in the chapter is to connect the changing scarcity structure of Section 1.12 to the institutional mechanisms through which income, access, and economic participation are distributed. The objective is to distinguish five elements that are often conflated: employment as an allocation channel, comparative capability as a condition of competitive access, automation as a transformation of task demand, productive abundance as distinct from broad resource access, and capability asymmetry as a possible source of economic power. The discussion proceeds historically and institutionally rather than as a forecast of aggregate employment. Artificial intelligence is treated as a contemporary case in which productive capability may become radically asymmetric while the allocation of livelihood and participation remains organized through institutions formed under earlier productive conditions.

1.13.1 Employment-Based Allocation

Wage employment became one of the central allocation mechanisms of industrial economies because it linked productive participation to command over resources. A worker supplied labor through an employment relation and received wages or salary that could be converted into food, housing, services, savings, and other goods. The arrangement also frequently mediated access to benefits, credentials, professional networks, legal status, and forms of institutional recognition. Employment therefore functioned as more than a contract for a discrete productive task. It connected a position within production to a wider bundle of claims upon economic resources.

The historical character of this arrangement is important. Polanyi's account of market society emphasizes the institutional construction required to treat labor as something organized through markets and contracts (Polanyi 1944). Sen's entitlement analysis makes a related point from the side of command over resources: access to goods depends on the entitlement relations through which a person can transform endowments, production possibilities, trade, and public transfers into effective command (Sen 1981). Wage employment is one such entitlement relation. Its importance arises from the way institutions connect labor contribution to purchasing power rather than from any timeless identity between work and livelihood.

Employment-based allocation also packages several relations together. The employer receives access to labor under organizational authority; the worker receives income; public institutions may attach taxation, insurance, pension rights, immigration status, or social protection to the employment relation; and households organize consumption and care around the resulting income stream. The economic significance of losing a job therefore depends on the institutional bundle attached to employment. Two economies with similar productive technologies can generate very different consequences from the same reduction in labor demand when healthcare, housing, social insurance, or legal membership are connected to employment in different ways.

This bundling made employment an efficient administrative recipient for allocation in periods when productive systems required extensive and continuing human labor. Income could be distributed through organizations already responsible for coordinating production, while participation in production supplied a socially legi-

ble basis for claims on output. The arrangement also created vulnerability because access to livelihood became dependent on continued inclusion in productive organizations. Historical labor politics, social insurance, and public provision can be read partly as responses to this vulnerability rather than as departures from an otherwise self-sufficient labor market.

Artificial intelligence makes the contingency of the employment-allocation linkage more visible. If a growing range of tasks can be performed with less human labor, the economic question extends beyond the number of jobs created or destroyed. It concerns whether institutions continue to use employment as the primary route through which people receive income, institutional access, and opportunities for participation. The issue is therefore one of allocation architecture: a productive system can change faster than the institutions that connect productive contribution to resource claims.

1.13.2 Comparative Capability and Competitive Access

Competitive allocation depends on relative as well as absolute capability. Where access to jobs, contracts, finance, education, or professional positions is limited, applicants are compared against one another under institutionally defined criteria. Improvements in one person's productive capacity can therefore alter the competitive position of others even when their own abilities remain unchanged. The scarcity lies in the number and quality of positions, while capability influences who can enter them.

Human-capital theory formalized one important part of this structure by treating education and training as investments that can raise productivity and earnings (Becker 1964). The approach helps explain why individuals invest in capabilities that improve access to scarce economic positions. A relational analysis adds the competitive environment in which those capabilities are evaluated. The return to a skill depends on the distribution of comparable skills, the technologies with which the skill is combined, the institutions controlling entry, and the criteria by which organizations recognize productive contribution.

The capability perspective further distinguishes possession of resources from effective opportunity. Sen emphasizes that people differ in their ability to convert resources into substantive freedoms because personal, social, and institutional conditions differ (Sen 1999). In labor and professional markets, the corresponding conversion problem includes credentials, networks, geographic access, legal status, organizational membership, and technological complements. A person can possess knowledge without possessing a recognized pathway through which that knowledge becomes economically consequential.

Artificial intelligence alters comparative capability in a complex way. Experimental and workplace studies have found that generative AI can raise performance in selected writing and customer-support tasks, with especially large gains for some lower-performing or less-experienced workers (Noy and Zhang 2023; Brynjolfsson et al. 2025). In such settings, AI can compress certain within-task performance differences by diffusing practices or supplying assistance. This equalizing effect at the task level can coexist with wider inequalities in access to frontier systems, proprietary data, compute, organizational authority, and the ability to redesign work around the technology.

Comparative capability therefore remains institutionally mediated. The relevant

economic unit is rarely a human capability considered in isolation or an artificial capability considered in isolation. Competitive access depends on combinations of persons, tools, organizations, infrastructures, and recognized claims. Radical capability asymmetry becomes economically significant when some actors can assemble these combinations more effectively than others or control the institutional interfaces through which combinations are admitted into competition.

1.13.3 Artificial Intelligence and Employment Scarcity

Artificial intelligence introduces a new form of uncertainty into employment-based allocation because it can substitute for selected cognitive and symbolic tasks while also complementing workers and generating new tasks. The task-based literature on automation distinguishes displacement effects from reinstatement effects: technologies can reduce labor demand in tasks they automate while new tasks and activities can restore labor demand elsewhere (Acemoglu and Restrepo 2019). The historical record therefore offers no basis for treating task automation as mechanically equivalent to aggregate technological unemployment.

The relevant problem for GRE is narrower and more structural. Employment scarcity can increase for particular groups, occupations, or periods when the number of positions capable of providing stable income and institutional membership grows more slowly than the number of people seeking such positions. AI can contribute to this condition when organizations reorganize production around machine performance and require fewer workers for tasks that previously justified large employment structures. New tasks, new industries, or increased demand can offset the effect, yet the offset depends on the speed, location, accessibility, and institutional form of the new opportunities.

Korinek and Stiglitz analyze AI and worker-replacing technological progress through distributional channels that include innovation rents, changes in factor prices, and possible forms of technological unemployment under specified conditions (Korinek and Stiglitz 2019). Their analysis is useful here because it separates greater productive capacity from the distribution of the resulting gains. A technology can increase aggregate output while changing bargaining positions, income shares, and the allocation of surplus. The distributive consequences depend on ownership, substitution patterns, policy, and institutional design rather than on productivity alone.

Current evidence also counsels against a simple capability hierarchy in which AI uniformly replaces weaker workers first. Brynjolfsson, Li, and Raymond find substantial productivity gains from an AI assistant in customer support, with larger gains among less-experienced and lower-skilled workers in their setting (Brynjolfsson et al. 2025). Such evidence suggests that AI can operate as a capability-diffusion mechanism inside organizations even while reducing the scarcity of some human task-specific skills. The same technology can therefore complement workers at one margin and weaken the market value of previously scarce expertise at another.

Employment scarcity should consequently be understood as a relational outcome rather than a direct property of AI capability. It depends on how quickly tasks are reorganized, which new roles appear, how income is connected to those roles, who can access complementary tools, and whether institutions create alternative routes to livelihood and participation. The historical significance of AI lies in its potential

to weaken the inherited coupling between human productive necessity and resource allocation. Whether that potential is realized, and in which sectors or populations, remains an empirical question.

1.13.4 Productive Abundance and Resource Concentration

Greater productive abundance does not determine how control over productive assets or resulting income is distributed. A production system can generate rapidly expanding quantities of output while ownership of capital, infrastructure, intellectual property, market access, or organizational decision rights remains concentrated. The distinction becomes especially important when the marginal cost of selected outputs falls faster than the cost of building or controlling the systems that generate them.

Digital and AI production display this asymmetry clearly. Section 1.11 noted that frontier AI development remains concentrated in large organizations with access to substantial compute, data, engineering capacity, and financing, even as downstream use diffuses more widely (Stanford Institute for Human-Centered Artificial Intelligence 2026). The result is a layered productive structure: symbolic and cognitive services can become cheaper and more abundant at the user interface while the infrastructure capable of producing frontier systems remains scarce and institutionally concentrated.

A broader empirical precedent is provided by the literature on superstar firms. Autor and colleagues document rising sales concentration in several industries and find that industries with larger increases in concentration experienced larger declines in labor's share, consistent with reallocation toward highly productive firms with relatively low labor shares (Autor et al. 2020). The analysis does not establish an AI-specific causal mechanism. Its relevance here is structural: productivity growth, concentration, and changes in the distribution of income can coexist when technological and market conditions shift activity toward a small number of highly productive organizations.

Resource concentration can also persist through control of complementary assets. Access to an AI model may be widespread while valuable deployment requires proprietary data, customer relationships, legal permissions, computing infrastructure, distribution channels, or organizational authority. The productive capability of the model becomes economically consequential through these relations. Actors controlling scarce complements can therefore capture a larger share of value even when the immediate technological output is reproducible at low marginal cost.

This distinction complicates abundance narratives. Productive abundance can reduce prices, widen access to services, and create new opportunities, while simultaneously increasing the strategic importance of the remaining scarce complements. Economic analysis therefore needs to track both output abundance and the distribution of control over the conditions that make abundance possible. Section 1.18 later identifies this divergence as one reason entity-level measures of possession can miss changes in relational and generative structure.

1.13.5 Capability Asymmetry and Economic Power

Capability asymmetry becomes economic power through institutional relations that convert superior capacity into control over resources, options, or the conduct of oth-

ers. A technically superior system does not automatically possess economic power. Power emerges when capability is connected to ownership, organizational authority, infrastructure control, bargaining position, institutional recognition, or the ability to determine access to scarce complements. The distinction is central to GRE because it separates differences in what actors can do from differences in what actors can compel, withhold, authorize, or capture.

The institutional mediation can be seen in ordinary firms. Organizational law and asset partitioning help establish entities capable of owning assets, entering contracts, and separating pools of claims (Hansmann and Kraakman 2000). Institutions therefore determine which actors can legally command productive resources and which claims are recognized when conflicts arise. Similar mediation applies to artificial capability. An AI system's productive capacity is exercised through the organization that owns, operates, licenses, deploys, or integrates it. The economically relevant power may reside in the relation among model capability, organizational control, and institutional recognition rather than in the model considered by itself.

Radical human–AI capability asymmetry makes this mediation especially important. The economic value of advanced AI partly arises because its performance can exceed human performance in selected tasks. Eliminating every capability difference would also eliminate much of the productive reason for deploying the technology. The practical problem is therefore not the existence of asymmetry alone. It is the structure through which asymmetry is converted into dependency, bargaining power, exclusion, or concentrated control over future opportunities.

Several conversion pathways are possible. An organization that controls scarce AI infrastructure can convert technical capability into lower production costs, then into competitive advantage, market access, revenue, and further investment. A platform can convert informational and computational capability into control over ranking, matching, or access. A worker equipped with an AI assistant can convert machine capability into higher individual productivity when organizational rules permit use and recognize the resulting output. Different institutional arrangements can therefore produce different power distributions from similar underlying technologies.

The same logic applies in the opposite direction. Humans and institutions can retain substantial power over technically superior systems through ownership, legal authority, access controls, energy supply, deployment permissions, and the design of organizational objectives. Capability and power can therefore diverge in both directions. The degree of divergence is a property of the relational architecture connecting subjects, institutions, and productive systems.

This distinction completes the section's historical argument. Employment-based allocation, competitive access, AI-mediated task transformation, resource concentration, and institutional conversion together create a setting in which productive capability can become radically asymmetric without determining a single distributive outcome. Economic consequences depend on the relations that connect capability to claims, resources, institutions, and participation. Section 1.14 turns next to symbolic abundance and representational crisis, where expanding productive capacity changes the reliability of the symbolic interfaces through which those relations are recognized and coordinated.

1.14 Symbolic Abundance and Representational Crisis

This section examines a second consequence of contemporary productive transformation: the expansion of symbolic production changes the conditions under which economic actors rely on representations of persons, organizations, transactions, risks, assets, claims, and states of the world. Its role in the chapter is to connect the symbolic abundance introduced by digitalization and artificial intelligence to a problem of economic coordination. The objective is to distinguish five layers of that problem: the scale of symbolic production, the relation between symbols and referents, the institutional effects of classification, the growing importance of provenance and epistemic trust, and the consequences of representational instability for coordination. The discussion is historical and institutional. It treats representations as economically consequential interfaces whose reliability depends on practices of classification, verification, authorization, and interpretation.

1.14.1 Expansion of Symbolic Production

Modern economies have long depended on symbolic production. Contracts, accounts, prices, reports, ratings, certificates, legal identities, statistical indicators, inventories, forecasts, and organizational records allow dispersed actors to coordinate without direct access to every underlying event or relation. Digital infrastructures greatly expanded the volume, speed, and granularity of these representations. Section 1.10 described how platforms, continuous observation, and algorithmic systems intensified the production and use of data. Section 1.11 added a further change: generative systems can now produce linguistically and visually plausible symbolic artifacts at very low marginal cost.

The economic significance of this expansion lies in the changing ratio between symbolic production and the resources required to evaluate it. A report, explanation, image, recommendation, summary, classification, or synthetic record can be generated quickly. The work required to determine provenance, contextual adequacy, factual support, relevance, and institutional standing may remain costly. Symbolic abundance therefore enlarges the set of representations available to actors while also increasing the burden placed on selection and verification.

The distinction between symbolic output and knowledge is essential. Language models can generate fluent text whose surface form resembles ordinary human communication, yet fluency alone does not establish understanding, reference, evidential grounding, or truth. Bender and colleagues emphasize this gap in their critique of large language models, warning against treating statistical success in language generation as equivalent to semantic understanding (Bender et al. 2021). The relevance for economics extends beyond debates about artificial intelligence. Economic coordination increasingly proceeds through representations whose production cost can fall much faster than the cost of establishing their epistemic status.

This asymmetry changes the practical meaning of abundance. A larger supply of symbols can improve access to explanation, translation, drafting, visualization, and administrative communication. The same expansion can also increase duplication, low-quality synthesis, strategic fabrication, and competition for attention. The resulting problem concerns the institutional relation among production, filtering, verifi-

cation, and use. Symbolic production becomes economically productive only when actors can establish which representations deserve reliance within a particular decision context.

The contemporary transformation therefore adds a new layer to scarcity. Section 1.12 argued that abundant information can increase the relative scarcity of attention. Symbolic abundance also increases the relative importance of infrastructures that authenticate sources, preserve context, establish responsibility, and connect representations to the relations they purport to describe. These infrastructures become part of the productive conditions of knowledge-intensive economic coordination.

1.14.2 Symbols and Referents

A representation becomes economically useful through a relation to something beyond its own symbolic form. A balance sheet refers to an organization's financial position; a credential refers to an institutional status; a price refers to a transactionally recognized valuation; a risk score refers to an inferred probability or classification; a written claim refers to an event, object, or relation that may be investigated independently. The relevant economic question therefore concerns the stability of the relation between symbolic form and referent.

That relation has never been automatic. Documentary practices, accounting rules, legal procedures, statistical classifications, professional standards, audits, and institutional routines have historically supplied the conditions under which a representation acquires standing. A monetary figure in an audited statement, for example, carries a different institutional status from the same numeral written in an unauthenticated message. The visible symbol may be identical while its relation to evidence, authority, and responsibility differs.

Artificial symbolic production increases the importance of this distinction because surface plausibility can be generated independently of a corresponding referent. A text can describe an event that did not occur; an image can depict a scene that was never captured; a synthetic profile can imitate the ordinary markers of an institutional identity; a generated citation can possess the form of scholarship without referring to an existing publication. The representational problem therefore concerns the mapping from sign to referent and the institutional conditions under which that mapping can be trusted.

The problem is broader than deception. A representation can be sincere and still detach from the structure it is meant to summarize. Statistical categories may lag behind changing economic relations. Administrative records may preserve a legal identity while control has shifted elsewhere. Organizational reporting may describe formally bounded entities whose productive processes depend on external networks. A model can continue to produce internally coherent outputs after the relations that once justified its parameters have changed. Representational instability therefore includes both fabricated symbols and historically outdated or structurally incomplete mappings.

GRE later develops a more explicit distinction between relational reality and manifestational reality. The historical purpose of the present section is narrower. It establishes why the distinction becomes economically urgent under contemporary productive conditions. When institutions coordinate through increasingly abundant repre-

sentations, the quality of economic action depends increasingly on the reliability of the relations connecting those representations to the subjects, processes, assets, and events they mediate.

1.14.3 Classification and Administrative Reality

Economic representations frequently take classificatory form. Persons are classified as employed, unemployed, self-employed, insured, resident, eligible, creditworthy, skilled, dependent, or vulnerable. Organizations are classified by legal form, sector, industry, size, ownership, reporting status, and jurisdiction. Assets, liabilities, expenditures, incomes, transactions, and risks are likewise organized through standardized categories. Classification makes complex relations administratively tractable by assigning them to recognized types.

The historical sociology of quantification shows that these categories are institutional achievements. Desrosières traces how statistical conventions construct comparability by defining categories, coding rules, and procedures of aggregation (Desrosières 1998). Hacking's work on historical ontology likewise emphasizes that classifications participate in the historical formation of the objects and kinds through which institutions organize knowledge (Hacking 2002). The relevant implication for GRE is that administrative representation can participate in constituting the economic reality upon which later decisions operate.

The System of National Accounts provides a concrete example. Its concept of an institutional unit identifies entities capable of owning assets, incurring liabilities, making economic decisions, and entering contracts, and uses those units to organize sectoral accounts (European Commission et al. 2009). Such classifications are indispensable for macroeconomic observation. They also establish a particular resolution at which economic activity becomes visible. Relations that cross recognized units or operate through informal, distributed, or hybrid arrangements can be less visible within the same framework.

Classification acquires performative force when eligibility, taxation, reporting duties, access, benefits, or regulatory treatment depend on category membership. An employment classification can affect social insurance and labor protections. A credit category can alter borrowing conditions. A platform's ranking category can affect discoverability. A statistical category can shape which population is recognized as a policy target. The representation therefore enters the relation it describes by altering the conditions under which actors are treated.

This feedback makes classification economically generative in a limited but important sense. A category can stabilize expectations, coordinate institutions, and support large-scale administration. It can also redirect behavior toward the criteria used for classification. As categories become integrated into automated systems, the speed of this feedback can increase. Classification, decision, and subsequent data generation can occur in a repeated loop, allowing an administrative representation to shape the future observations from which it is later updated.

The resulting issue is neither a rejection of classification nor a preference for unstructured description. Complex economies require abstractions. The analytical task is to identify the relations that an abstraction preserves, the relations it suppresses, and the institutional consequences produced when the abstraction becomes an operational category. Representational crisis emerges when categories remain administra-

tively powerful while their fit with changing relational structures becomes increasingly uncertain.

1.14.4 Authenticity, Provenance, and Epistemic Trust

Symbolic abundance increases the economic importance of authenticity and provenance. Authenticity concerns the standing of an artifact or claim as the artifact or claim it purports to be. Provenance concerns the history of its production, modification, custody, and transmission. Epistemic trust concerns the willingness to rely on a representation within a decision process. These dimensions interact, yet each answers a different question.

The distinction is visible in contemporary provenance standards. The C2PA Content Credentials specification defines technical mechanisms for binding signed provenance assertions to digital assets, recording creation and editing information, and validating whether those assertions remain associated with the underlying content (Coalition for Content Provenance and Authenticity 2026). The specification also draws an important boundary: validation of provenance data does not by itself determine whether the represented claim is true or normatively acceptable. Provenance supplies evidence about source and transformation history; interpretation remains necessary.

This separation has direct economic significance. A cryptographically verified document can still contain a mistaken forecast. An authenticated identity can make a false statement. A valid model output can be based on inappropriate assumptions. Conversely, an artifact without machine-verifiable provenance can still be accurate. Reliable coordination therefore depends on several layers of trust: confidence in source identity, confidence in chain of custody, confidence in the procedure that generated the claim, and confidence in the claim's adequacy to the decision at hand.

Porter's history of quantitative objectivity shows that impersonal procedures and standardized measures became important partly because institutions required forms of judgment that could travel across distance and survive disputes over personal authority (Porter 1995). Digital provenance infrastructures can be understood as a contemporary extension of the same organizational problem. Where direct familiarity is unavailable, institutions construct portable signals through which strangers can coordinate. The contemporary difference lies in the scale and speed of symbolic production, which increase the number of artifacts for which such signals may be demanded.

Provenance itself can therefore become an economic resource. Actors able to establish trusted identity, verified histories, recognized credentials, and auditable production chains may obtain advantages in markets where surface form is easy to imitate. Verification infrastructures can also become sites of dependency when a small number of institutions control identity, certification, reputation, or access to trusted channels. The problem of epistemic trust thus connects symbolic abundance to the power questions developed later in the book.

The historical shift is consequently double. Artificial systems reduce the cost of producing persuasive symbolic form, while institutions respond by increasing investment in provenance, authentication, audit, reputation, and trusted intermediation. Economic coordination moves toward a regime in which the ability to produce symbols is widespread, while the ability to establish their standing remains institutionally

differentiated.

1.14.5 Economic Coordination under Representational Instability

Economic coordination depends on representations because actors routinely decide in the absence of direct access to the underlying relations they seek to govern. Firms rely on accounts and forecasts; creditors rely on identities, histories, and risk measures; consumers rely on labels, reviews, and reputational signals; governments rely on administrative records and statistical indicators; platforms rely on profiles, rankings, and behavioral traces. Representational instability therefore becomes an economic problem when actors can no longer assume that the cost and reliability of these interfaces remain roughly stable.

Several consequences follow. Verification becomes a larger component of transaction and coordination costs. Organizations may devote more resources to authentication, audit, provenance, identity management, model validation, and source assessment. Trusted intermediaries can gain strategic importance because they reduce uncertainty for participants who cannot verify every claim independently. At the same time, concentration around trusted intermediaries can create new dependencies and bottlenecks. The infrastructure that restores trust can itself become a source of economic power.

Representational instability also affects temporal coordination. Decisions are often made before verification is complete. A false or poorly grounded representation can influence prices, hiring, credit, procurement, or public response before correction arrives. Later correction may fail to reverse the relational consequences already produced. The economic effect of a representation therefore depends partly on the speed with which it is produced, circulated, believed, acted upon, challenged, and revised.

Classification feedback adds a further layer. Once an institution acts on a representation, the action changes subsequent data. A risk classification can alter access to credit; altered access changes later repayment histories; those histories then become inputs to subsequent classification. A ranking can redirect attention; redirected attention changes observed popularity; popularity then reinforces the ranking. These loops make representational systems participants in the processes they measure.

The resulting crisis is best understood as a problem of alignment among symbolic production, referential reliability, institutional classification, and practical trust. The term *crisis* refers here to intensified instability in that alignment rather than to universal collapse of representation. Many representations remain highly reliable, and digital systems can improve traceability, consistency, and access. The historical change lies in the simultaneous expansion of symbolic productive capacity and the growing economic importance of institutions that determine which representations can be trusted, acted upon, and converted into recognized claims.

This shift prepares the next problem in the chapter. Economic subjects themselves are partly stabilized through representational systems: occupational titles, employment records, credentials, income categories, organizational roles, legal identities, and measures of contribution all participate in defining how persons and organizations appear within economic institutions. When productive relations and representational systems change together, established subject positions can lose part of the

institutional support that previously made them stable. Section 1.15 therefore turns from representational instability to the destabilization of the economic subject.

1.15 Destabilization of the Economic Subject

This section examines how contemporary productive transformation unsettles the institutional relations through which modern economic subjects have been stabilized. Its role in the chapter is to connect the preceding transformations of production, scarcity, allocation, and representation to a problem of subject formation. The objective is to identify the historical relations among economic roles, work, social recognition, productive necessity, and participation, and then to clarify why artificial intelligence places pressure on arrangements that have tied material access and social standing to comparative productive contribution. The discussion proceeds historically and institutionally. It first reconstructs economic roles as socially organized positions, then examines work as a source of recognition and membership, distinguishes productive contribution from productive necessity, analyzes the possibility of productive redundancy, and closes by identifying forms of economic participation that need not depend on productive superiority.

1.15.1 Economic Roles and Subject Formation

Modern economic institutions do more than allocate resources among pre-existing persons and organizations. They also assign recognizable positions through which participants become legible as workers, employers, owners, consumers, creditors, debtors, taxpayers, dependants, professionals, and members of organizations. Section 1.4 reconstructed these positions as historically formed economic subjects, while Section 1.5 showed how law, accounting, statistics, and administrative classifications stabilize the entities to which those positions attach. The present subsection develops the further implication that repeated participation in such roles can become part of the practical continuity through which persons understand their place in economic life.

An economic role carries a bundle of expectations, rights, obligations, resources, and relations. Employment connects a worker to wages, working time, organizational authority, occupational identity, social insurance, and often a trajectory of promotion or skill formation. Ownership connects an actor to control, exclusion, residual claims, and asset-based security. Professional status connects expertise to credentials, jurisdiction, reputation, and access to specialized work. Household positions connect provision, care, dependence, and intergenerational transfer. These arrangements differ across legal systems and historical periods, yet they share a general structure: economic subject positions are reproduced through institutional relations that make some forms of participation recognizable and consequential.

This relational formation does not imply that persons are exhausted by economic roles. A person can remain a parent, friend, citizen, learner, creator, believer, neighbor, or participant in many other relations whose meaning exceeds economic classification. The analytical point concerns the historical importance of economic roles for access and recognition. In industrial and post-industrial societies, employment status, occupation, income, property, organizational affiliation, and professional credentials

have often affected where a person can live, which institutions become accessible, how risk is borne, and which forms of contribution become publicly visible. Economic roles therefore participate in the stabilization of subject positions even though they never constitute the whole of subjectivity.

Polanyi's historical account of market society is useful here because labor, land, and money became increasingly organized through market institutions that restructured the relation between livelihood and social organization (Polanyi 1944). Marx's analysis of wage labor likewise places labor-power inside a historically specific relation in which access to the means of livelihood is mediated through the sale of labor capacity and the organization of production under capital (Marx 1867). The theoretical traditions differ substantially, yet both make visible a common historical fact: participation in production became deeply connected to the institutions through which subjects acquired income and occupied recognizable social positions.

The contemporary problem arises when the relations that stabilize those roles change faster than the categories through which subjects remain institutionally recognized. A person can retain knowledge, experience, responsibility, and the capacity for meaningful action while the labor market value of a previously recognized role declines. An organization can retain formal identity while its productive function is redistributed across platforms, contractors, automated systems, and external infrastructures. A credential can continue to certify a competence even as the task structure associated with that competence changes. Subject destabilization therefore begins as a mismatch between historically stabilized roles and changing productive relations.

The economic subject is consequently vulnerable to transformations that leave the underlying person or organization intact. The worker can persist while the job disappears; the professional can persist while the exclusive jurisdiction of a profession erodes; the firm can persist while productive control migrates toward infrastructure providers; the household can persist while the employment structure supporting its income becomes less stable. This distinction prepares the analysis of recognition in the next subsection. What becomes unstable is often the relation through which a subject is economically recognized, rather than the existence of the subject itself.

1.15.2 Work and Social Recognition

Work has historically supplied more than output. It can connect persons to income, routine, organization, skill formation, collective membership, reciprocal dependence, and publicly recognizable contribution. The relative importance of these dimensions varies widely across occupations and societies, and many forms of socially necessary activity remain unpaid or weakly recognized. Even so, the institutional centrality of employment means that changes in work can affect both material access and the social recognition attached to participation.

The material relation is direct. Section 1.6 described employment as a major channel through which households receive claims on resources. Wages can determine access to housing, credit, insurance, savings, mobility, and many forms of consumption. Employment can also serve as an administrative gateway to benefits and legal protections. Where these arrangements are strong, work becomes one of the principal institutional bridges between productive participation and livelihood.

The recognitional relation operates differently. A role becomes socially recog-

nizable when institutions and communities possess a vocabulary for identifying its contribution. Occupational titles, credentials, organizational positions, portfolios, rankings, and professional standards make contribution visible in standardized ways. Recognition can therefore depend on representation as well as performance. Section 1.14 showed that representational systems participate in economic coordination; they also participate in subject formation by stabilizing the categories through which contribution is noticed and attributed.

This dependence creates asymmetries among forms of work. Market-mediated labor often leaves records of hours, wages, outputs, contracts, and titles. Care, informal coordination, emotional support, household maintenance, community work, mentoring, and many forms of relational labor may generate substantial capacities while remaining weakly represented in conventional accounts. The economic subject produced through employment institutions therefore reflects a selective architecture of recognition. Activities become more visible when they enter established categories of paid contribution, while other relations can remain economically consequential without receiving equivalent institutional standing.

Sen's capability approach helps clarify the stakes because material resources matter through the substantive opportunities they enable rather than through possession alone (Sen 1999). Participation in work can be valuable partly because it supports income, but also because it can expand capabilities through learning, association, mobility, voice, and institutional membership. The same perspective also permits a distinction between work and the broader capabilities work sometimes supports. If technological change weakens the employment channel, the relevant loss cannot be assessed adequately by asking only whether income can be replaced. The consequences may concern access to relations, routines, opportunities for contribution, and forms of recognition previously carried by employment.

This point gives subject destabilization a wider scope than unemployment. A person may remain employed while experiencing reduced autonomy, weaker occupational jurisdiction, diminished bargaining power, or increasing dependence on algorithmic systems. Conversely, a person outside paid employment may possess rich capacities and participate in relations of care, learning, creation, and community life. Economic subjecthood therefore becomes unstable when inherited institutions continue to use employment as a privileged signal of contribution while productive and socially valuable activity becomes more heterogeneous.

Artificial intelligence intensifies this problem because it can alter the informational basis on which professional recognition rests. When generative systems assist writing, coding, analysis, design, diagnosis, or customer interaction, observed output becomes increasingly co-produced by persons, models, organizations, datasets, and infrastructures. Brynjolfsson, Li, and Raymond find that generative-AI assistance can increase worker productivity while producing heterogeneous gains and forms of knowledge diffusion (Brynjolfsson et al. 2025). The broader implication is that contribution becomes more relational: the performance attributed to an individual may depend increasingly on access to shared artificial capabilities. Recognition systems organized around isolated individual productivity may therefore become less informative about the relations that actually generate performance.

The historical role of work in social recognition should consequently be separated into its component relations. Employment can provide income, status, routine, membership, learning, bargaining position, and visibility of contribution. Technological

transformation can affect these components differently. A future institution may preserve income while weakening membership, preserve work while changing autonomy, or expand productive capacity while concentrating recognition in those who control infrastructures. The economic problem concerns the reorganization of these relations rather than a single binary distinction between employment and unemployment.

1.15.3 Production and Social Necessity

The relation between production and subjecthood becomes especially important when productive capability grows faster than the need for particular forms of human contribution. This subsection distinguishes productive contribution from productive necessity. A person can contribute to production without being indispensable to it, and a society can possess the technical capacity to produce more output while reducing the number of human tasks required for a given production process. The distinction matters because modern allocation and recognition systems have often tied access to resources to the continuing demand for labor.

Industrial production already contained this tension. Mechanization increased output while reorganizing the demand for particular skills and tasks. The task-based framework developed by Acemoglu and Restrepo describes technological change through a balance between displacement, in which capital or automation performs tasks previously assigned to labor, and reinstatement, in which new tasks create new domains for labor demand (Acemoglu and Restrepo 2019). This framework is useful for GRE because it avoids treating technical capability as a direct forecast of employment. Productive transformation changes the task structure, while institutions, demand, complementary innovations, and new activities shape the resulting labor relation.

Artificial intelligence extends the same problem into domains of cognitive and symbolic production discussed in Section 1.11. The relevant change is the widening set of tasks for which machine systems can provide useful substitutes or complements. Writing, translation, coding, search, classification, planning, image production, and analytic support can increasingly be performed through human–AI configurations. The resulting productivity gains can expand output, lower costs, generate new demand, and create new roles. They can also reduce the amount of human labor required for some existing outputs. Both directions are compatible with the same technological advance.

The concept of social necessity adds another layer. A task may cease to be technically necessary for producing a given output while remaining socially meaningful. Human teaching, care, artistic performance, deliberation, companionship, craftsmanship, or face-to-face service can retain value even when some associated informational or productive functions are automatable. The persistence of such activity depends on institutions of valuation and participation as much as on comparative technical efficiency. Productive necessity and social desirability therefore belong to different analytical dimensions.

This distinction prevents a narrow interpretation of technological progress. If machine systems can produce a report faster than a person, the technical relation concerns the production of the report. The economic and social relation also concerns who learns through producing it, who is recognized for judgment, who bears respon-

sibility for its consequences, who retains access to the relevant institution, and which capabilities are reproduced through repeated practice. An output-equivalent substitution can therefore change the relations surrounding production even when the immediate product appears unchanged.

The implications for subject formation are substantial. Modern societies have often connected the worth of economic participation to productive necessity: a worker receives income because an organization requires the worker's labor, and the need for that labor supports bargaining position and recognition. As artificial productive capacity expands, that connection can weaken in some domains. Technical abundance may make a person's participation less necessary for output without making the person's experience, judgment, relationships, or potential contribution meaningless. A tension then emerges between the organization of production and the organization of subject recognition.

Korinek and Stiglitz emphasize that the distributional effects of artificial intelligence depend on how technological change affects factor returns, innovation rents, ownership, and labor demand (Korinek and Stiglitz 2019). The implication for the present argument is institutional. Productive capability alone does not determine who receives resources or recognition. The connection between production and livelihood is mediated through property, employment, bargaining institutions, taxation, public provision, and other mechanisms of allocation. Productive necessity can therefore decline before the institutions built around it have been replaced or reconfigured.

The resulting subject problem is historically specific. Industrial modernity stabilized a powerful chain linking work, contribution, income, and social position. Contemporary artificial productive capacity can loosen individual links in that chain at different rates. Economic theory therefore needs concepts capable of distinguishing output production from capability formation, necessity from participation, and technical substitution from the broader relational functions historically carried by work.

1.15.4 Productive Redundancy and Subjective Instability

Productive redundancy names a condition in which an actor's participation becomes less necessary for achieving an established productive objective because comparable or superior output can be generated through other configurations. The term refers to a relation between an actor and a production system, rather than to a judgment about the actor's intrinsic worth. This distinction is central to the section. An economic system can treat a contribution as redundant while the person remains fully capable of experience, learning, care, judgment, creation, and participation in other relations.

Redundancy can arise gradually. A task may first receive machine assistance, then become standardized, then shift toward supervision, and eventually require little direct human production. It can also arise unevenly across workers. Access to artificial tools may allow some employees to perform a wider range of tasks, reducing demand for specialized positions elsewhere. Organizational redesign can redistribute tasks among workers, models, platforms, and external contractors. The resulting instability therefore concerns the configuration of productive relations rather than a uniform technological shock.

The subjective consequences depend on how strongly a person's economic continuity has been organized around a productive role. Where income, professional iden-

tity, daily routine, social network, institutional membership, and perceived contribution are concentrated in employment, the weakening of that role can produce several forms of instability at once. Material insecurity may be accompanied by a loss of recognized position, reduced opportunities for skill use, and uncertainty about the relation between personal capability and social need. These effects can occur even when aggregate production rises.

The concept should remain analytically restrained. Productive redundancy is a possibility generated by changing task relations; it is not a forecast that human labor as a whole will become unnecessary. Acemoglu and Restrepo's displacement-reinstatement framework explicitly leaves room for new tasks and new forms of human comparative advantage (Acemoglu and Restrepo 2019). Artificial intelligence may also create complementary roles whose content cannot yet be specified. GRE therefore treats redundancy as a local and historically variable relation that can expand, contract, or transform as institutions and production systems evolve.

Even a local form of redundancy can expose a deeper problem in allocation. If access to income and social resources depends heavily on being competitively necessary to production, a decline in necessity can become a decline in material command. Section 1.13 described the institutional channels through which capability asymmetry can affect allocation. Subjective instability adds the consequence that the same institutions also influence how persons understand their place in economic life. A system can therefore preserve productive abundance while generating insecurity among participants whose recognized roles weaken.

Income replacement addresses only part of this structure. Transfers, social insurance, public provision, or asset ownership can protect material access when employment falls. Such arrangements may be indispensable, yet the relations previously carried by work can remain unresolved. A person can possess income while lacking a recognized field of contribution; possess leisure while lacking access to communities of practice; possess consumption opportunities while lacking participation in decisions that shape shared institutions. The difference between material security and relational participation is therefore analytically important.

This distinction also constrains simplistic claims about a post-work economy. Reduced labor requirements can expand freedom from undesirable work, create time for care and learning, and weaken forms of domination tied to economic necessity. The same reduction can intensify exclusion if institutions continue to allocate recognition, voice, and access through employment. The consequences depend on which relations replace the employment nexus and how those relations distribute opportunities for meaningful participation.

The historical significance of artificial intelligence therefore lies partly in the possibility that productive abundance and subjective insecurity can coexist. A society may become technically capable of producing more with less human labor while retaining institutions that interpret reduced labor demand as reduced social claim. The tension arises from the lag between productive transformation and the institutional forms through which subject positions are recognized. This lag motivates the final subsection's focus on participation beyond productive superiority.

1.15.5 Economic Participation beyond Productive Superiority

The destabilization of inherited subject positions creates a positive analytical task: economic participation needs to be distinguished from productive superiority. Modern institutions have often rewarded actors who possess scarce capabilities, control productive assets, or occupy roles that organizations require. These mechanisms remain important, yet they provide an incomplete basis for subjecthood when artificial systems can exceed human performance across expanding sets of tasks. A relational economy therefore requires concepts of participation that remain intelligible even when contribution cannot be justified by superior output alone.

Sen's capability perspective offers one foundation because it evaluates substantive opportunities rather than reducing well-being to resource possession or commodity command (Sen 1999). Applied to participation, the relevant question concerns which relations persons are effectively able to enter, sustain, and shape. Access to education, public institutions, collaborative work, culture, care, research, community life, and collective decision-making can matter because these relations expand what persons are able to become and do. Their value need not depend on proving that human performance exceeds the best artificial alternative.

Economic participation can therefore be analyzed through several distinct dimensions. Material participation concerns access to resources and infrastructures required for life. Productive participation concerns contribution to the production and maintenance of goods, services, organizations, and shared capacities. Epistemic participation concerns access to inquiry, learning, interpretation, and the production of knowledge. Institutional participation concerns membership, voice, and the ability to influence rules. Relational participation concerns access to durable relations through which trust, care, identity, cooperation, and future opportunities can be generated. These dimensions can overlap while remaining analytically separable.

The distinction matters because technological systems affect them differently. Artificial intelligence may reduce the labor required for a productive task while increasing opportunities for learning, experimentation, or collaborative creation. It may improve access to knowledge while concentrating control over computational infrastructure. It may enable small organizations to perform functions previously requiring large staffs while increasing dependence on a few platform providers. Evaluation therefore requires tracing which forms of participation expand, which contract, and which become conditional on new intermediaries.

Participation also has a temporal dimension. A relation can be valuable because it generates later capabilities that were unavailable at the moment of entry. Apprenticeship, education, research collaboration, caregiving, community membership, and participation in institutions can produce skills, trust, confidence, reputation, and future opportunities. A purely output-centered account can undervalue such relations when their immediate productivity is modest. GRE later develops this problem through the concept of generativity. The historical point here is that the weakening of productive necessity makes these longer-horizon relational effects more visible as economic questions.

The same perspective changes the interpretation of artificial capability. If machine systems outperform humans on a task, the comparison answers a question about task performance under specified conditions. It does not determine whether humans should cease to participate in every relation organized around that task. Education of-

fers the clearest example: a system may know more than a learner while the learner's engagement with a subject still generates human capability. Similar distinctions may arise in art, research, care, deliberation, and craftsmanship, where participation itself can transform the participant and the surrounding relational system.

This approach preserves the role of productive efficiency while limiting its jurisdiction. Efficiency remains relevant when a goal is well specified and output can be compared meaningfully. Subject formation, capability development, institutional membership, and relational continuity introduce additional objects of economic evaluation. A society facing radical artificial capability therefore confronts a problem of institutional design: how to organize access, contribution, recognition, and participation when comparative productive superiority no longer provides a stable general foundation for each of them.

The next section develops the relational basis required for that problem. Section 1.16 examines economic subjecthood as a relatively stable configuration generated and sustained through social and institutional relations. The move does not assign final ontology to the subject. It identifies the relational conditions under which subjects acquire sufficient persistence, recognition, and causal efficacy to become objects of economic analysis.

1.16 Relational Constitution of Economic Subjecthood

Section 1.15 identified a historical strain in the modern alignment among productive contribution, income, recognition, and subject position. The present section provides the conceptual bridge required by that diagnosis. Its role is to reconstruct economic subjecthood through the relations that generate, stabilize, and recognize an actor as a participant in economic life. The objective is deliberately limited: the section develops a relational account sufficient for economic analysis while reserving stronger metaphysical questions for the ontological discussion in Chapter 4. The argument proceeds through five steps. It first locates subject formation within social relations, then examines the mechanisms that stabilize economic actors, turns to institutional recognition, states a minimal account of relational reality under ontological suspension, and finally considers how the framework applies to human and artificial economic subjects. The method is historical-institutional and analytical. It asks what practical conditions allow an actor to persist as a recognizable bearer of roles, resources, obligations, capacities, and consequences across time.

1.16.1 Social Relations in Subject Formation

Economic subjecthood becomes intelligible once the subject is approached through the relations in which economic capacities acquire determinate form. A worker is constituted economically through relations of employment, remuneration, authority, skill recognition, and social reproduction. An owner occupies relations of title, exclusion, transfer, inheritance, and control. A consumer appears through monetary access, market exchange, product classification, credit, and infrastructures of distribution. A household becomes actionable through membership, care, income pooling, taxation, welfare rules, and statistical recognition. These positions differ sharply in

content, yet they share a structural feature: the economic subject is recognizable because a network of relations gives the position continuity and practical consequences.

This relational reconstruction extends the historical argument developed earlier in the chapter. Economic action has long been embedded in ongoing structures of social relations, and Granovetter's critique of atomized economic action remains useful precisely because it directs attention to the social structures through which apparently individual conduct becomes possible and consequential (Granovetter 1985). The relational point can be taken further without assuming that every feature of a person is socially produced. Economic subjecthood concerns a domain-specific position. The person who occupies that position exceeds it, while the position itself is formed through relations that make certain actions, claims, obligations, and resources available.

The distinction between bearer and position prevents two forms of analytical compression. One compression treats the subject as a self-contained unit whose economically relevant capacities are already present before interaction. The other treats the subject as fully exhausted by the relations currently observed. A relational account can preserve a practical identity while recognizing that the capacities attached to that identity are historically conditioned. Skills are acquired through education and work; creditworthiness is constituted through records and institutional judgment; ownership depends on recognized title; occupational identity depends on social classification and organizational demand; household responsibility depends on membership rules. These capacities become attributes of actors in practice even though their production is relational.

Historical categories participate in this formation. Hacking's historical-ontological work emphasizes that classifications, descriptions, and styles of reasoning can participate in bringing into view kinds of persons and objects that become available for thought and action (Hacking 2002). In economic life, categories such as employee, unemployed person, shareholder, debtor, beneficiary, incorporated firm, or dependent household member do more than summarize pre-existing properties. They organize eligibility, obligation, comparison, and institutional response. Once repeatedly used, a category can become part of the relational environment through which actors understand their position and through which others act upon them.

Subject formation therefore has a recursive structure. Relations generate positions; positions organize expectations and conduct; conduct reproduces or modifies the relations that generated the positions. This recursion explains why economic subjects can appear stable while remaining historically transformable. A worker can persist as a recognizable subject across many transactions because employment law, payroll systems, occupational classifications, organizational routines, and social expectations stabilize the position. Changes in technology, law, family structure, or organizational form can later alter the same position without requiring the person occupying it to disappear.

The relational constitution of subjecthood also clarifies why new economic actors can emerge historically. Platform sellers, data workers, content creators, gig workers, cooperative members, algorithmic service providers, and other contemporary positions become economically salient when repeated relations stabilize distinctive expectations, flows, rights, risks, and forms of recognition around them. The emergence of a subject position can therefore be studied historically through the relations that make it durable enough to enter allocation, accounting, regulation, and collective

interpretation.

1.16.2 Relational Stabilization of Economic Actors

Subject formation alone does not explain persistence. Economic analysis ordinarily requires actors that can be followed across transactions, held responsible for obligations, assigned resources, and recognized by counterparties. Relational stabilization names the process through which a changing configuration becomes sufficiently continuous to support those practices. The relevant stability is practical and historical. It can be strong enough for accounting, contracting, policy, and statistical analysis while remaining open to transformation.

Several mechanisms contribute to stabilization. Repetition is the most elementary. Recurrent interaction allows counterparties to form expectations about conduct, reliability, skill, payment, or role performance. Records extend repetition across time by making prior actions institutionally available. Contracts and property titles preserve obligations beyond the moment of agreement. Organizational routines preserve roles across personnel changes. Membership rules define who remains inside a household, association, cooperative, or firm. Trust lowers the need to renegotiate every relation from the beginning. Infrastructures such as payment systems, registries, identity systems, and digital platforms provide technical continuity across otherwise separate encounters.

Stabilization also depends on complementarity. A position becomes durable when other positions are organized around it. The worker position is sustained by employers, payroll systems, labor law, training institutions, tax systems, and household expectations. The firm is stabilized by workers, suppliers, customers, creditors, regulators, accounting practices, and legal recognition. The consumer position depends on sellers, money, distribution, standards, information, and rights of redress. The durability of an actor is therefore partly a property of the surrounding configuration. A subject can lose economic continuity when complementary relations dissolve even if the bearer remains materially unchanged.

This point is especially important for collective actors. A corporation may survive the departure of founders, managers, workers, investors, and customers because the relations composing the organization are reproduced through roles, records, procedures, assets, contractual continuity, and external recognition. Section 1.5 showed how organizational law and accounting provide institutional mechanisms for such persistence. Relational stabilization adds the wider economic condition: counterparties continue to orient their conduct toward the organization as one participant. The collective actor acquires continuity because many relations converge on a sufficiently stable reference point.

Stabilization admits degrees. Some subject positions are highly standardized and portable across institutions; others depend on a narrow local relation. An incorporated firm with registered assets, audited accounts, recurring contracts, and regulatory standing possesses stronger institutional continuity than an informal collaboration assembled for a single project. A household can be stable for purposes of taxation and unstable for purposes of care or resource sharing. A digital identity may be persistent within one platform and irrelevant outside it. Economic subjecthood therefore varies with the domain, scale, and relation under examination.

The degree structure matters for contemporary transformation. New technologies

can produce economically consequential actors faster than legal and statistical systems can stabilize them. A software agent can repeatedly perform purchasing, pricing, recommendation, or coordination functions while formal responsibility remains assigned to a human or organization. A decentralized collective can coordinate resources before established law provides a clear organizational category. Relational stabilization can therefore precede full institutional recognition, creating a period in which practical economic agency and formal subject status diverge.

1.16.3 Institutional Recognition of Subject Positions

Institutional recognition converts relational stabilization into forms that large-scale economic systems can administer. Law, accounting, taxation, statistics, welfare systems, financial institutions, and organizational procedures require identifiable units to which rights, obligations, resources, liabilities, and observations can be attached. Recognition gives a subject position an address within these systems. It also changes the position by creating consequences that follow from being classified in one way rather than another.

Modern economic administration offers clear examples. The System of National Accounts defines institutional units through capacities such as owning assets, incurring liabilities, making economic decisions, and engaging in transactions in their own right (European Commission et al. 2009). Financial reporting similarly constructs reporting entities whose boundaries can include a legal entity, part of an entity, or several entities, depending on the informational purpose of the report (IFRS Foundation 2018). Organizational law stabilizes further distinctions by partitioning assets and creditor claims around recognized organizational forms (Hansmann and Kraakman 2000). These frameworks do not merely discover a universal natural boundary. They create standardized interfaces through which heterogeneous relational configurations become comparable and actionable.

Recognition has distributive consequences. Employment status can determine access to wages, insurance, leave, taxation, and legal protection. Household classification can alter benefit eligibility and tax liability. Corporate status can affect asset ownership, limited liability, financing, and continuity. Residency, citizenship, professional certification, and organizational membership can determine access to institutions and resources. Recognition therefore participates in the production of economic capacity. A subject position that enters an institutional category can acquire options unavailable to an otherwise similar actor outside it.

The same process can exclude. Relations that do not fit established categories may remain economically consequential while receiving weak institutional visibility. Informal care, unpaid collaboration, platform-mediated labor, collective knowledge production, or cross-border digital activity can generate value and obligations without aligning neatly with inherited administrative units. The mismatch does not make these relations unreal. It affects whether economic systems can see them, allocate to them, regulate them, or assign responsibility through existing procedures.

Institutional recognition is therefore performative in a bounded sense. A classification can change access, incentives, responsibility, and behavior because institutions act through it. Its efficacy still depends on relations beyond the classification itself. Declaring an organization independent does not produce suppliers, trust, productive capacity, or internal coordination. Recognizing a worker category does not

determine the actual distribution of bargaining power or care burdens. Recognition becomes economically effective when classificatory rules connect to infrastructures, resources, expectations, and enforcement.

This bounded performativity provides a useful bridge to the later discussion of manifestation. Economic systems often encounter subjects through institutional representations: accounts, legal statuses, employment records, credit files, identifiers, statistical categories, or platform profiles. These manifestations can stabilize action while preserving only part of the underlying relational structure. The analytical task is therefore twofold: to take institutional recognition seriously as a causal component of economic subjecthood and to preserve the possibility that the recognized manifestation leaves economically relevant relations unresolved.

1.16.4 Relational Reality under Ontological Suspension

The preceding analysis permits a minimal ontological stance suitable for the historical argument of this chapter. An economic subject can be treated as relationally real when a configuration is generated and sustained through relations, persists sufficiently to support recurrent interaction, and exercises causal effects within the economic system. This criterion concerns analytical standing rather than ultimate metaphysical substance. Chapter 4 develops the distinction more fully through ontological suspension, relational reality, and manifestational reality.

Ontological suspension is useful because the economic subjects considered in this chapter are heterogeneous. A person, household, corporation, cooperative, state agency, platform account, and software agent do not need to share one ultimate mode of being in order to participate in economically consequential relations. Economic analysis can ask how each is generated, recognized, stabilized, and causally effective while leaving deeper questions about consciousness, personhood, identity, or metaphysical composition open where the economic argument does not require their resolution.

Relational reality also guards against premature reification. A stabilized subject can be treated as a unit for a particular analytical purpose while its boundary, capacities, and continuity remain dependent on relations. The firm can be a real contracting and accounting subject even though its productive capacity depends on workers, suppliers, law, finance, infrastructure, and knowledge networks. The household can be a real administrative unit even though its internal distribution cannot be inferred from aggregate resources. A worker can be a real employment subject while occupational identity and earning capacity remain historically generated. Reality at the relational level therefore supports unit-level analysis without converting provisional boundaries into timeless essences.

The same stance preserves practical identity. Relational constitution does not require economic analysis to dissolve every subject into an unbounded network. Contracts, liabilities, rights, welfare claims, preferences, plans, and histories frequently attach to identifiable actors. The question is how those identities are sustained and what relations make them economically effective. A relational account can therefore move between levels: it can treat the subject as a unit where the unit is causally and institutionally stabilized, and it can reopen the unit when internal or external relations become necessary for explaining an outcome.

This level-sensitive stance is especially important for value and responsibility. Eco-

economic systems often need to know who receives a transfer, who owes a debt, who controls an asset, who bears a risk, or who is accountable for a decision. These questions require subjects. GRE later asks how resources and value move through the relations composing and surrounding those subjects. Relational reality allows both inquiries to proceed without forcing one level to replace the other.

Ontological suspension also supports theoretical pluralism. Different disciplines may describe the same economic participant through different ontological vocabularies. Law may focus on personhood and responsibility; sociology on role and recognition; psychology on agency and cognition; computer science on system architecture; economics on choice, production, and allocation. GRE can use relational criteria to compare these descriptions where they intersect economically while allowing each domain to retain questions that exceed economic analysis. This discipline becomes decisive when artificial systems enter the picture.

1.16.5 Human–Artificial Economic Subjecthood

Artificial intelligence intensifies the subjecthood problem because economically consequential activity can increasingly be produced by systems whose legal, moral, cognitive, and institutional status differs from that of human participants. Section 1.11 showed that contemporary AI systems already participate in cognitive production, symbolic generation, workplace assistance, and organizational coordination. The question here concerns the analytical conditions under which such participation supports an economic subject position.

Four dimensions should be separated. Productive agency concerns the capacity to perform economically relevant tasks or alter outcomes. Relational continuity concerns whether counterparties repeatedly orient their conduct toward the system or toward a stable role mediated by it. Institutional recognition concerns whether rights, liabilities, accounts, contracts, or administrative consequences can be attached to the position. Normative standing concerns questions such as welfare, rights, responsibility, consciousness, or moral consideration. These dimensions can vary independently. A system may possess substantial productive agency and relational continuity while institutional and normative standing remain assigned to the human or organizational actors surrounding it.

The distinction prevents economic efficacy from carrying an ontological burden it cannot bear. Current language models can generate fluent symbolic output, while fluency itself does not establish understanding or meaning in the strong sense cautioned against by Bender and colleagues (Bender et al. 2021). Economic analysis nevertheless has reason to follow the causal role of such systems when organizations change staffing, prices, workflows, search processes, or service provision in response to them. Productive and relational effects can therefore be studied without treating those effects as evidence of human-equivalent cognition.

Institutional mediation remains central. A software agent that purchases goods, schedules labor, executes trades, recommends credit, or negotiates within a platform usually acts through accounts, permissions, assets, and liabilities ultimately connected to recognized persons or organizations. The economic subject may therefore be layered: an artificial system can occupy an operational role, a firm can bear legal responsibility, workers and users can supply inputs, and platform owners can control the infrastructure. The relevant unit depends on the question being asked.

Production analysis may focus on the artificial agent's task performance; liability analysis may focus on the organization; power analysis may focus on ownership and infrastructure; welfare analysis may focus on affected humans.

This layered structure also clarifies why human and artificial economic subjects should not be treated as automatically equivalent. Human economic subjecthood is embedded in embodiment, vulnerability, social reproduction, capability development, legal rights, and forms of recognition that exceed productive output. Sen's capability perspective is relevant because it locates evaluation in substantive opportunities and the institutional conditions under which persons can act and become (Sen 1999). Artificial systems may participate powerfully in economic production without sharing the same capability, welfare, or rights framework. A relational analysis can compare economically relevant functions while preserving these normative differences.

Artificial systems can nevertheless acquire increasingly stable subject-like positions within particular economic domains. Recurrent identity, persistent memory, delegated authority, autonomous task execution, access to resources, and counterparties that adapt to system behavior can create a durable operational position. Institutional evolution may later attach new forms of recognition to such positions. The trajectory is an empirical and legal question rather than a conclusion established by technical capability alone.

The wider significance for GRE is methodological. Economic subjecthood should be analyzed through the relations that generate and stabilize participation rather than through a single universal test of entity status. Human persons, collective organizations, and artificial systems may occupy different subject positions, with different degrees of persistence, recognition, agency, and normative standing. The framework therefore preserves heterogeneous subjecthood while retaining enough structure for allocation, production, power, and responsibility to remain analyzable.

Section 1.17 takes the next step. Once subjects are understood as relationally stabilized, the central question shifts from the persistence of a subject to the capacity of relations to transform subjects, generate capabilities, alter future possibilities, and reproduce or change the conditions under which later relations form. That movement introduces the generative dimension that distinguishes GRE from a purely relational economics.

1.17 Generative Relations and Relational Subjecthood

This section develops the transition from relational constitution to generativity. Its role in the chapter is to show why identifying the relations that stabilize an economic subject is only the first stage of analysis. The objective is to examine how persistent relations can transform subjects, generate capacities, alter the range of future possibilities, and organize forms of participation whose effects extend beyond an immediate transaction. The discussion proceeds conceptually and historically, drawing on the relational insights established in Sections 1.8 and 1.16. It first distinguishes persistence from mere recurrence, then analyzes subject transformation and capacity formation, extends the analysis to future possibility, and closes by specifying the generative structure of economic participation.

1.17.1 Persistence of Relational Structures

A relation becomes historically consequential when it persists long enough to condition later action. Persistence can arise through repeated interaction, institutional recognition, durable expectations, shared infrastructure, accumulated knowledge, legal rules, organizational routines, or material dependence. The resulting structure can outlast the particular exchange in which it first appeared. Employment relationships can generate occupational identities and skill trajectories; credit relations can alter future borrowing conditions; supply relationships can create specialized productive capacities; educational relations can reshape later opportunities; and platform-mediated relations can reorganize access to markets, audiences, and information. The economic significance of a relation therefore depends partly on the temporal structure through which its effects continue.

Persistence should be distinguished from simple repetition. A sequence of transactions can recur without producing a durable change in the participants or in the surrounding institutional environment. A persistent relational structure has a stronger property: earlier interaction affects the conditions under which later interaction occurs. Trust, reputation, contractual routines, shared standards, specialized assets, organizational memory, and accumulated expectations are familiar mechanisms through which past relations become active conditions of the present. Granovetter's account of embedded economic action remains useful here because it directs attention to ongoing social structures rather than isolated transactions (Granovetter 1985). For GRE, the further question concerns what these ongoing structures make possible over time.

The persistence of relations can be located at several scales. A dyadic relation between worker and employer may stabilize expectations about effort, compensation, learning, and advancement. Repeated relations among firms can create interorganizational routines and shared technical standards. Relations among research institutions can stabilize channels through which knowledge, personnel, and equipment circulate. Financial relations can become embedded in clearing systems, regulatory arrangements, and expectations about liquidity. The relevant unit of analysis therefore expands as persistence becomes distributed across multiple participants.

Institutionalization is one important mode of persistence. A relation becomes institutionally durable when rules, classifications, legal forms, accounting practices, credentials, or administrative procedures reproduce it beyond the memory or intention of particular participants. Section 1.5 showed how modern economic entities are stabilized through precisely these mechanisms. The same mechanisms can stabilize relations among entities. A professional credential reproduces a relation between certified expertise and institutional access; a property title stabilizes a relation of exclusion and control; a standard contract reproduces a recognizable pattern of obligation across many interactions. Persistence can therefore be carried by symbolic and administrative infrastructures as well as by repeated personal contact.

Material complementarity can also make relations persistent. Specialized productive systems often create capacities that have value only within a wider configuration. A supplier investing in a highly specific component, a worker acquiring organization-specific knowledge, or a laboratory developing equipment around a shared protocol may become increasingly connected to a particular relational environment. The relation persists partly because the capacities generated within it are difficult to redeploy

elsewhere without loss. This structure can support coordination and learning while also creating dependence and switching costs.

Persistence is normatively ambiguous. Durable relations can support trust, learning, care, coordination, and collective capacity. They can also reproduce dependency, exclusion, hierarchy, or unequal bargaining positions. The analytical importance of persistence lies in its generative potential rather than in any presumption that durability is beneficial. Once a relation modifies the conditions of later interaction, economic analysis must attend to the trajectory it produces and to the distribution of the capacities and constraints that accumulate within it.

This temporal perspective prepares the move from relational stability to subject transformation. A subject stabilized by relations can also be changed by those relations. Persistence therefore provides the medium through which economic participation becomes formative rather than merely connective.

1.17.2 Relations and Subject Transformation

Economic subjects enter relations with histories, capacities, expectations, and institutional positions, and participation can modify each of these. The relevant transformation may concern skill, preference, identity, reputation, bargaining position, access, trust, obligation, or the practical categories through which a subject understands available action. Relations thereby participate in the production of later subjects. A relational account of economic life becomes generative when it follows this transformation across time.

Work provides a familiar example. Employment can alter a worker through training, occupational socialization, access to colleagues, exposure to organizational routines, and participation in professional communities. Human-capital theory captures one component of this process by treating education and training as investments that alter productive capacity (Becker 1964). A generative relational perspective widens the object. Skill formation occurs through relations with instructors, coworkers, institutions, technologies, standards, and bodies of knowledge. The capacity that later appears to belong to an individual can therefore have a distributed history of generation.

Organizations undergo analogous transformation. Repeated collaboration can produce routines, trust, shared vocabularies, coordination practices, and collective memory that are unavailable to participants acting separately. Powell, Koput, and Smith-Doerr's study of biotechnology is important because innovation appears within networks of interorganizational learning rather than inside fully self-sufficient firms (Powell et al. 1996). The productive subject in such settings changes through its relations: a firm's effective knowledge base and opportunity structure depend on the collaborations through which it learns and combines capabilities.

Relational transformation also occurs through institutions that classify and recognize subjects. Credentials can transform access to occupations; credit scores can change financing conditions; legal statuses can alter eligibility and responsibility; platform ratings can influence future matching and visibility. These representations can become part of the causal environment in which later subject positions are formed. Section 1.14 described the representational instability associated with symbolic abundance. The present point is temporal: once a representation affects later relations, it participates in the trajectory through which a subject is transformed.

Transformation can be cumulative and path dependent. Two subjects with initially similar resources can acquire different capacities because they enter different relational environments. Early access to strong mentors, well-connected institutions, trusted collaborators, stable employment, or high-quality infrastructure can generate later advantages that compound through subsequent relations. Conversely, exclusion from these environments can limit the opportunities through which capacities would otherwise develop. The distribution of present resources therefore provides only a partial account of future economic position when the relations through which resources are converted into capacities differ systematically.

This dynamic also complicates the usual separation between preference and constraint. Participation can alter what subjects value, what they can imagine, which goals appear attainable, and which forms of activity become meaningful. Economic relations can therefore affect both the feasible set and the orientation of the subject within it. GRE does not require a universal theory of preference formation at this stage. It requires only the weaker historical observation that economic participation can modify the subject who later chooses, works, invests, cooperates, or withdraws.

Artificial intelligence introduces a new set of formative relations. A worker who repeatedly relies on an AI system may acquire new capabilities through augmentation, lose others through reduced practice, reorganize attention around system outputs, or become dependent on infrastructures controlled elsewhere. Organizations can similarly redesign workflows, expertise hierarchies, and decision routines around artificial systems. The long-run economic effect therefore concerns more than the productivity of a task at one moment. It also concerns the kinds of human and organizational subjects produced by sustained participation in AI-mediated relations.

Subject transformation provides the bridge to capacity formation. A generative relation becomes especially important when participation produces abilities, resources, forms of coordination, or institutional access that were unavailable to the participants before the relation developed.

1.17.3 Relations and Capacity Formation

Capacity formation gives the generative dimension a more precise economic object. A relation is generatively significant when participation helps produce a capacity that changes what a subject or collective can subsequently do. Capacities can be productive, epistemic, organizational, relational, political, or adaptive. They may reside partly in identifiable subjects and partly in the relations and infrastructures through which those subjects act.

The capability perspective offers an important point of contact because it evaluates resources through the substantive opportunities they enable rather than through possession alone (Sen 1999). GRE extends this concern temporally. The question becomes how present relations contribute to the formation of later capabilities and how unequal access to those relations shapes future opportunity. A training grant, for example, has one immediate recipient, yet its effect depends on educational institutions, mentorship, time, social support, recognition, and pathways into later work. Resource allocation and capacity generation are therefore analytically distinct stages.

Some capacities are intrinsically relational. Trust cannot be possessed by one actor in isolation in the same manner as a physical asset. Coordination capacity emerges through repeated mutual adjustment. A professional network becomes

useful through reciprocal recognition and access. Collective knowledge depends on communication, shared standards, and institutional memory. Organizational resilience can depend on redundancy, distributed expertise, and the quality of relations among units. These examples show why a purely possessive vocabulary can underdescribe capacities whose efficacy lies in structured interdependence.

Capacity can also be generated at a higher level than the participants through whose interaction it arises. A research collaboration can create a shared dataset, protocol, instrument, or body of tacit knowledge that later participants inherit. A supply network can develop standards and logistical routines that increase the productive capacity of the network as a whole. A community can establish norms and institutions that support collective action. The resulting capacity is real in its effects even when it cannot be assigned without remainder to any single member.

Relational capacity formation is often cumulative. Early participation can create the competence required to enter more advanced relations, which then generate further capability. Education, professional apprenticeship, scientific collaboration, entrepreneurship, and institutional membership frequently exhibit this structure. The trajectory can become self-reinforcing when generated capacities increase access to subsequent opportunities. The reverse is also possible: weak initial access can reduce later participation and create cumulative disadvantage.

The distribution of capacities therefore depends partly on the distribution of generative relations. Two actors receiving identical nominal resources can experience different long-run outcomes because their surrounding relations differ. Access to mentors, infrastructure, stable institutions, trusted collaborators, legal recognition, and time can determine whether a resource becomes an enduring capability. This observation is central to the later GRE treatment of allocation. Allocation affects economic futures partly by changing the relations through which capacity can be generated.

Capacity formation also clarifies why generativity should remain separate from immediate performance. A relation may reduce short-term efficiency while increasing learning, redundancy, adaptability, or future option space. Conversely, a highly optimized arrangement may produce excellent immediate output while generating little new capability among participants. GRE later develops the evaluative consequences of this distinction. At the historical level of the present chapter, the important point is that the productive significance of a relation can appear only across time.

The temporal extension of capacity leads directly to future possibility. Generated capability matters because it changes the set of relations, actions, and trajectories available later.

1.17.4 Relations and Future Possibilities

Economic relations participate in the construction of future possibility by changing which actions, affiliations, projects, and institutional positions become available. A future opportunity is rarely created by a resource alone. It emerges from a configuration that connects capacity, recognition, infrastructure, information, legal permission, social access, and material conditions. The generative effect of a relation can therefore be described partly through the possibilities it opens, preserves, redirects, or forecloses.

This perspective adds a temporal dimension to scarcity. Section 1.12 argued that contemporary scarcity increasingly concerns attention, trust, institutional access, and

generative opportunity alongside persistent material scarcity. Generative opportunity is distinctive because its value lies in what can follow from participation. Access to a research laboratory matters partly through experiments that become possible; access to a professional community matters through collaborations and recognition that may emerge; access to a stable learning environment matters through capabilities that develop over time. The economic object is therefore a pathway rather than a single consumable unit.

Future possibility is path dependent because present participation can alter later access. A first job can generate experience that changes eligibility for later work. A credit relation can create a repayment history that affects future finance. Membership in a standards body can provide information and influence over later technical rules. Participation in a platform can accumulate reputation and audience. These relations create histories that institutions later use when allocating further opportunities. Economic systems thereby convert past relations into conditions of future participation.

Possibility can also be foreclosed. Debt burdens can constrain later choices; restrictive contracts can limit mobility; dependency on proprietary infrastructure can raise switching costs; narrow credential systems can exclude forms of competence that lack recognized representation; concentrated ownership can prevent participants from converting contribution into control. The generative analysis of economic relations therefore requires attention to both expansion and contraction of future option spaces.

The same structure operates collectively. A community that loses a school, clinic, transport link, financial institution, or research facility may lose more than the immediate service. It can lose the relations through which later capabilities and projects would have formed. Conversely, shared infrastructure can generate opportunities that were not specified in the original investment. The return on infrastructure may therefore include emergent activities that could not be enumerated in advance because they depend on subsequent relations among users.

This openness distinguishes generative possibility from prediction. A generative relation can expand the range of feasible futures without determining which future will occur. Educational access can enlarge capability without fixing occupation; scientific infrastructure can enable discoveries without specifying them; social trust can support cooperation without determining its object. GRE is therefore interested in conditions that make later generation possible while retaining contingency in the trajectories that follow.

Future possibility also introduces a distributional problem. Some actors possess wide option spaces because they can draw on wealth, institutions, networks, mobility, and recognized credentials. Others confront narrow spaces even when their current consumption appears similar. A static snapshot can therefore understate inequality when it ignores the unequal capacity to generate future alternatives. The later GRE framework will treat this issue through generative opportunity, value circulation, and justice across time.

The relation between participation and possibility now becomes explicit. Participation is economically generative when it changes the conditions under which later participation can occur. This gives the final subsection its organizing principle.

1.17.5 Generative Structures of Economic Participation

Economic participation has a generative structure when taking part in an activity changes the participant, the relation, or the surrounding institutional conditions in ways that affect later participation. This formulation extends the conventional focus on what an activity produces immediately. Employment can produce goods and income while also generating skills, reputations, dependencies, and organizational roles. Education can deliver instruction while generating curiosity, competence, social connection, and later access. Research can produce findings while creating instruments, communities, standards, and new questions. Care can meet present needs while sustaining the capacities through which persons participate in future social and economic life.

The generative structure of participation can be analyzed through several dimensions. The first is subject formation: participation can stabilize or transform the identity and position of the participant. The second is capacity formation: participation can generate abilities and resources that persist. The third is relational reproduction: participation can strengthen, weaken, or reorganize relations among actors. The fourth is institutional transformation: repeated participation can alter rules, expectations, and recognized categories. The fifth is option-space transformation: the preceding changes can expand or contract future possibilities.

These dimensions need not move together. A relation can generate productive capacity while reducing autonomy. It can expand organizational capability while concentrating control. It can strengthen trust within a group while increasing exclusion at its boundary. It can create valuable knowledge while producing dependency on infrastructure controlled by another actor. Generativity therefore describes a structure of downstream production rather than a complete normative evaluation. Later chapters address power and justice because the distribution, direction, and control of generative effects require separate analysis.

Participation can also generate relations that were not specified by the initiating objective. Collaboration undertaken to complete a project may produce a durable research network. Shared use of infrastructure may create a community of practice. A cooperative response to crisis may establish institutions that persist after the immediate problem has passed. These outcomes matter because they alter the relational environment from which later economic action begins. The economic significance of participation can therefore exceed the objective under which the activity was initially organized.

The distinction between ordinary relationality and generativity can now be stated positively. Relational analysis asks how actors, organizations, and institutions are connected and constituted through relations. Generative analysis asks how those relations produce changes that become conditions of subsequent economic life. The object includes newly generated subjects, capacities, institutions, relations, constraints, and possibilities. This temporal extension is the reason GRE requires more than a static map of economic relations.

The distinction is especially important under conditions of artificial intelligence and symbolic abundance. An AI-mediated relation can improve immediate productivity while changing skill formation, professional recognition, dependency, organizational memory, and access to future work. A platform can facilitate exchange while reshaping market entry, reputation, data accumulation, and bargaining power. A trans-

fer can raise present consumption while leaving generative opportunity unchanged, or it can support relations that produce durable capability. The same immediate outcome can therefore sit inside very different generative trajectories.

Generative participation also provides an alternative route for thinking about economic inclusion after the destabilization described in Section 1.15. If productive necessity weakens as a universal basis of social membership, participation can still matter through learning, care, inquiry, creation, cooperation, institution building, and other relations that generate capacities and future possibilities. This observation does not establish a normative programme or an allocation rule. It identifies an economic object that becomes more visible when productive contribution, productive necessity, and meaningful participation no longer coincide automatically.

Section 1.18 develops the analytical consequence. Once economic subjects and capacities are understood as relationally generated, an entity-centered account becomes incomplete whenever internal relations, external relations, relations among relations, downstream effects, or transformations of future generative conditions are required to explain an intervention. The next section therefore specifies the relational and generative limits of entity-centered economics before the chapter turns to the scientific conditions that make more demanding forms of analysis increasingly possible.

1.18 Relational and Generative Limits of Entity-Centered Economics

This section specifies the analytical boundary reached by entity-centered economic description after the historical developments reconstructed in Sections 1.5–1.17. Its role in the chapter is to identify the conditions under which persons, firms, households, states, and other recognized entities remain adequate units of analysis, and the conditions under which additional relational and generative description becomes necessary. The objective is therefore one of scope rather than replacement: entity-centered analysis remains powerful where entity boundaries are stable and the economically relevant effects of an intervention can be represented at the level of the recipient. The discussion proceeds from relations internal to entities, through relations surrounding them and relations among relations, to downstream intervention effects and transformations of future generative conditions. The method is conceptual and comparative, using established work on firms, embeddedness, network organization, global value chains, and entitlement to show that economically consequential structure can reside both within and between recognized entities.

1.18.1 Internal Relations within Economic Entities

An economic entity is often represented by variables attributed to the entity as a whole: income for a household, productivity for a firm, assets for a corporation, expenditure for a public body, or output for a national economy. Such variables are indispensable for comparison and administration. Their adequacy depends, however, on whether the internal relations through which the entity operates can be treated as analytically secondary for the question at hand. When internal organization shapes the conversion of resources into action, the same entity-level quantity can correspond

to substantially different economic capacities.

The firm provides the clearest historical example. Coase's classic analysis of the firm begins from the observation that productive activity can be coordinated through authority inside an organization as well as through market exchange across organizational boundaries (Coase 1937). The distinction matters because a firm is more than an owner of inputs. It is a patterned arrangement of authority, employment, information, routines, and contractual relations through which inputs are combined. Two firms holding similar assets can therefore exhibit different productive capacities when their internal coordination, knowledge distribution, worker relations, or organizational routines differ.

Organizational law reinforces this point by stabilizing the entity without exhausting its internal structure. Hansmann and Kraakman show that organizational law supports standardized legal entities partly through asset partitioning, which separates organizational assets and creditor claims from those of owners or managers (Hansmann and Kraakman 2000). This legal boundary is economically consequential because it makes the organization tractable as a bearer of assets and obligations. Yet the boundary does not describe how authority, expertise, risk, reward, and decision rights are distributed inside it. A legally unified corporation can contain highly unequal or internally fragmented relational structures while appearing as one administrative recipient.

Households display a parallel difficulty. A transfer recorded at household level can alter the resources available to the household while leaving open the internal distribution of control, care obligations, time, bargaining position, and effective access. Treating the household as a single recipient can be appropriate for some fiscal or demographic questions and inadequate for questions concerning who can actually command the transferred resources. The general issue is the conversion from entity-level possession to participant-level capability. Where this conversion depends on internal relations, the entity boundary becomes an important part of the explanation rather than a neutral container.

Internal relations also shape the persistence of capacities. Knowledge can be distributed among workers and routines rather than stored in any single individual. Trust can be localized in teams. Authority can be centralized or dispersed. Care obligations can allocate time asymmetrically. Data can be accessible to some organizational positions and unavailable to others. These structures influence what an entity can do even when conventional balance-sheet or resource measures remain unchanged. A relational description therefore becomes useful when variation inside the entity explains variation in action, learning, adaptation, or access that entity-level quantities cannot capture.

The implication is a scope condition. Entity-centered analysis is strongest when internal heterogeneity does not materially affect the causal or evaluative question. Relational analysis becomes increasingly necessary as internal organization determines the conversion of nominal resources into effective capacities. This does not dissolve the entity. It adds a second analytical resolution at which the entity is reconstructed as a stabilized configuration of relations.

1.18.2 External Relations around Economic Entities

Economic entities also derive capacities from relations that cross their recognized boundaries. Suppliers, customers, creditors, regulators, professional communities, infrastructures, knowledge networks, platforms, and public institutions can alter what an entity is able to produce, access, learn, or survive. Entity-level resources therefore acquire economic meaning partly through the external relations that make those resources usable.

Granovetter's account of embeddedness provides a foundational statement of this problem by showing that economic action is situated in ongoing structures of social relations rather than occurring among atomized actors (Granovetter 1985). The analytical consequence is especially visible where trust, reputation, repeated interaction, or social position affect exchange. A firm with modest internal resources can occupy a highly advantageous position in a dense network of reliable partners, while a better-capitalized firm can remain constrained by weak access, low trust, or peripheral position. Entity attributes and relational position therefore provide distinct information.

Interorganizational production sharpens the distinction. Powell's analysis of network forms of organization identifies arrangements in which reciprocal communication and continuing exchange coordinate activity in ways that are poorly described as either discrete market transactions or internal hierarchy (Powell 1990). Section 1.8 used this literature to reconstruct the expansion of relational production. The present concern is analytical: once production depends on continuing interorganizational relations, a firm's productive capacity cannot be inferred from its owned assets alone. It also depends on the quality, accessibility, and durability of relations through which complementary capabilities are obtained.

Global value chains extend this structure across jurisdictions and organizational scales. Gereffi, Humphrey, and Sturgeon distinguish several governance forms whose emergence depends on transaction complexity, codifiability, supplier capability, explicit coordination, and power asymmetry (Gereffi et al. 2005). The relevant unit of analysis is therefore larger than any one firm. Lead firms, suppliers, standards, logistics systems, contractual practices, and technical interfaces together produce the conditions under which production occurs. An intervention directed toward one participant can propagate through this wider configuration.

External relations are also central to effective command over resources. Sen's entitlement analysis demonstrates that access to food cannot be inferred from aggregate availability alone because persons obtain command through production possibilities, trade opportunities, state entitlements, and other socially recognized channels (Sen 1981). The same analytical lesson generalizes cautiously: a resource can exist in the environment and remain economically inaccessible to an entity whose relational pathways to it are absent or blocked. Access is therefore a relational condition connecting resources to subjects.

This point becomes particularly important under digital and AI-mediated production. Access to compute, datasets, model interfaces, platforms, payment systems, professional networks, standards, and trusted intermediaries can determine the usefulness of nominally owned assets. External relations can also impose dependency: an organization may appear autonomous at the entity level while relying on a small number of infrastructural or platform relations for essential functions. Relational analysis reveals these conditions without requiring the abandonment of entity-level account-

ing.

The external limit of entity-centered analysis is reached when economically decisive capacities and constraints arise from position in a relational environment. At that point, the question changes from the quantity of resources held by an entity to the relations through which those resources become actionable, exchangeable, recognized, and reproducible.

1.18.3 Relations among Economic Relations

Economic systems frequently contain structures in which one relation changes the operation of another. These higher-order configurations cannot be represented fully by listing pairwise ties because the economically relevant object is the relation among relations. Credit conditions can alter employment relations; legal classifications can reshape market access; platform rules can mediate buyer–seller relations; professional standards can condition relations between expertise and institutional authority; and ownership structures can change how organizational decisions are connected to labor, investment, and distribution.

The distinction is easiest to see in mediated exchange. A buyer and seller can transact through a platform, yet the terms of their relation depend on a further relation between each participant and the platform. Visibility, ranking, payment, data access, dispute resolution, and reputation can all be mediated through this additional structure. The buyer–seller relation therefore changes when the platform’s rules or incentives change even if the two participants remain otherwise identical. The economically significant object is a configuration in which one relation governs, conditions, or transforms another.

Organizations contain similar higher-order structures. A manager’s authority over a worker may be conditioned by labor law, collective agreements, professional norms, internal grievance procedures, or algorithmic monitoring systems. A creditor’s claim may alter the relation between managers and investment decisions. A shareholder structure can influence how organizational surplus is connected to workers, suppliers, or research expenditure. These arrangements involve several relations whose interaction produces effects that no single dyad carries alone.

Network and value-chain research provides empirical settings in which such configurations become visible. Network forms coordinate relations among organizations through repeated exchange and reciprocal communication (Powell 1990), while global value-chain governance connects lead-firm coordination, supplier capability, standards, and power asymmetry within structured production relations (Gereffi et al. 2005). A relation can therefore become consequential because of the other relations in which it is embedded. The same supplier tie can generate learning in one network, dependence in another, and exclusion in a third.

This higher-order perspective also clarifies why institutional change can have broad economic effects without transferring resources directly. A change in legal recognition, reporting rules, standards, or eligibility criteria can modify the relations through which many other interactions occur. Section 1.5 showed that legal personality, accounting boundaries, statistics, and administrative recognition stabilize economic entities. The same institutional devices can restructure relations among those entities by changing who may contract, who bears liability, what counts as compliant performance, or which transactions are visible to regulators and counter-

parties.

Relations among relations create a methodological demand for explicit boundary and scale choices. An analyst can always enlarge the relational map, and no practical inquiry can include every connection. The relevant question is whether omitting a higher-order relation changes the explanation of the outcome under study. GRE therefore treats higher-order analysis as problem-dependent. It becomes warranted where the behavior of a focal relation varies systematically with the configuration of surrounding relations.

The resulting picture remains compatible with entity-level economics. Entities continue to matter as legal, administrative, and organizational condensations. The additional analytical layer concerns the architectures through which their relations are coupled. This layer becomes central whenever intervention in one relation changes the operation of others.

1.18.4 Downstream Effects of Economic Intervention

Entity-centered evaluation commonly begins with a defined intervention and a defined recipient: a transfer to a household, a subsidy to a firm, a loan to an organization, a tax on an income stream, or an investment in a public body. This structure is often appropriate for immediate incidence. Its generative limit appears when the intervention changes relations whose later effects extend beyond the initial recipient and evaluation horizon.

A resource transfer can generate several distinct downstream pathways. It may alter bargaining position, enable entry into a network, support education or training, change creditworthiness, reduce dependence on a particular employer, permit migration, create time for care or inquiry, or allow an organization to invest in standards and relationships that affect later collaboration. Two transfers with the same nominal value can therefore produce different trajectories because they enter different relational configurations.

The distinction between receipt and command is again useful. Sen's entitlement framework shows that resource outcomes depend on socially organized channels through which persons gain effective command (Sen 1981). In a generative setting, the question extends further: effective command at one moment can alter the channels available later. Access to credit can create a repayment record; access to education can change occupational networks; access to infrastructure can change market participation; access to a platform can generate data and reputation that affect future visibility. An intervention can therefore modify the relations through which later interventions or opportunities are converted into capability.

Downstream effects can also propagate across entities. Support to one firm may sustain suppliers, preserve specialized knowledge, alter local employment, or strengthen a technological standard. A procurement decision can reorganize a supply network. A platform rule can change incentives for thousands of participants. A financial intervention can alter expectations and counterparties beyond its formal recipient. The immediate recipient remains administratively important, while the causal object expands to include the relational pathways through which the intervention propagates.

Evaluation horizons shape whether these effects appear. A short-horizon assessment may correctly report immediate consumption, output, employment, or solvency

while omitting changes in learning, trust, dependency, network position, institutional access, or option availability that emerge later. Longer horizons create their own uncertainty and attribution problems. GRE therefore does not presume that downstream effects can always be measured precisely. It treats temporal extension as a question of analytical adequacy: when plausible downstream mechanisms are central to the intervention's significance, the evaluation should state which are included, which are excluded, and what evidential confidence attaches to them.

The same discipline applies to negative downstream effects. An intervention can create dependency, crowd out alternative relations, increase concentration, lock participants into proprietary infrastructure, or shift risk to actors outside the original evaluation boundary. Entity-centered accounting may record a local gain while relational analysis detects a redistribution of constraint elsewhere. Such cases are especially important when the initial recipient and the later bearer of cost are different entities.

Downstream analysis therefore changes the unit of evaluation from a recipient-state pair to a trajectory through a relational system. The intervention remains identifiable, and the recipient remains important, yet the relevant economic question includes what relations the intervention forms, strengthens, weakens, or redirects over time.

1.18.5 Transformation of Future Generative Conditions

The deepest limit of entity-centered analysis appears when economic activity changes the conditions under which future economic activity can be generated. At this point the object is no longer only a downstream outcome. It is the transformation of the relational, institutional, material, or epistemic conditions that structure later possibilities.

Capacity formation provides one route. A relation can generate skills, trust, organizational routines, infrastructure, or shared knowledge that later activities presuppose. Section 1.17 described these processes as generative because participation changes what subjects and institutions can subsequently do. The same logic applies to constraints. A relation can produce dependency, exclusion, standardized interfaces, proprietary lock-in, debt obligations, or institutional classifications that narrow later options. Generativity therefore includes the production of enabling and constraining conditions.

Institutional persistence amplifies these effects. Once a relational arrangement is stabilized through law, accounting, standards, administrative categories, or organizational routines, it can shape later transactions that were absent from the original decision. A financing rule can influence which organizations survive long enough to innovate. A credentialing system can determine who enters a profession. A platform's data architecture can shape later visibility and bargaining power. A property regime can influence which forms of cooperation or exclusion become ordinary. These structures operate as inherited conditions for actors who did not choose their initial form.

The transformation of future conditions is especially important for value and allocation. A present allocation can generate capacities that increase later access to resources, or it can support relations whose benefits circulate beyond the initial recipient. Conversely, a present extraction can weaken the relations required for future generation even when current output remains high. The later Parts of this book de-

velop these questions through relational allocation, heterogeneous value, generative return, spacetime, power, and justice. The historical argument of the present chapter is narrower: contemporary economic organization increasingly makes these future-conditioning effects difficult to treat as peripheral.

Artificial intelligence intensifies the issue because current arrangements can shape the distribution of future productive intelligence. Decisions about compute, data, model access, research infrastructure, intellectual property, standards, and institutional participation can influence which actors are able to learn from and contribute to later technological development. Immediate productivity effects are therefore only one dimension of the economic significance of AI-related investment and allocation. The configuration of relations around artificial productive capacity can alter the future distribution of capability itself.

A generative analysis also requires restraint. Future conditions are uncertain, relational pathways branch, and interventions can produce unintended effects. Strong claims about long-horizon generation therefore require stronger evidence than descriptions of present allocation. GRE's later methodology distinguishes association, enablement, contribution, co-generation, and stronger forms of attribution so that temporal extension does not become speculative license. The present section establishes only the analytical reason for asking the question.

The resulting scope condition can be stated positively. Entity-centered economics remains highly effective when the relevant outcomes are well represented by attributes of recognized entities within a specified horizon. Relational analysis becomes necessary when internal organization, external position, or higher-order relational structure materially affects those outcomes. Generative analysis becomes necessary when present relations transform the subjects, capacities, constraints, institutions, or possibilities through which later economic life unfolds. These analytical layers are complementary resolutions of economic reality rather than mutually exclusive schools.

This distinction completes the historical movement from the modern entity-centered order reconstructed in Sections 1.3–1.6 to the relational and generative problems made increasingly visible by globalization, digital mediation, artificial intelligence, symbolic abundance, and changing subjecthood. Sections 1.19 and 1.20 now turn from historical necessity to historical possibility: the scientific formalisms, computational resources, and analytical vocabularies that make more demanding relational and generative inquiry increasingly feasible.

1.19 Scientific Conditions for Relational Analysis

This section identifies the scientific conditions that have made relational economic analysis increasingly tractable. Its role in the chapter is historical and methodological: the preceding sections established why contemporary economic problems increasingly exceed an exclusively entity-centered description, while the present section asks which analytical developments make more explicit study of relations feasible. The objective is to specify a repertoire rather than to prescribe a single formalism. The discussion proceeds from dynamical systems and complex-systems approaches to network and higher-order representations, field-based descriptions, and multiscale or background-sensitive formalisms. Each subsection distinguishes the analytical pos-

sibility supplied by a scientific language from the stronger claim that economic reality literally possesses the ontology of the formal system used to describe it.

1.19.1 Dynamical Systems

Dynamical-systems theory enlarges economic analysis by making trajectory, stability, feedback, and qualitative change explicit objects of study. A static description records the state of an economic entity or relation at a selected moment. A dynamical description asks how that state changes, which states are reachable from it, which configurations persist after disturbance, and how local changes accumulate along a trajectory. The analytical language is mature across the natural and applied sciences, where nonlinear systems are studied through state spaces, flows, fixed points, periodic behavior, bifurcations, and sensitivity to initial conditions (Strogatz 2024). Its relevance to relational economics lies in the possibility of treating relations and relational configurations as time-indexed variables whose evolution matters to the economic outcome.

The gain is especially clear when a relation has memory. Employment relations accumulate experience and expectation; credit relations acquire repayment histories; supply relations generate specialized routines; platform relations accumulate reputation and data; institutional relations carry prior classifications into later access. A cross-sectional description can identify that a relation exists, while a dynamical description can ask how its present form depends on the path by which it was reached. The trajectory becomes economically relevant because two configurations that appear similar at one moment may respond differently to later disturbance when their histories have generated different capacities, expectations, or constraints.

Dynamical systems also provide a precise distinction between stability and value. Stability concerns how a configuration responds to perturbation. It does not establish that the configuration is efficient, just, desirable, or generative. This distinction is important for GRE because persistent economic structures can include durable cooperation, durable exclusion, resilient infrastructure, or resilient dependency. A dynamical description can characterize persistence without silently converting persistence into normative endorsement.

Nonlinearity further expands the range of analyzable relational phenomena. When the effect of one relation depends on the state of other relations, aggregate behavior may fail to equal a simple sum of isolated effects. Feedback can amplify or damp disturbances; thresholds can make similar interventions consequential in one configuration and negligible in another; interaction among several processes can produce regime changes absent from any component considered separately. Such possibilities matter in economies organized through interdependent firms, financial claims, standards, infrastructures, and institutional expectations.

The methodological contribution remains bounded. A dynamical model requires a defensible specification of states, variables, boundaries, and transformation rules. Social and economic systems also include reflexive subjects whose interpretation of a model can enter the subsequent dynamics. The availability of dynamical-systems theory therefore establishes a scientific possibility: economic relations can be studied as evolving configurations rather than as static background conditions. It does not by itself establish which dynamical representation is appropriate to a particular economic problem. That question belongs to model construction, evidence, and later

methodological chapters.

1.19.2 Complex Systems

Complex-systems research provides a second condition for relational analysis by directing attention to systems whose macroscopic behavior depends on interaction among heterogeneous, adaptive, and partially autonomous components. The relevant scientific shift is analytical rather than terminological. A system can display regularities at one scale that are difficult to infer from isolated components because interaction, feedback, adaptation, and boundary formation contribute to the collective pattern. Holland's work on complex adaptive systems, for example, treats signals, boundaries, and evolving organization as central to the behavior of systems ranging from biological organization to markets and governments (Holland 2012).

For economic analysis, this perspective weakens the presumption that explanation must begin and end with attributes of independently specified units. Firms can adapt to competitors and regulators; households respond to institutions and changing prices; standards alter which technologies are compatible; market participants learn from one another; organizations modify routines in response to observed outcomes. The state of one participant is therefore partly conditioned by a surrounding configuration that is itself changing in response to participants. Complexity-oriented analysis provides a vocabulary for studying this reciprocal dependence without requiring that every collective regularity be reduced immediately to a single representative agent or equilibrium condition.

The approach also makes heterogeneity analytically productive. Differences among actors in resources, expectations, information, capabilities, and network position can affect system-level behavior because interaction transmits and transforms those differences. Heterogeneity can produce clustering, specialization, segmentation, cascades, or uneven adaptation. In a relational economy, the distribution of positions can therefore matter as much as an average attribute. A system composed of actors with the same mean income, skill, or productivity can exhibit different dynamics when the relations among them differ.

Complex-systems approaches are particularly useful for distinguishing local rule from global pattern. A participant may act according to a relatively simple decision rule while the aggregate configuration exhibits persistence, volatility, concentration, or coordination that no participant designed. This possibility resonates with the historical argument developed earlier in the chapter. Modern economic institutions often generate structures whose consequences exceed the horizon of the actors participating in them. The scientific significance of complexity research is that such distributed generation can be represented and investigated without assigning the collective pattern to a central designer.

Adaptation introduces another important dimension. Economic actors respond to outcomes, and their responses alter the environment to which later actors adapt. The resulting feedback can change the effectiveness of a rule over time. A regulatory threshold, ranking metric, trading strategy, or recommendation system can have one effect before widespread adaptation and another after participants reorganize around it. Complexity-oriented analysis therefore encourages researchers to treat observation, strategy, and institutional response as potentially endogenous components of the system.

The term *complexity* can easily become too broad to discipline analysis. GRE therefore uses complex-systems language only when the local problem exhibits the relevant structure: interaction, heterogeneity, feedback, adaptation, multilevel organization, or emergent collective regularity. Complexity is a scientific resource for relational inquiry rather than an explanation by itself. Its historical importance lies in the development of formal and computational methods capable of treating interdependence as a primary analytical object.

1.19.3 Network and Higher-Order Models

Network science provides the most direct formal language for representing economic relations among identifiable entities. Nodes represent analytically specified units and edges represent specified relations among them. Once such a representation is justified, analysis can address connectivity, centrality, clustering, community structure, path length, assortativity, diffusion, robustness, and the interaction between network topology and dynamical processes. Newman's review of complex networks documents the development of these concepts across social, technological, and biological systems and emphasizes the study of both network structure and dynamics on networks (Newman 2003).

The relevance to economics is immediate because many economic phenomena already have relational form. Credit links connect borrowers and lenders; supply chains connect buyers and suppliers; ownership links connect shareholders and firms; labor mobility connects organizations; communication links connect teams; trade links connect jurisdictions; platform relations connect several participant groups through an intermediary. A network representation can therefore preserve relational information that disappears when each entity is summarized only by its own attributes.

Network models also make positional effects explicit. Two firms with similar observable resources can occupy very different positions in a supply network. Two researchers with similar individual capabilities can have different access to knowledge because their collaborative neighborhoods differ. Two households with similar income can face different opportunity structures because transport, care, credit, or social-support connections differ. In each case, an entity-level variable remains relevant, while network position adds information about the pathways through which resources, risks, information, and opportunities can move.

Pairwise networks have a clear limitation: many economic relations involve groups, institutions, or coordinated sets of participants whose effects cannot be represented adequately as collections of independent dyads. A project consortium, household, standards committee, cooperative, research team, or multilateral agreement can impose conditions on a group as a group. Higher-order network research has developed explicit representations for such cases through hypergraphs, simplicial complexes, and related structures. Battiston and colleagues survey this literature and show that interactions among three or more units can generate dynamical behavior that is not captured by pairwise links alone (Battiston et al. 2020).

Higher-order models are especially relevant to the GRE concern with relations among relations. A contract can depend on a regulatory institution; a supply relation can depend on a standard jointly maintained by several organizations; a worker's access to employment can depend on credentialing relations linking educational

institutions, professional bodies, and employers. Such structures can be flattened into pairwise edges, but flattening can erase the condition that the relevant effect exists only when several relations are jointly present. Higher-order representations make that joint dependence visible.

These models nevertheless remain representations. Nodes must be chosen, edges must be defined, interaction order must be specified, and the temporal stability of the representation must be justified. A legal entity, household, platform account, institution, or community can function as a node for one question and as an internally structured relational system for another. Network analysis therefore does not eliminate the boundary problem; it renders the boundary decision explicit and makes its consequences inspectable. This is a scientific advance because relational structure can be formalized, compared, and tested while preserving awareness that the graph is an analytical construction.

1.19.4 Field-Based Representations

Field-based representations become useful when economically relevant conditions are distributed across a domain and cannot be localized adequately in a finite set of isolated links. In mathematics and mathematical physics, field descriptions assign quantities to locations in a continuous or discretized domain and study how local states vary, interact, and propagate. Partial differential equations provide a developed formal language for representing such spatially or continuously distributed dynamics, including nonlinear propagation, diffusion, transport, and wave-like processes (Evans 2010). GRE draws from this scientific repertoire at the level of representation: some economic conditions may be better described as distributed environments than as attributes attached to individual entities.

Several economic objects have this character. Accessibility can vary continuously across geographic space; labor-market opportunity can depend on local density and transport; information exposure can vary across communication environments; regulatory intensity can differ across jurisdictions; trust or reputational climate can be unevenly distributed; infrastructure can create gradients of connection and cost. In such cases, the relevant condition surrounds many actors at once and changes the consequences of local relations. A field representation can encode this distributed context without assigning the whole effect to one neighboring entity.

Field language also helps distinguish a relation from the conditions under which the relation operates. The same contractual form can have different consequences in regions with different institutional capacity. The same amount of credit can generate different outcomes where market access differs. The same platform rule can affect participants differently when local alternatives, network density, or legal protections vary. Treating the surrounding condition as a field makes it possible to model systematic variation in relational effect across position.

The approach can be extended beyond geographic space when the relevant domain is abstract. A field can be defined over a state space, capability space, or other structured domain if distance and neighborhood have defensible meanings. Such constructions can represent how similar configurations experience similar pressures or how local changes propagate through a structured possibility space. Their usefulness depends on whether the chosen geometry captures an empirically meaningful relation rather than merely providing a visually attractive mathematical surface.

Field-based representation therefore carries a stronger burden of justification than ordinary metaphor. A model must specify what the field variable represents, what domain indexes it, what counts as locality, how interactions propagate, and how the representation connects to evidence. GRE's ontological suspension is important here. The success of a field model would show that a distributed representation is analytically productive for a given problem; it would not establish that an economy is literally a physical field. The scientific condition consists in the availability of mature mathematics for distributed, locally coupled systems and in the possibility of adapting that mathematics under explicit domain-specific assumptions.

1.19.5 Multiscale and Background-Sensitive Formalisms

Relational economic systems operate across several scales at once. Individuals participate in households, organizations, networks, institutions, markets, jurisdictions, and transnational systems; processes at each level can constrain or enable processes at others. Multiscale analysis supplies concepts for studying how organization, variation, and response differ across scale rather than assuming that one analytical resolution is sufficient. Bar-Yam's multiscale treatment of complex systems formalizes the idea that effective response depends on matching the scale of variation in a system and has been applied to biological and social organization (Bar-Yam 2004).

The economic importance of scale is visible in ordinary examples. A workplace policy can affect an individual immediately while altering organizational culture slowly. A local supply disruption can propagate into sectoral production when many firms share dependencies. A financial position can be safe at the level of one institution while contributing to correlated systemic exposure. A household decision can be rational under prevailing prices while repeated decisions across many households alter the market conditions on which those choices depended. Relational analysis therefore requires the ability to move among levels without presuming that a pattern observed at one scale can be transferred unchanged to another.

Multiscale formalisms also clarify why aggregation can both reveal and conceal. Coarse-graining can expose collective regularities invisible at the level of individual events, while the same operation can erase heterogeneity and local dependence that matter to causal interpretation. Disaggregation can recover local structure while making system-level constraints harder to see. The choice of scale is therefore part of the model rather than a neutral technical detail. A relational account should report which distinctions are preserved at the selected resolution and which are suppressed.

A related scientific development concerns formalisms in which the background against which dynamics unfold is itself allowed to vary. General relativity provides a paradigmatic case: spacetime geometry is dynamical rather than a fixed stage, and background-independent approaches in gravitational physics develop descriptions in which the geometry relevant to motion is part of the system being modeled (Rovelli 2004). GRE does not infer a social ontology from this physical result. The methodological significance is narrower: modern science contains coherent formalisms in which the structure conditioning local dynamics need not be treated as permanently external and fixed.

This possibility matters for relational economics because economic backgrounds are often historically produced. Market boundaries change; infrastructures are built and abandoned; legal categories are revised; standards alter compatibility;

platforms reorganize access; institutions modify the relations they regulate. A model that holds the surrounding structure fixed can be adequate over a limited interval, while a longer-horizon analysis may need the background itself to become variable. Section 1.20 develops this issue in generative terms by asking how states, relations, constraints, and transformation rules can coevolve.

Background sensitivity also disciplines comparison. A relation observed in one institutional setting may not preserve its effects when transplanted into another because the surrounding rules, infrastructures, histories, and scales differ. Formal models can represent this contextual dependence through parameters, boundary conditions, changing topology, or evolving geometry. The appropriate device depends on the problem. The common principle is that the relation cannot always be interpreted independently of the structure in which it is embedded.

The scientific opening described across this section is therefore plural. Dynamical systems make trajectories and stability analyzable; complex-systems approaches make interaction, heterogeneity, feedback, and adaptation central; networks and higher-order models represent explicit relational structure; field approaches represent distributed conditions; multiscale and background-sensitive formalisms permit analysis across levels and under changing contextual structure. None of these formalisms establishes GRE by itself. Together they change the historical feasibility of a relational economics by providing mathematical and conceptual languages in which relations can become explicit objects of analysis. Section 1.20 turns to the stronger problem of generativity, where the analytical task includes the endogenous transformation of the structures and rules through which later economic change occurs.

1.20 Scientific Conditions for Generative Analysis

This section identifies the scientific conditions that make generative economic analysis increasingly possible. Its role in the chapter is to move beyond the explicit representation of relations developed in Section 1.19 toward a stronger analytical problem: economic relations can change the structures, constraints, and transformation rules under which later economic activity occurs. The objective is to specify the scientific languages capable of representing this endogeneity without treating every historical change as an instance of one universal mechanism. The discussion proceeds through endogenous dynamics, structure-changing processes, path dependence, coevolution, and the evolution of transformation rules. The method is comparative and conceptual. It draws on evolutionary economics, institutional economics, path-dependent dynamics, and complex-adaptive-systems research to identify analytical possibilities that later GRE chapters may formalize more precisely.

1.20.1 Endogenous Dynamics

Generative analysis begins where the conditions of change enter the dynamics being studied. A model can describe an economic system dynamically while leaving its transformation law fixed: prices, quantities, employment, or network positions may change through time according to a stable rule. Such a model is already richer than a static comparison because it represents trajectories. Generative analysis asks a fur-

ther question. Economic activity can alter the conditions that shape later activity, so the variables governing subsequent change may themselves become endogenous to the history of the system.

Evolutionary economics supplies a developed precedent for this orientation. Nelson and Winter organize economic analysis around processes in which firm behavior, routines, search, innovation, and competitive selection jointly determine industrial change through time rather than around instantaneous optimization toward a predetermined equilibrium (Nelson and Winter 1982). The analytical importance of this move for GRE lies in its treatment of economic behavior and industrial structure as mutually consequential. Firms act within inherited routines and market conditions, yet search, innovation, imitation, investment, and differential survival can alter the distribution of routines and capabilities that later firms confront.

Endogeneity in this stronger sense can appear through several channels. Learning can change an actor's future response to a similar situation. Investment can create infrastructure that changes the feasible action set. Repeated exchange can build trust or dependency. Regulation can produce new categories to which future regulation refers. Platform participation can generate data that improve the platform's later matching or ranking capability. A subsidy can expand a technology sufficiently to lower its later cost, and the lower cost can alter subsequent adoption. In each case, present activity modifies a condition relevant to the next round of activity.

Institutional economics adds another level of endogeneity. North treats institutions as humanly devised constraints that structure political, economic, and social interaction while also developing an account of institutional change in which organizations, incentives, and accumulated choices affect the evolution of those constraints (North 1990). This creates an analytical loop important for GRE: institutions condition economic action, economic action generates incentives and organizational responses, and those responses can contribute to institutional persistence or transformation. The conditioning structure therefore belongs to the history of the system rather than remaining permanently external to it.

Endogenous dynamics should still be specified locally. Some constraints can remain effectively fixed over the time horizon of a study; some institutional changes arrive through exogenous shocks; some actor responses are well represented by stable rules. GRE therefore does not require every model to endogenize every background condition. The scientific condition established here is the availability of frameworks in which a conditioning variable can become part of the dynamics when the research question requires it. This possibility is the first step from relational description toward generative analysis.

1.20.2 Structure-Changing Processes

Generative economic processes can alter more than the values attached to a fixed set of variables. They can change the structure through which variables are related. A supply relation can be created or terminated; a firm can merge with another; a market can acquire a platform intermediary; a legal category can make a new organizational form available; an infrastructure investment can connect previously separated regions; a technological standard can render previously incompatible components interoperable. The analytical object is therefore sometimes a changing architecture rather than movement inside an unchanged architecture.

This distinction matters because parameter adjustment and structural change carry different implications. A fall in a transaction cost changes the strength of an existing relation. The creation of a new intermediary changes which relations exist and how other relations are routed. A wage increase changes the terms of an employment relation. The legal recognition of a new form of worker, firm, property, or digital asset can change the categories through which economic relations are constituted. Generative analysis requires formalisms capable of representing these alterations in topology, membership, boundary, rule, or institutional status.

Evolutionary approaches again provide an important scientific precedent. Nelson and Winter's framework treats technological and organizational change as processes in which variation, search, selection, and retained routines can alter the composition and behavior of industries over time (Nelson and Winter 1982). Complex-adaptive-systems research broadens the representational possibility by treating signals, boundaries, and hierarchical organization as structures that can themselves develop and reorganize (Holland 2012). These traditions differ in object and formal detail, yet both make structural transformation an analytical problem rather than a residual category for changes that a fixed-state model cannot absorb.

Network and higher-order models discussed in Section 1.19 can also be made generative when the relational topology evolves. Nodes may enter or leave; edges may form, strengthen, weaken, or dissolve; higher-order groups may assemble or fragment; network position can affect the probability of subsequent tie formation. The same principle applies beyond networks. Field boundaries can shift, institutional classifications can be rewritten, and the scales at which coordination occurs can change. The scientific requirement is a representation in which the structure at one time can influence, and be influenced by, the processes unfolding within it.

Structure-changing analysis also disciplines causal interpretation. When an intervention alters the architecture through which later effects propagate, the relevant causal question extends beyond the immediate response of a fixed system. The intervention may create new channels of diffusion, new dependencies, new exclusion boundaries, or new organizational capacities. Two interventions with identical short-term outputs can therefore generate different long-term trajectories when one leaves the surrounding structure unchanged and the other rewrites it. This distinction becomes central later in GRE's treatment of relational allocation and generative value.

1.20.3 Path Dependence and Historical Trajectories

Generative analysis requires historical trajectories because the effect of a present relation can depend on the sequence through which the current configuration was produced. Path dependence provides a scientific language for this dependence on prior development. Arthur's analysis of competing technologies shows how increasing returns can make early events consequential for later adoption and can produce lock-in under specified conditions (Arthur 1989). The contribution is methodological as much as substantive: a historically contingent event can matter because it changes the returns, expectations, compatibility relations, or learning environment confronting later choices.

A path-dependent account differs from a simple statement that history matters. The relevant claim identifies a mechanism through which earlier events alter later transition possibilities. Increasing returns, sunk investments, institutional comple-

mentarity, network effects, learning, or accumulated expectations can make the consequences of an action depend on when it occurs and on what has occurred before. A trajectory therefore contains information that a comparison of endpoints can lose.

Institutional development displays the same structure in a different register. North's account of institutional change emphasizes that existing institutions shape the incentives and organizations through which later change proceeds, giving institutional development a cumulative and historically conditioned character (North 1990). The implication for GRE is that economic relations can inherit constraints generated by earlier relations even after the original circumstances have disappeared. Ownership forms, labor classifications, accounting conventions, technical standards, transport networks, and financial infrastructures can continue structuring action because later investments and expectations have formed around them.

Historical trajectories also permit branching. A configuration can support several feasible continuations, and relatively small differences in timing, sequencing, or local interaction can direct development toward different regions of the possibility space. This does not require the claim that every historical outcome is radically contingent. Some paths are strongly constrained; others are open across a wider range. Generative analysis therefore benefits from distinguishing structural persistence, path dependence, branching possibility, and exogenous disturbance rather than placing all historical change under a single label.

For GRE, the importance of path dependence extends to value and subject formation. Skills acquired under one technological regime can shape access to the next. A reputation accumulated in one institutional setting can affect later credit or employment. A community's prior exclusion can constrain current participation even after formal barriers are removed. A platform's early relational centrality can attract further participants and data. The generative consequence of a relation is therefore partly temporal: it can modify the conditions under which later relations become possible, valuable, or difficult to escape.

Path dependence also has a methodological limit. Lock-in claims can be too easily inferred retrospectively from persistence alone. Arthur's mechanism depends on specific increasing-return processes rather than on the mere fact that one outcome endured. GRE should therefore identify the mechanism through which prior states affect later transition probabilities, costs, or available options. Historical narrative and formal path dependence can complement one another only when the connection between sequence and later constraint is made explicit.

1.20.4 Coevolution of States, Relations, and Constraints

A generative economic system can contain several mutually changing layers. Actor states change, relations among actors change, and the constraints governing those relations change. Treating these layers separately can be useful for local analysis, while longer-horizon explanation often requires their coevolution. The scientific challenge is to represent feedback across layers without assuming that one layer permanently determines the others.

Consider an employment system. Workers acquire skills and experience; firms reorganize tasks and technologies; labor-market relations alter bargaining positions and mobility; legal institutions revise classifications and protections; training systems respond to changing demand. Each layer conditions the others. A change in technol-

ogy can alter the value of a skill, which changes hiring patterns, which changes incentives for training, which changes the future distribution of skills, which can alter the technologies firms find profitable to adopt. A single state variable can describe one slice of this process, while a coevolutionary account follows the reciprocal modification of several kinds of structure.

The same logic applies to finance, platforms, and knowledge systems. Credit histories influence lending relations, lending relations shape investment, investment changes productive capability, and new capabilities alter future creditworthiness. Platform rules shape interaction, participant behavior generates data, data influence algorithmic ranking, and revised ranking changes participant behavior. Research institutions allocate attention and resources, resulting inquiry changes the stock of knowledge, and new knowledge changes which questions appear feasible or valuable. In each case, generative relations operate through recursive coupling among state, relation, and constraint.

Complex-adaptive-systems research supplies conceptual resources for such recursive organization. Holland's treatment of evolving signals and boundaries emphasizes that adaptation can occur through changing interactions and organizational structures rather than through movement of an isolated variable alone (Holland 2012). Evolutionary economics similarly treats behavior, search, capability, and competitive structure as historically linked processes (Nelson and Winter 1982). GRE draws from these approaches a methodological possibility: the object of explanation can be a coupled trajectory in which the units, relations, and constraints relevant to later behavior are partly generated by earlier behavior.

Coevolution also limits simple attribution. When several layers change together, a downstream outcome can be jointly generated by processes that are difficult to isolate as independent causes. A regulatory change may alter firm behavior only because technological capabilities have changed; a technological opportunity may matter only because institutions recognize a new organizational form; a new organizational form may diffuse only because financing relations support it. Generative analysis therefore requires language for contribution, enablement, mediation, and co-generation in addition to strong single-cause attribution. Later methodological chapters develop those distinctions explicitly.

The coevolutionary perspective remains compatible with analytical decomposition. Researchers can hold some layers fixed to study a local mechanism, compare periods in which one layer changes faster than another, or construct reduced models for particular questions. The crucial scientific advance is the ability to relax those simplifications when they become explanatorily consequential. States, relations, and constraints can be modeled as jointly historical objects rather than as permanently separated levels.

1.20.5 Evolution of Transformation Rules

The strongest form of generative analysis treats the rule governing change as historically variable. A conventional dynamical representation specifies how a current state is transformed into a later state under a given transition rule. Many economic applications can legitimately hold that rule fixed over the period of interest. A generative system can require another level of description when learning, institutional change, technological innovation, or reflexive adaptation modifies the rule through which

subsequent states are produced.

Economic routines provide a concrete illustration. Nelson and Winter treat organizational routines as persistent elements of firm behavior while also giving search and innovation a role in changing the routines and capabilities that shape later behavior (Nelson and Winter 1982). The analytical implication is subtle. A firm's current action may be generated by an inherited routine, while the outcome of that action can contribute to search, learning, imitation, or selection that changes the routine governing future action. The transformation process therefore has a history of its own.

Institutional rules exhibit a similar recursion. Property definitions, accounting standards, eligibility criteria, contractual forms, and regulatory classifications can shape economic action. Repeated use of those rules can generate disputes, workarounds, constituencies, complementary investments, or new information that later motivates rule revision. Once revised, the institution changes the mapping from economic circumstance to permitted or rewarded action. Institutional change is therefore generative in a stronger sense when it alters the rule through which later economic relations are constituted or evaluated.

Adaptive digital systems make this issue especially visible. A ranking or recommendation rule can be updated from observed behavior; participants then adapt to the updated rule; their adaptation generates new observations that affect subsequent updates. The operative transformation rule is consequently embedded in a feedback process. Economic analysis that treats the algorithm as a fixed parameter can be adequate for a short interval, while analysis of longer-run behavior may need to represent the update procedure, participant adaptation, and institutional oversight as part of the system.

The evolution of transformation rules marks the boundary between a merely dynamic account and the more demanding conception of generativity developed in this book. Generativity does not require that every transformation rule change continuously. It requires analytical openness to the possibility that present relations can modify the mechanisms, constraints, classifications, or rules through which future relations are produced. This is the scientific condition that later permits GRE to study economic spacetime as historically generative rather than as a fixed arena containing changing entities.

The section's five conditions can now be stated together. Endogenous dynamics make conditioning variables part of the process; structure-changing models allow relational architectures to evolve; path dependence gives prior trajectories causal relevance; coevolution links changing states, relations, and constraints; evolving transformation rules make the mechanisms of change themselves historical objects. These scientific resources do not yield a complete generative economics, and none supplies a universal formalism. They establish a historical possibility: contemporary economic analysis possesses increasingly developed languages for asking how economic activity changes the conditions of its own continuation. Section 1.21 turns from scientific form to computational capacity and asks what makes these richer representations practically analyzable at scale.

1.21 Computational Conditions of Contemporary Analysis

This section identifies the computational conditions that make the richer scientific representations introduced in Sections 1.19 and 1.20 practically analyzable. Its role is distinct from the previous two sections. Scientific formalisms establish that relational and generative structures can be represented; computational infrastructures determine whether those representations can be explored at useful scale, temporal resolution, and heterogeneity. The objective is to reconstruct a historical shift in feasible economic inquiry rather than to equate computational power with explanatory adequacy. The discussion proceeds from the expansion of computational capacity to large-scale simulation, dynamic network computation, agent-based and multiscale modeling, and emerging paradigms that make increasingly complex models differentiable, composable, and computationally tractable. Throughout, computational feasibility is treated as an enabling condition for inquiry rather than as evidence that a model is empirically correct.

1.21.1 Expansion of Computational Capacity

The first computational condition is the sustained expansion of the scale at which numerical procedures can be executed. Gordon Moore's 1965 observation concerning rapidly increasing component density in integrated circuits became a historical marker for a broader technological trajectory in which increasingly capable processors, memory systems, storage, networking, and software infrastructures reduced the cost of many forms of computation (Moore 1965). The significance for economic analysis lies less in any single hardware metric than in the resulting expansion of the model classes that can be investigated routinely.

Earlier analytical methods often benefited from strong reductions because computational constraints made large heterogeneous systems difficult to represent directly. Representative agents, aggregate state variables, stationary environments, sparse interaction structures, and short simulation horizons can all be theoretically justified in appropriate domains. They also reduce computational burden. As computational capacity expands, however, some reductions become choices rather than unavoidable technical necessities. Researchers can preserve more heterogeneity, maintain explicit interaction structures, examine longer trajectories, repeat analyses across parameter configurations, and compare several model specifications rather than committing immediately to a single reduced representation.

The increase in feasible computation changes the relation between model complexity and empirical discipline. A richer model can carry more of the structure that the research question considers consequential: multiple actor types, institutional rules, evolving networks, spatial structure, delayed effects, and several temporal scales. The same computational expansion also makes it easier to construct models whose internal complexity exceeds their evidential support. The historical opening is therefore double. More relational structure can be represented, while the space of underdetermined models also becomes larger.

Computation further changes the practice of uncertainty analysis. A model need not be examined at one parameter vector or under one deterministic scenario. Ensembles can explore sensitivity to initial conditions, stochastic shocks, behavioral rules,

boundary assumptions, and alternative institutional specifications. This makes uncertainty more explicit when the ensemble is designed around substantively meaningful alternatives. It can also create an appearance of comprehensiveness when the sampled alternatives omit the main source of uncertainty. Computational abundance expands the set of questions that can be asked; it does not decide which uncertainties deserve representation.

For GRE, the main historical consequence is that relational detail has become less dependent on analytical compression than in earlier computational environments. A model can increasingly retain the identity of several classes of relations, preserve temporal ordering, and follow feedback across scales. This capacity does not remove the need for abstraction. It changes the reason for abstraction: simplification should be defended by the analytical role it serves rather than by computational necessity alone.

1.21.2 Large-Scale Simulation

Simulation provides a second computational condition because it allows researchers to investigate systems whose aggregate consequences are difficult to derive analytically from local rules. Epstein and Axtell's *Growing Artificial Societies* provided an influential demonstration in the social sciences by constructing artificial populations in which macro-level patterns emerge from repeated interaction among heterogeneous agents (Epstein and Axtell 1996). The methodological importance of this approach lies in the ability to make an explicit set of micro-level rules generate a trajectory that can then be inspected, perturbed, and compared with alternatives.

Large-scale simulation is especially useful when a research question concerns interaction effects. A rule governing one actor may have little meaning in isolation because its consequences depend on the simultaneous behavior of many others. Credit defaults can propagate through balance-sheet relations; supply interruptions can move through production networks; migration decisions can alter local opportunity structures; institutional rules can induce adaptation that changes the effect of the rule itself. Simulation permits these interactions to be represented as processes rather than collapsed immediately into an equilibrium condition or comparative-static result.

The growth of computational capacity also makes repeated simulation more important than a single illustrative run. A stochastic model can be executed across many seeds; a parameterized model can be explored across ranges; several institutional designs can be compared under the same disturbance; rare but consequential trajectories can be searched for rather than assumed absent. Such ensembles are particularly relevant to generative analysis because the object of interest may be a distribution of possible trajectories, the frequency of transition between regimes, or the conditions under which a local perturbation produces a system-level effect.

Simulation also supports counterfactual reasoning under explicit assumptions. A model can compare a historical baseline with altered network structure, different access rules, alternative timing, or modified institutional constraints. The comparison is valuable because it forces the counterfactual mechanism to be stated operationally. Its evidential standing remains conditional. A simulated counterfactual shows what follows within the model from the altered assumptions; it does not establish that the real economy would have followed the same path. Calibration, validation, historical

plausibility, and comparison with observed trajectories remain separate tasks.

This distinction is essential for GRE. Simulation can make generative hypotheses visible by showing how a proposed relational mechanism could produce a downstream configuration. It can also reveal that an intuitively plausible mechanism fails to generate the expected effect once interactions and feedback are made explicit. Both outcomes are useful. Neither converts synthetic output into empirical confirmation. Computational simulation is therefore best understood as a controlled environment for mechanism exploration, sensitivity analysis, and the comparison of possible trajectories.

1.21.3 Dynamic Network Computation

Network analysis becomes more powerful when computation can follow relations that change through time. A static network records a topology for a selected interval. Many economic relations, however, form, dissolve, recur, switch direction, or change weight. Temporal-network research formalizes this problem by representing contacts or ties with explicit timing and duration, making the order of interactions part of the analytical object (Holme and Saramäki 2012). The computational condition is important because temporal ordering substantially enlarges the information required to describe a network and the number of possible paths through it.

Dynamic network computation changes several familiar economic questions. In finance, the relevant exposure structure can evolve as positions are opened and closed. In production, suppliers can be replaced, duplicated, or vertically integrated. In labor markets, workers move among organizations and carry skills and information across firm boundaries. On digital platforms, recommendation, ranking, and participant behavior can change the effective network on a much shorter timescale. The economic consequence of a relation can therefore depend on when it exists, what preceded it, and which other relations are simultaneously active.

Temporal computation also makes path-sensitive diffusion analyzable. A sequence of edges can transmit information, liquidity, disruption, reputation, or opportunity only when their timing permits the sequence to occur. Two networks with the same aggregate number of edges can support different propagation because the edges appear in different orders. This matters for GRE because the generative effect of a relation may depend on whether it arrives before or after a complementary capability, institutional recognition, or competing pathway has formed.

The same computational logic extends to networks whose topology coevolves with behavior. Participants can create or sever relations in response to outcomes, and those relational changes alter later incentives. A supplier may diversify after disruption; a lender may reduce exposure after loss; a platform participant may migrate after changes in ranking; a research group may form new collaborations after acquiring a technique. Computation permits the network itself to become an endogenous state variable rather than a fixed background for action.

Dynamic network models nevertheless inherit the representational limits described earlier. The existence of a time-stamped edge still depends on a definition of the relation, a boundary around the system, and data that capture the relation with sufficient resolution. Computational tractability cannot recover relations that were never observed, distinguish causal influence from coincident timing by itself, or decide whether a higher-order configuration should be represented as several edges

or as a distinct collective relation. The historical advance is the capacity to compute with changing topology; the epistemic burden of defining and validating the topology remains.

1.21.4 Agent-Based and Multiscale Modeling

Agent-based computation provides a fourth condition by permitting heterogeneous actors, local rules, institutional constraints, and interaction structures to coexist within one executable model. Agent-based computational economics explicitly developed this possibility as an alternative way to study decentralized economic systems whose aggregate behavior is generated through interaction, learning, strategic adaptation, conventions, organizations, and institutional arrangements (Tesfatsion 2006). The approach complements the complex-systems perspective of Section 1.19 by giving the interacting components an operational computational representation.

The value of agent-based modeling for GRE lies in the ability to preserve heterogeneity that may be generatively consequential. Workers can differ in skills and network position; firms can differ in routines and financing; households can differ in obligations and access; institutions can impose different rules across categories; artificial agents can possess capabilities unavailable to human participants. These differences can be represented together with local interaction rules, allowing the analyst to ask whether macro-level concentration, segregation, coordination, instability, or capacity formation emerges from the specified configuration.

Agent-based representation does not require an ontological commitment to isolated atomic individuals. An “agent” can be an analytical object whose behavior is partly constituted by relational position, organizational membership, inherited resources, institutional classification, or internal state. Organizations, households, collective bodies, and algorithmic systems can also be represented as agents at appropriate scales. The computational framework is therefore compatible with a relational account so long as the model does not treat the agent’s attributes as independent of the relations the theory claims are constitutive.

Multiscale modeling extends the same logic when economically relevant processes operate at different resolutions. Local transactions can occur rapidly, organizational routines can change more slowly, institutions can evolve over longer intervals, and infrastructure can impose constraints across several scales. A computational model can couple these layers explicitly, allowing fast processes to generate inputs into slower processes and slower structures to condition the space within which faster interactions occur. Such coupling is particularly important for the fast–slow historical perspective developed elsewhere in GR, while GRE need not assume that every economic system admits a clean separation of timescales.

The difficulty lies in validation. A model that includes heterogeneous agents, networks, institutions, and several scales can fit many qualitative patterns for many different reasons. More computational detail can increase realism in one dimension while reducing identifiability overall. Agent-based and multiscale models therefore require careful documentation of which mechanisms are load-bearing, which parameters are calibrated, which structures are empirical, and which are exploratory. Their historical significance is that such questions can now be investigated computationally with far fewer reductions than before; their scientific standing still depends on evidence and comparative model evaluation.

1.21.5 Emerging Computational Paradigms

Contemporary computation is also changing the form of modeling itself. One important development is automatic differentiation, which evaluates derivatives of computer programs efficiently and has become a central component of modern machine-learning systems and differentiable programming (Baydin et al. 2018). The broader significance is that increasingly complex computational pipelines can be treated as composable objects whose parameters may be estimated, optimized, or linked to inference procedures without requiring every derivative or intermediate transformation to be derived manually.

For relational and generative analysis, this opens several possibilities. A simulation can be connected to parameter estimation; a network process can be embedded within a larger model; a surrogate model can approximate a computationally expensive component; and an end-to-end pipeline can propagate information across several stages. These possibilities reduce the technical distance between formal specification, simulation, estimation, and sensitivity analysis. They also make it easier to construct hybrid models that combine institutional rules, network dynamics, statistical components, and learned functions.

Parallel and distributed execution further alters the feasible scale of inquiry. Rather than treating a simulation as a single sequence of calculations, researchers can divide parameter sweeps, Monte Carlo replications, network partitions, or independent scenarios across many processors or machines. Accelerator-based computation makes some matrix- and tensor-intensive models practical at scales that would previously have been prohibitive. Cloud infrastructures can make such resources available without local ownership of equivalent hardware. These developments broaden access to some forms of computation while also introducing new dependencies on software ecosystems, specialized hardware, infrastructure providers, and technical expertise.

Machine-learning methods introduce another change by allowing components of a model to be estimated from data when an explicit functional form is unavailable or deliberately left flexible. This can support prediction, emulation, dimensionality reduction, or the approximation of expensive simulations. It can also weaken interpretability when learned components become more complex than the mechanism the model was intended to clarify. GRE therefore treats learned components as one computational resource among others. Their use should follow the epistemic role of the model: prediction, mechanism reconstruction, counterfactual exploration, or decision support impose different requirements on transparency and validation.

The emergence of these paradigms does not imply convergence toward a single computational methodology. Some economic questions remain best served by transparent low-dimensional models; others benefit from simulation, networks, agent-based systems, or learned approximations. The historical change lies in the expansion of feasible combinations. Formal components can increasingly be composed, differentiated, simulated, and compared within one computational environment. This makes generative relational questions more tractable while also making model governance, reproducibility, provenance, and infrastructure dependence more important.

The five conditions developed in this section define a computational opening rather than a computational solution. Expanding capacity permits richer representations;

large-scale simulation explores interaction and counterfactual trajectories; dynamic network computation follows changing relations; agent-based and multiscale models preserve heterogeneity across levels; and emerging paradigms make complex computational systems increasingly composable. None resolves the evidential problem of whether the modeled relations correspond to the world. Section 1.22 therefore turns from computational feasibility to evidential conditions: the data infrastructures, longitudinal records, continuous observation, and distributed evidence systems through which relational and generative claims may be confronted with empirical traces.

1.22 Evidential Conditions of Contemporary Governance

This section identifies the evidential conditions that make more adaptive forms of economic governance and institutional decision-making increasingly feasible. Its role in the chapter is narrower than a general theory of governance. The objective is to reconstruct how changes in data production, longitudinal linkage, distributed observation, evidence updating, and feedback-oriented decision processes alter the practical possibility of following relational and generative economic processes through time. The discussion proceeds from continuous data collection to longitudinal infrastructures, distributed sources of observation, iterative evidence revision, and adaptive decision processes. The method is historical and institutional: the section treats contemporary evidence infrastructures as enabling conditions for GRE while preserving the distinction between evidence, interpretation, judgment, and legitimate action.

1.22.1 Continuous Data Collection

A first evidential condition is the movement from episodic measurement toward more continuous forms of observation. Traditional censuses, surveys, audits, and periodic administrative reports remain indispensable because they are designed around explicit statistical purposes and can provide carefully structured observations. Contemporary public sectors, however, increasingly operate alongside administrative databases, digital service records, transaction logs, sensor streams, platform traces, and machine-generated records that are produced as part of ongoing activity. The World Bank's 2021 account of public-intent data explicitly includes administrative, census, survey, citizen-generated, and machine-generated sources and emphasizes their roles in policy design, execution, monitoring, and evaluation (World Bank 2021). The OECD similarly describes a data-driven public sector as one in which data become an integral resource for policy making, service delivery, organizational management, and innovation (Ooijen et al. 2019).

The methodological change is temporal as much as quantitative. A periodic observation compares a small number of states separated by an interval. A more continuous evidential infrastructure can preserve intermediate changes, timing, sequence, and recurrence. This matters for relational analysis because a relation can form, weaken, reverse, or disappear between conventional observation points. It matters even more for generative analysis because the sequence through which capacities, constraints, and institutional responses develop may be part of the explanation. A record of endpoints can show that a transition occurred; a denser temporal record

can sometimes reveal the pathway through which it occurred.

Continuous observation also changes the practical relation between evidence and intervention. When evidence arrives only after a long reporting cycle, institutions often evaluate effects retrospectively. When administrative or operational indicators are updated more frequently, deviations can become visible during implementation. Such visibility does not by itself determine whether a deviation matters, whether the underlying measure is valid, or whether action should follow. It changes the feasible timing of inquiry. Institutions can potentially distinguish a transient fluctuation from a persistent change sooner, compare the development of several trajectories, and identify where additional investigation is needed before the end of an intervention cycle.

The increase in observational frequency introduces corresponding risks. Data generated continuously are often generated for operational rather than analytical purposes. Definitions can change as software, eligibility rules, administrative procedures, or institutional priorities change. Missingness may become systematic because participation in digital systems is unequally distributed. High-frequency measurement can also encourage attention to what changes rapidly while slower structures remain difficult to observe. A rich stream of immediate indicators may therefore produce an evidential bias toward fast variables precisely when the economic process of interest depends on institutional, demographic, ecological, or cultural variables that move more slowly.

Continuous data collection should therefore be treated as an expansion of temporal access rather than as complete observation. It increases the density of traces available to analysis while leaving unresolved questions of validity, provenance, representativeness, privacy, and interpretation. For GRE, its historical significance lies in making trajectories easier to reconstruct. The evidential object can increasingly become a process unfolding through time rather than a pair of states compared before and after an event.

1.22.2 Longitudinal Evidence Infrastructures

The second condition is the development of infrastructures capable of relating observations across time. Longitudinal evidence differs from repeated measurement when records can be connected to persons, organizations, places, programs, institutions, or relational configurations in ways that preserve temporal continuity. The analytical gain is substantial. Repeated cross-sections reveal population-level change; longitudinal systems can additionally show trajectories, persistence, transitions, and heterogeneous sequences within the changing population.

Contemporary data-governance initiatives increasingly recognize integration and linkage as institutional questions rather than purely technical tasks. The World Bank's *World Development Report 2021* develops the idea of an integrated national data system in which data production, exchange, and use are connected across public institutions and, under appropriate arrangements, with academic, private-sector, civil-society, and individual participants (World Bank 2021). The OECD's account of a data-driven public sector likewise emphasizes data governance across the public sector rather than isolated use within single agencies (Ooijen et al. 2019). These developments create the possibility of observing economic processes whose relevant evidence is distributed across organizational boundaries.

Longitudinal linkage is especially important for generative questions because effects can appear after substantial delay. An educational intervention may affect labor-market position years later; infrastructure can alter patterns of firm formation only after complementary investments accumulate; institutional recognition can affect credit access, organizational survival, or intergenerational opportunity over long horizons. A short evaluation window may correctly measure immediate outputs while missing later relational or capacity effects. Longitudinal evidence creates the possibility of following these effects without assuming that the value of an intervention is exhausted by its first measurable consequence.

The same infrastructure also supports the analysis of path dependence. If later outcomes depend on the sequence through which earlier states were reached, an evidential system must preserve more than current status. It must retain enough historical structure to distinguish trajectories that end at similar observed states but arrive there through different institutional histories. This requirement links evidence design to the historical arguments developed in Section 1.20: path dependence is analytically meaningful only when the history required to identify the path has been preserved.

Longitudinal evidence is therefore inseparable from institutional memory. Data definitions, identifiers, classifications, and access rules must persist long enough for records to remain comparable, or their changes must themselves be documented. A category that changes meaning over time can create false continuity when the same label is treated as stable. Conversely, a change in classification may be evidence of institutional transformation rather than a nuisance to be harmonized away. The evidential infrastructure must preserve both observations and the history of the categories through which those observations were produced.

This point is central to GRE's emphasis on future re-epistemization. Evidence retained for one analytical purpose may later be revisited under different concepts or methods. Longitudinal infrastructure therefore has a generative epistemic function of its own: it preserves the possibility that future inquiry will reconstruct present processes differently. The value of preservation is not limited to improving current prediction. It also maintains future access to historical relational structure.

1.22.3 Distributed Observation

A third evidential condition is the distribution of observation across many institutions and forms of participation. Economic reality is rarely observed from a single point. Tax administrations, statistical offices, regulatory agencies, firms, financial institutions, researchers, civil-society organizations, households, digital platforms, sensors, and citizens can all produce traces relevant to the same economic process. The World Bank describes the contemporary data-governance ecosystem as extending beyond government to the private sector, civil society, academia, and other actors, and it emphasizes the institutional problem of enabling data to be combined and exchanged while safeguarding rights, security, and integrity (World Bank 2021).

Distributed observation matters because different observers have access to different manifestations of the same relational system. Administrative records may reveal recognized membership and formal transfers. Surveys may reveal experiences and expectations that administrative systems do not record. Transaction data may reveal realized exchanges with high temporal resolution. Qualitative fieldwork may reveal

meanings and informal relations that standardized records cannot represent. Citizen-generated evidence can make visible local conditions that centralized institutions observe poorly. None of these sources provides a neutral view from nowhere; their combination can nevertheless reveal discrepancies that would remain invisible within a single evidential regime.

The analytical opportunity is therefore triangulation across positions. When several sources converge despite different production processes, confidence in some claims may increase. When they diverge, the divergence can become substantive evidence. A statistical indicator may report stable service delivery while interview evidence documents changing barriers to access. Administrative records may show formal program participation while transaction data reveal that effective use is concentrated among a subset of recognized participants. The discrepancy may indicate measurement error, category mismatch, selective observation, or a genuine difference between formal recognition and realized relation.

Distributed observation also introduces a relational problem among evidence producers themselves. Data are generated under different mandates, incentives, legal constraints, business models, technical standards, and temporal rhythms. Combining them requires interfaces: shared identifiers, interoperable formats, provenance records, agreements over access, and institutions capable of resolving conflict among sources. Evidence infrastructure is therefore itself a relational system. Its architecture influences which observations can be connected, which remain isolated, which actors gain interpretive authority, and which absences become structurally persistent.

This makes evidential plurality both a strength and a governance challenge. A system with many observers can reduce dependence on one institutional viewpoint, yet concentration in key infrastructures can create new forms of asymmetry. Platforms with privileged access to behavioral data may see relations unavailable to public institutions or researchers. Public agencies may possess administrative authority that makes their classifications consequential even when alternative descriptions exist. Communities may hold contextual knowledge that has little institutional standing. The distribution of evidence production is consequently linked to the distribution of epistemic power, a theme developed more fully in later parts of the book.

For GRE, distributed observation expands the possibility of reconstructing relational reality from multiple manifestations. It also reinforces ontological and epistemic restraint. Agreement among sources can strengthen an inference; disagreement can reveal the dependence of representation on institutional position. The existence of many observations does not eliminate the inverse problem of moving from manifestations to the relational structures that generated them.

1.22.4 Evidence Updating

The fourth condition is the institutional capacity to revise evidential judgments as new information becomes available. Evidence-informed policy making is defined by the OECD broadly enough to include statistics, data, research evidence, and evaluation in decisions to plan, implement, and, where relevant, alter public policies and programs (OECD 2020a). This formulation is important because it treats evidence as part of an iterative process rather than as a single justificatory input delivered before action begins.

Updating has several analytically distinct forms. New observations can change estimates within an existing model. They can reveal that a previously measured relation has weakened or reversed. They can expose a missing variable, a classification error, or a boundary condition that the original analysis omitted. In stronger cases, evidence can undermine the representation itself and require a change of model, category, or theory. GRE's generative perspective makes the last possibility especially important because the system under study may change the relations that made an earlier model adequate.

An updating infrastructure must therefore preserve revision rather than merely replace earlier states of knowledge. Versioned datasets, documented methodological changes, model histories, evaluation reports, and explicit records of revised assumptions allow later researchers to reconstruct why a decision or interpretation changed. Without such provenance, an institution can update its current estimate while losing the history of its own learning. The result is a paradoxical form of informational abundance in which current dashboards improve while the trajectory of interpretation becomes harder to recover.

Evidence updating also requires a distinction between evidential revision and automatic policy response. An estimate can change without changing the relevant decision because the difference is too small, the intervention is costly to reverse, normative commitments constrain the available actions, or several evidential sources point in different directions. Conversely, a modest evidential change can become decision-relevant when a system is close to an institutional threshold or when delay carries large costs. Evidence informs judgment; it does not mechanically substitute for judgment.

This distinction becomes more important when evidence arrives at different frequencies. Operational indicators may update daily, survey estimates quarterly, fiscal data annually, and structural outcomes only over several years. Treating every update as equally decision-relevant would allow high-frequency indicators to dominate simply because they arrive more often. A generative-relational approach instead asks which timescale corresponds to the process being governed and whether the evidence updates the fast state, the slower relational architecture, or the assumptions linking the two.

The scientific significance of evidence updating is therefore deeper than responsiveness. It institutionalizes revisability. A governance system capable of learning from new evidence can revise representations, evaluations, and interventions without assuming that the original model was final. This does not guarantee learning; institutional incentives can suppress inconvenient findings, methods can remain locked into outdated categories, and rapid updating can amplify noisy indicators. It creates a historical possibility for governance to remain epistemically open while acting under incomplete knowledge.

1.22.5 Adaptive Decision Processes

The fifth condition is the incorporation of feedback into decision processes. The OECD's policy framework on public governance describes monitoring information as a resource that can feed decision-making, track implementation, and support adjustment, and it emphasizes feedback loops and evaluation across the policy cycle (OECD 2020c). Its cross-country work on policy evaluation likewise treats evaluation

as a source of accountability, learning, and improved decision-making rather than as a purely retrospective exercise (OECD 2020b). These institutional practices make it increasingly feasible to treat some interventions as revisable processes rather than fixed decisions followed by a single final assessment.

Adaptive decision processes are especially relevant where causal structure is uncertain and the consequences of intervention unfold over time. An institution can begin with a provisional model, monitor selected consequences, compare observed and expected trajectories, revise the model, and alter the intervention when predefined or deliberately assessed conditions are met. The practical logic resembles the research-practice relation developed later in this book: action generates evidence, evidence revises understanding, and revised understanding changes subsequent action.

Adaptation requires more than frequent data. The evidence must arrive in a form that can be interpreted relative to the decision. Institutions need authority to revise implementation, procedures for recording why revisions occur, and safeguards against the continuous redefinition of objectives in response to short-term indicators. An adaptive process also needs temporal discipline. Some interventions require enough time for effects to emerge; premature adjustment can prevent the very relation being evaluated from stabilizing. Other interventions create rapidly compounding harms for which delayed response is costly. The appropriate update interval is therefore a property of the intervention and the relevant dynamics rather than a universal preference for faster feedback.

Reversibility further conditions adaptation. When an action can be adjusted at low cost, institutions can learn through incremental changes more readily. When interventions alter legal status, infrastructure, ecological conditions, or long-horizon expectations, later correction may be partial or impossible. In such cases, evidence updating still matters, but adaptive governance must operate through staged commitments, safeguards, contingency planning, or more demanding *ex ante* justification. The availability of real-time evidence does not make irreversible action experimental in the same sense as a reversible pilot.

Adaptive decision processes also remain normatively and politically situated. Evidence can indicate consequences and uncertainty; it does not decide which consequences deserve priority, whose losses require protection, or which distributions are acceptable. These questions lead directly to Section 1.23, which examines the political and normative conditions under which relational governance becomes institutionally meaningful. The evidential architecture developed here supplies information for decision; it does not supply the legitimacy or normative ordering of the decision itself.

The historical opening is therefore specific. Contemporary institutions can increasingly observe economic processes at higher frequency, connect evidence across time and organizations, revise interpretations as evidence accumulates, and alter some decisions during implementation. These capacities make relational and generative governance more technically conceivable because trajectories and feedback can enter institutional practice. They also expose new problems of surveillance, data concentration, representational power, model dependence, and temporal mismatch. GRE treats this evidential expansion as a condition of possibility for adaptive economic analysis and action, while retaining the distinction between observing a generative system and possessing the knowledge or authority required to control it.

1.23 Political and Normative Conditions of Relational Governance

This section identifies the political and normative conditions that have made relational questions increasingly admissible within economic governance. Its role in the chapter is historical and disciplinary: Sections 1.19–1.22 reconstructed scientific, computational, and evidential capacities, whereas the present section concerns the standards by which institutions decide whose relations, capabilities, interests, and temporal claims enter the field of evaluation. The objective is to show how political participation, human-rights recognition, capability-oriented development, commons governance, and environmental or intergenerational normativity widened the range of economically relevant objects beyond administratively isolated recipients and contemporaneous outputs. The discussion proceeds through those five developments in sequence. Its method is reconstructive rather than prescriptive. The section treats these traditions as historical conditions that make relational governance thinkable and institutionally legible; systematic governance theory remains outside the scope of this chapter and is reserved for later GRE interfaces with Generative Relational Governance.

1.23.1 Political Participation

Political participation changes the position from which governance problems are formulated. An administrative model can treat persons primarily as recipients, taxpayers, employees, consumers, regulated entities, or statistical units. Participatory arrangements introduce an additional status: persons and organized groups can enter the process through which public problems, priorities, and institutional responses are interpreted. This change matters for relational analysis because affected parties often possess information about dependencies, informal practices, exclusion mechanisms, and downstream effects that remain weakly represented in administrative categories.

The institutionalization of participation as a governance concern is visible in twentieth-century rights instruments. Article 25 of the International Covenant on Civil and Political Rights recognizes for citizens the right and opportunity to take part in the conduct of public affairs, directly or through freely chosen representatives, alongside electoral and public-service rights (United Nations General Assembly 1966). The significance for the present argument lies in the formal recognition of participation as part of the structure of public affairs. Governance is thereby evaluated partly in terms of relations between institutions and those subject to, represented within, or participating in public decisions.

Participation also alters the evidential architecture described in Section 1.22. Distributed observation acquires a political dimension when experiences and local knowledge enter institutional deliberation through hearings, consultation, representative bodies, associations, unions, community organizations, or other channels. Administrative evidence can reveal formally recorded transfers and statuses; participants can identify how those arrangements operate in practice. A benefit formally available to all eligible persons may be difficult to obtain because of language, time, location, documentation, digital access, stigma, or dependence on intermediaries. These conditions are relational because the effective outcome depends on the config-

uration linking claimant, institution, infrastructure, and other actors.

The analytical value of participation therefore extends beyond preference aggregation. Participants can contest the definition of the object itself. A housing problem may be framed as insufficient units, insecure tenure, spatial exclusion, financing constraints, discriminatory access, or inadequate transport relations. Each formulation identifies a different relational structure and therefore a different possible intervention. Participatory processes can expose these competing formulations before an administrative category becomes fixed as the sole representation of the problem.

Participation also has clear limits. Access is uneven, organized interests possess different resources, participation can be costly, and institutional forums can reproduce existing asymmetries. A meeting or consultation does not establish that every affected relation has become visible. Nor does participation remove the need for expertise, legal authority, or accountable decision. For GRE, the historical importance of participatory norms is more specific: they weaken the assumption that the economic object of governance can be fully specified from the administrative center before those situated within its relational field are heard.

This condition matters especially for generative questions. The long-run effects of an intervention may include changes in trust, capability, dependency, organizational learning, and future access. Such effects often appear first in the experiences of participants rather than in the primary output metric. Political participation creates institutional channels through which some of these effects can become objects of public interpretation and later evidence.

1.23.2 Human Rights and Institutional Recognition

Human-rights frameworks provide a second condition by institutionalizing forms of recognition that are not exhausted by economic role. The Universal Declaration of Human Rights states that everyone has a right to recognition everywhere as a person before the law and articulates equality before the law among its foundational guarantees (United Nations General Assembly 1948). The present chapter does not derive a complete normative theory from these provisions. Their historical significance for GRE lies in the expansion of institutional standing: a person enters governance as a bearer of recognized claims whose relevance cannot be reduced to ownership, productivity, income, contractual position, or contribution to measured output.

This development complicates purely recipient-centered economic description. A transfer system can be efficient in reaching a target population while still affecting privacy, family relations, freedom of association, legal recognition, or access to remedy. A labor arrangement can increase output while altering dependence, voice, or exposure to arbitrary exclusion. A data infrastructure can improve administrative coordination while creating new asymmetries in visibility and classification. Once recognized rights become part of the institutional environment, these dimensions become relevant constraints on the design and evaluation of economic governance.

Institutional recognition is itself relational. A right requires more than the internal possession of an attribute by an isolated individual. Its practical effect depends on relations among the person, legal rules, administrative bodies, courts or review mechanisms, documentation systems, and other actors capable of honoring or violating the recognized claim. Formal recognition can therefore be represented as a stabilized institutional relation whose effectiveness varies with access, enforcement,

and the organization of remedies. This does not reduce rights to economic relations; it clarifies why rights matter to economic institutions even when their normative foundation is external to economics.

The distinction is especially important for heterogeneous subjects. Section 1.16 separated economic subjecthood from final metaphysical or moral personhood. Human-rights traditions reinforce the need to preserve that separation. Economic systems may assign roles to persons, organizations, or artificial agents for purposes of contract, production, or allocation, while normative and legal standing follows different criteria. GRE therefore requires care whenever economic functionality is used as a proxy for broader status. Productive capacity does not settle legal recognition, and administrative recognition does not settle moral standing.

Human-rights frameworks also expand the temporal stability of claims. Economic positions can change rapidly: employment can end, assets can be lost, and market participation can fluctuate. Rights-based recognition is designed to persist across many such changes. This creates an institutional layer whose continuity can constrain short-horizon optimization. From a generative perspective, such continuity can affect future options by preserving access to institutions, remedies, participation, and protections during periods of economic transition.

The resulting contribution to relational governance is a boundary condition rather than a policy formula. Rights language identifies some relations and statuses as institutionally salient even when they are poorly captured by current output measures. GRE can analyze the economic consequences of those relations while leaving their ultimate normative justification to political philosophy, law, and human-rights theory.

1.23.3 Capability and Human Development

The capability and human-development traditions provide a third condition by shifting evaluation from resources alone toward substantive opportunities. Sen's capability-oriented account treats development in terms of the expansion of substantive freedoms and the effective opportunities persons possess to pursue valued ways of living (Sen 1999). This change is directly relevant to relational economics because identical resource bundles can generate different practical possibilities when persons occupy different social, institutional, bodily, geographic, or infrastructural positions.

Capability analysis changes the evaluative unit without dissolving the importance of resources. Income, assets, services, and public provision remain means through which capabilities can be supported. Their significance depends on conversion conditions. A transport subsidy has little mobility effect where transport infrastructure is absent. Digital access has different consequences when literacy, language, hardware, electricity, or institutional recognition differ. Formal educational access has different value when care obligations, discrimination, health, or local labor-market structures alter the feasible use of education. These examples make visible the relational environment through which resources become effective opportunities.

This shift also creates a bridge between entity-centered and relational evaluation. The person remains a central normative referent, while the explanation of effective freedom requires attention to the relations surrounding that person. The analytical question becomes wider than resource possession. It includes the social and institutional conditions through which possession is converted into the ability to act. GRE

can therefore inherit an important discipline from capability analysis: resources, outcomes, and opportunities should remain distinct analytical objects.

The capability perspective also introduces plurality into economic evaluation. If development concerns several kinds of functioning and freedom, a single aggregate output measure provides only a partial view. Health, education, mobility, participation, security, and other dimensions can interact without being reducible to one immediate metric. For GRE, the importance of this plurality is methodological as well as normative. Heterogeneous values may require different evidential forms and may circulate through different relational pathways. Later chapters extend this problem into value conversion and partial commensurability; the present section identifies the historical tradition that made plural opportunity structures a legitimate economic concern.

A generative extension follows when present capabilities affect the production of future capabilities. Education can generate learning capacity; political participation can generate organizational experience; secure institutional recognition can expand future access; health can affect later employment and care relations. Capability at one moment can therefore become an enabling condition for capability at another. This temporal extension should be handled cautiously because long-horizon attribution is difficult. It nevertheless reveals why capability-oriented evaluation is congenial to a generative framework: the object of interest can include the changing possibility set through which later economic action becomes feasible.

The relationship between GRE and the capability tradition remains one of dialogue rather than identity. Capability analysis supplies a normative and evaluative vocabulary centered on substantive opportunity. GRE adds questions about relational generation, circulation, conversion, and historical transformation. The two can overlap substantially while preserving different theoretical commitments.

1.23.4 Commons and Collective Governance

Commons scholarship supplies a fourth condition by demonstrating that shared-resource problems can be organized through institutional forms more diverse than a binary opposition between centralized control and individualized private ownership. Ostrom's comparative work on common-pool resources analyzes self-organized and self-governed arrangements, including both long-enduring institutions and cases of fragility or failure (Ostrom 1990). The historical importance of this research lies in making collective rule formation, monitoring, boundary definition, conflict resolution, and institutional adaptation legitimate objects of economic analysis.

The commons perspective is relational at several levels. Resource use depends on relations among appropriators, relations between users and the resource system, and relations between local arrangements and wider authorities. The relevant economic object is therefore difficult to represent as a resource plus a set of independent claimants. Rules concerning access, monitoring, sanctions, contribution, and conflict resolution alter how the group interacts and how the resource is reproduced over time. Institutional performance depends on the configuration of these relations.

This perspective also widens the concept of governance capacity. Coordination can emerge from participants who construct and revise rules rather than receiving a fully specified institutional design from an external authority. Such self-organization does not imply spontaneity without structure. Ostrom's analysis emphasizes institutions,

information, credible commitments, monitoring, and the conditions under which participants can organize collective action (Ostrom 1990). The result is an empirical challenge to analytical frameworks that treat collective governance as conceptually secondary to state administration or market exchange.

For GRE, commons research is especially relevant to the distinction between allocation and generativity. A shared resource can be allocated among current users while the institutional relations required for future reproduction are simultaneously strengthened or weakened. Rules that maximize present extraction may reduce future resource availability or institutional trust. Rules that preserve the resource can impose present costs while maintaining later options. Evaluation therefore requires attention to the relation between current distribution and the reproduction of the relational system through which future use remains possible.

The commons tradition also provides a useful warning against idealizing relational organization. Collective governance can fail, exclude outsiders, reproduce internal hierarchy, or become fragile under changing conditions. Ostrom's own comparative programme includes failures as well as successes (Ostrom 1990). Relational density therefore has no automatic normative priority. GRE treats the structure, distribution, revisability, and generative effects of relations as empirical and normative questions rather than assuming that more relation is inherently better.

This restraint clarifies the contribution of commons scholarship to the present chapter. Its historical significance is the expansion of the institutional imagination available to economics. Shared resources can be governed through architectures in which users, rules, monitoring, and collective learning form an evolving system. That possibility supplies an important precedent for GRE's later examination of relational allocation, collective capacity, and institutional generativity.

1.23.5 Environmental and Intergenerational Normativity

Environmental and intergenerational norms provide a fifth condition by extending economic evaluation across temporal and ecological boundaries. The World Commission on Environment and Development's 1987 report, *Our Common Future*, articulated sustainable development through the relation between present needs and the ability of future generations to meet their own needs, while explicitly linking environmental limits to technology and social organization (World Commission on Environment and Development 1987). This formulation helped stabilize a normative vocabulary in which future consequences and ecological conditions became integral to development rather than external aftereffects.

The temporal extension changes the structure of the economic subject. Future persons cannot participate in current markets, vote in current institutions, or contract with present actors, yet current investment, extraction, infrastructure, emissions, debt, and technological choices can alter their opportunity sets. Intergenerational evaluation therefore requires institutions to represent interests that are temporally absent from ordinary exchange. This is a relational problem because current actions create relations of inheritance, dependence, exposure, and constraint across time even when the later participants are not presently available as counterparties.

Environmental problems introduce a related spatial and systemic extension. Ecological processes cross property boundaries, jurisdictions, and accounting periods. Resource depletion, pollution, biodiversity loss, and climate effects can connect actors

who never transact directly. The relevant causal structure can therefore extend beyond the legal boundaries of the entity generating an immediate economic output. Environmental normativity makes these externalized relations harder to exclude from evaluation simply because they fall outside the original contract or reporting unit.

The combination of environmental and intergenerational concerns also changes the meaning of economic efficiency across horizons. An arrangement can produce high current output while degrading ecological or institutional conditions required for later production. Conversely, present investment can maintain capacities whose returns become visible only over long periods. GRE's generative vocabulary is well suited to this temporal structure because it distinguishes present outcomes from the conditions under which future outcomes can be generated. The normative judgment about how present and future claims should be weighted remains a separate problem.

This separation is important. Generativity does not itself determine goodness. A system can generate durable forms of domination as readily as durable capabilities; an environmentally persistent arrangement can remain unjust; preservation can conflict with present claims of people facing urgent deprivation. Environmental and intergenerational evaluation therefore requires explicit normative reasoning about distribution, rights, risk, recognition, and acceptable tradeoffs. GRE can contribute an account of how current relations transform future possibility while leaving the ranking of competing claims open to normative theory.

The five developments reconstructed in this section collectively widen the space within which relational governance can be conceived. Participation makes affected relations relevant to problem formation; human-rights recognition gives institutional standing to persons beyond their market roles; capability analysis directs attention toward effective opportunities and conversion conditions; commons research establishes collective institutional arrangements as substantive economic objects; and environmental or intergenerational normativity extends evaluation across ecological systems and historical time. None of these traditions yields GRE by itself. Together they create a political and normative environment in which economic governance can increasingly be asked to account for relations, heterogeneous forms of standing, future possibilities, and the conditions through which economic life is reproduced. Section 1.24 turns next to the development of *nomos* and institutional form: the legal and organizational structures through which such expanded objects of recognition can acquire durable institutional expression.

1.24 Development of *Nomos* and Institutional Form

This section identifies the institutional developments through which relational and collective economic claims acquire durable forms of recognition. Its role in the chapter is to connect the political and normative opening reconstructed in Section 1.23 with the legal and organizational forms that make such claims actionable over time. The objective is to show how *nomos*, used here in a deliberately broad sense for the operative normative and institutional order that assigns statuses, claims, duties, boundaries, and procedures, changes the range of economic relations that can be represented and governed. The discussion proceeds from legal recognition of economic subjects to collective and relational interests, then examines fiduciary, cooperative, and commons-based institutions before turning to adaptive and revisable

governance. The method is institutional and comparative. It treats legal and organizational forms as historically developed devices for stabilizing relations, allocating authority, preserving claims, and structuring revision, while leaving the systematic theory of governance to later GRG work.

1.24.1 Legal Recognition of Economic Subjects

Legal recognition supplies one of the principal mechanisms through which an economic subject becomes durable across transactions. Section 1.5 showed that modern economic entities become administratively legible through legal personality, property, contract, accounting, and statistical classification. The present subsection develops the institutional implication of that argument. Recognition gives continuity to a position that can own assets, incur liabilities, enter contracts, appear in accounts, receive transfers, and bear responsibilities across time. Economic analysis can then treat that position as sufficiently stable for allocation and coordination even when the persons, assets, or internal relations composing it change.

Organizational law illustrates the structure clearly. Hansmann and Kraakman emphasize the role of organizational law in separating organizational assets and creditor claims from the personal asset positions of owners and managers (Hansmann and Kraakman 2000). This legal partitioning stabilizes a boundary through which an organization can persist as an economic unit across changes in membership and management. The System of National Accounts similarly treats institutional units as basic economic and statistical units capable of owning assets, incurring liabilities, making economic decisions, and entering transactions in their own right (European Commission et al. 2009). The legal and statistical vocabularies differ, yet both rely on institutional criteria that transform a changing configuration of persons and resources into a recognizable economic position.

Recognition therefore participates in the production of the economic object it later regulates. Once an entity is recognized as a corporation, public body, household, nonprofit institution, or other institutional unit, contracts, accounts, taxes, liabilities, transfers, and statistics can attach to that recognized position. The resulting stability supports coordination across actors who need not reconstruct the entity's entire internal relational history before every transaction. Recognition reduces uncertainty by supplying a durable institutional address for claims and obligations.

The same mechanism also creates selective visibility. Legal and administrative forms foreground the relations that are necessary to maintain the recognized position: ownership, authority, liability, membership, contractual capacity, reporting boundaries, and related incidents. Other relations can remain external to the formal identity of the unit even when they matter economically. Care relations within households, dependencies in supply chains, informal obligations, platform-mediated access, or ecological dependencies can shape the capabilities of an entity while receiving weaker recognition in the formal representation.

The development of nomos therefore changes economic ontology at the practical level. The point concerns institutional reality rather than ultimate metaphysics. A legal form can make a configuration sufficiently stable and causally efficacious for economic coordination, while the broader social and relational constitution of that configuration remains open to analysis. This institutional stabilization is one historical condition for entity-centered economics, and it also creates the starting point from

which relational analysis can ask which constitutive relations remain outside the recognized boundary.

1.24.2 Recognition of Collective Interests

Collective interests extend institutional recognition beyond a simple aggregation of individually held claims. Their significance for GRE lies in the possibility that an institution can assign standing, assets, decision rights, or continuity to a group whose economic activity depends on coordinated relations among members. The relevant development concerns the creation of forms through which a collective can persist and act even as individual participants enter, leave, or change their contributions.

The corporation is one familiar example, though collective recognition extends beyond shareholder-owned firms. Associations, cooperatives, mutuals, unions, pension arrangements, foundations, public bodies, and commons institutions organize interests whose practical content depends on continued relations among multiple participants. Organizational forms can provide a durable account of membership, authority, assets, obligations, and procedures for collective decision. The recognized collective thereby acquires a temporal continuity that individual contracts alone may reproduce only at substantial cost.

Cooperative institutions provide a particularly explicit example of collective economic recognition. The International Cooperative Alliance defines a cooperative as an autonomous association of persons who voluntarily unite to meet common economic, social, and cultural needs through a jointly owned and democratically controlled enterprise (International Cooperative Alliance 1995). The institutional form links economic participation to membership and democratic control rather than treating invested capital as the sole basis of authority. The form therefore stabilizes a collective interest while preserving identifiable relations between members, enterprise, capital, and decision procedures.

Collective recognition also changes the possible recipient of economic allocation. Resources can be directed toward a jointly owned reserve, a common infrastructure, a pension fund, a mutual insurance pool, or an institution whose purpose concerns a class of members rather than an isolated owner. The economic consequence is important: the same nominal transfer can have different effects depending on whether it becomes private property, common capital, an indivisible reserve, or an institutional asset governed under membership rules. Collective forms therefore make visible the organization of the recipient, not merely its legal name.

The analytical implication for GRE concerns persistence and aggregation. A collective interest gains economic relevance when the institutional form can preserve some relation or capability across turnover in individual participants. The collective then becomes a legitimate object of analysis because decisions taken at the collective level can affect access, bargaining position, risk sharing, investment, and future participation. Collective recognition does not establish that every group claim is normatively valid. It establishes that economic institutions have developed devices through which certain shared claims can be stabilized, governed, and carried through time.

This development widens the space of economic subjecthood introduced in Section 1.16. Subject positions can be individual, organizational, or collective, and their stability can depend on different institutional mechanisms. GRE can therefore examine how a form of collective recognition alters the relations through which resources,

risks, authority, and returns circulate.

1.24.3 Recognition of Relational Interests

Relational interests concern claims whose practical meaning depends on a structured relation among parties rather than on possession by a single isolated holder. Their institutional significance becomes visible when economic law or organizational design protects a beneficiary relation, membership relation, stewardship relation, access relation, dependency, or continuing obligation whose value cannot be described fully as an immediately transferable asset. The objective of this subsection is to identify the institutional possibility of recognizing such interests while preserving the distinction between a relation and an entity created to administer it.

Trust law offers a useful illustration. Hansmann and Mattei analyze the trust as an organizational form that structures relations among parties to the trust and between those parties and third parties, with asset partitioning playing a central role in the form's economic function (Hansmann and Mattei 1998). The legal arrangement separates dimensions of control, benefit, and creditor access that coincide more closely under simple ownership. A beneficiary's economic interest therefore depends on an institutionalized relation to assets managed through another position. The interest is intelligible through the relation among trustee, beneficiary, trust assets, and third parties.

Membership provides a second illustration. Cooperative rights derive their practical meaning from a person's relation to the cooperative and to the procedures through which the cooperative is controlled. The ICA principles connect membership to participation in policy and decision making, member economic participation, autonomy, and cooperation among cooperatives (International Cooperative Alliance 1995). These rights have an economic content that differs from a detached claim to an asset because their exercise depends on continuing membership and institutional procedures.

Commons institutions provide a third form. Ostrom's comparative work documents arrangements in which groups establish rules concerning access, use, monitoring, sanctioning, and collective choice around common-pool resources (Ostrom 1990). The relevant interest is structured through relations among users, resource conditions, monitoring practices, and institutional rules. Access to the resource can therefore depend on membership and rule-governed relations rather than on exclusive ownership by a single actor.

These examples suggest a cautious extension of economic representation. Some interests can be represented more adequately by specifying the relation through which the claim is sustained. A transfer to a beneficiary, a member, or a resource user changes more than the recipient's balance sheet when it also alters membership, control, dependence, monitoring obligations, or future access. Relational analysis becomes useful where these continuing relations materially shape the effect of the transfer.

Institutional recognition can nevertheless reify what it stabilizes. A fluid relation may be converted into a fixed legal category, a standardized entitlement, or an administratively bounded membership class. Such stabilization can be necessary for enforceability and coordination, while also narrowing the variation that the institution can perceive. GRE therefore treats recognition as a generative intervention into

the relation itself. The act of making an interest legible can alter the boundaries, participants, duties, and future trajectories of that interest.

The resulting problem is central to later relational allocation theory. Economic institutions require stable addresses for claims, yet generative relations can change through time. A relationally sensitive *nomos* therefore needs forms that can recognize continuing interests while leaving room for revision when the relations supporting those interests change.

1.24.4 Fiduciary, Cooperative, and Commons-Based Institutions

Fiduciary, cooperative, and commons-based institutions demonstrate several ways in which economic organization can distribute ownership, control, benefit, and responsibility across differentiated positions. Their importance for the present chapter lies in institutional variety. Modern economic ordering already contains forms that depart from the simple image of one owner controlling one asset for one private purpose. These forms provide concrete precedents for GRE's later inquiry into allocation toward relations, shared infrastructures, collective capacities, and future beneficiaries.

Fiduciary structures separate authority from beneficial interest under a rule-governed relation. Trust law can partition assets and structure claims among trustees, beneficiaries, and third parties in ways that ordinary bilateral contracting may reproduce only imperfectly (Hansmann and Mattei 1998). The institutional form permits resources to be administered under purposes and duties that persist beyond a particular transaction. Pension funds, charitable trusts, and other fiduciary arrangements differ substantially in law and function, yet they share the broader feature that control over assets and entitlement to benefits can occupy distinct institutional positions.

Cooperatives organize a different separation. Their institutional identity places membership, joint ownership, and democratic control at the center of the enterprise. The ICA principles include voluntary and open membership, democratic member control, member economic participation, autonomy, cooperation among cooperatives, and concern for community (International Cooperative Alliance 1995). These principles provide an explicit example of an economic organization whose architecture links capital to a wider structure of membership and collective decision. The form does not guarantee equal outcomes or successful governance. It demonstrates that economic control and return can be institutionally organized through relations other than proportional investor ownership.

Commons-based institutions add another configuration. Ostrom's cases show that users of common-pool resources can, under some conditions, develop durable rules for access, monitoring, conflict resolution, sanctioning, and collective choice (Ostrom 1990). Their significance lies in the institutionalization of reciprocal and continuing relations around a shared resource. The resource remains economically consequential through a pattern of use and governance that cannot be reduced to a sequence of isolated transfers.

Taken together, these forms show that institutional architecture can distribute economic functions across multiple roles. Asset control, beneficial claim, membership, monitoring, participation, stewardship, and residual return can be attached to different positions and linked through rules. GRE can therefore treat institutional form as

part of the causal structure of allocation. A resource entering a trust, cooperative, or commons arrangement enters a different generative configuration from the same resource entering an individually controlled account.

The comparison also supplies a methodological caution. Fiduciary, cooperative, and commons institutions arise from distinct legal histories and solve different problems. Their inclusion in one subsection identifies a family resemblance in the distribution of economic roles, rather than an equivalence among the forms. Later GRE chapters can ask which structural features matter for generativity, participation, return, or justice without treating any existing institution as a ready-made model for a generative relational economy.

The historical lesson is therefore modest and important. Institutional pluralism already exists within modern economic orders. The development of GRE does not require inventing relational organization from an empty institutional field. It requires learning how existing forms distribute relations, which capacities they preserve, which asymmetries they create, and how their rules affect the circulation and return of value.

1.24.5 Adaptive and Revisable Governance

Adaptive and revisable governance provides the final institutional condition considered in this section. Relational and generative systems change while institutions act upon them, so a governance form that can monitor consequences, evaluate implementation, revise rules, and reopen decisions possesses a different temporal structure from a one-time allocation. The objective here is to identify institutional revisability as a historically developed governance capacity, while maintaining the distinction between revisability and a complete theory of adaptive governance.

Institutional revision begins with explicit procedures for observation and feedback. The OECD's framework on sound public governance treats monitoring as a source of information during implementation and connects monitoring and evaluation to adjustment of policy and resource allocation (OECD 2020c). Its comparative work on policy evaluation similarly presents evaluation as a mechanism for accountability, learning, and improved decision making (OECD 2020b). These practices create formal channels through which observed consequences can re-enter the decision process.

Revisability matters because the object of governance can change during implementation. A program can alter incentives, participation, organizational routines, information flows, or the composition of the population it serves. A rule designed for one relational configuration can therefore become mismatched to the configuration partly generated by the rule itself. Monitoring then has a generative significance: the institution observes a system in which its own intervention has become one of the causal relations.

Adaptive capacity also depends on the architecture of amendment. Institutions vary in who can initiate revision, what evidence can count, whose testimony has standing, which decisions are reviewable, how quickly rules can change, and which commitments remain protected from short-horizon adjustment. These procedural differences shape the relation between stability and learning. Rapid revision can make an institution responsive while reducing predictability; rigid rules can preserve expectations while allowing mismatch to accumulate. The relevant design problem concerns the organization of temporal responsiveness across different kinds of rule

and different timescales of change.

Existing institutions already embody partial solutions. Cooperative principles can be interpreted and updated through living guidance while preserving a continuing institutional identity (International Cooperative Alliance 2017). Commons arrangements can contain collective-choice and monitoring procedures through which rules respond to local conditions (Ostrom 1990). Public-governance frameworks increasingly formalize monitoring, evaluation, and revision across policy cycles (OECD 2020c; OECD 2020b). These examples differ in authority and domain, yet each illustrates an institutional attempt to combine continuity with revisability.

For GRE, revisability has a further implication. If institutions participate in generating the relations they govern, evaluation cannot be confined to whether an intervention reached its initial target. It must also ask what relations, capacities, dependencies, and future options emerged through implementation. The answer can justify revision even when the initial output metric was achieved. This creates an institutional bridge between the evidential conditions of Section 1.22 and the generative analysis developed in Sections 1.17–1.20.

The development of *nomos* therefore expands the practical possibility of relational economics in two directions. Institutional forms can recognize subjects, collectives, and continuing relational interests; revision procedures can preserve the capacity to learn when those recognized forms change through time. The same developments also create new risks of reification, unequal recognition, procedural capture, and excessive administrative complexity. Sections 1.25 and 1.26 turn to these limits directly by examining the remaining epistemic and governance constraints on relational analysis.

1.25 Contemporary Limits of Relational Knowledge

This section specifies the epistemic limits that remain after the scientific, computational, evidential, political, and institutional openings developed in Sections 1.19–1.24. Its role in the chapter is to prevent the historical possibility of richer relational analysis from being mistaken for complete access to relational reality. The objective is to distinguish five persistent limits: partial observation, dependence on representation and model choice, causal underdetermination, boundary and scale dependence, and the temporal incompleteness of generative evaluation. The discussion is epistemological and methodological. It treats these limits as conditions under which relational knowledge must be produced, qualified, compared, and revised, while reserving the fuller epistemology of GRE for Chapter 5.

1.25.1 Partial Observation

Relational economic analysis begins from evidence that is necessarily selective. Some relations are formally recorded because institutions require contracts, accounts, registrations, transactions, tax records, administrative classifications, or platform logs. Other relations remain informal, tacit, private, strategic, episodic, or distributed across several organizations. Even where a relation leaves traces, the traces may register only a subset of its dimensions: a payment can record transfer without recording dependence; an employment contract can record legal status with-

out recording informal authority; a platform interaction can record clicks without recovering the meaning assigned to them by participants. The expansion of data infrastructures therefore increases observational capacity while leaving observation partial.

The limitation is partly institutional. Observation follows the categories and purposes of the apparatus that produces the record. Administrative systems collect information relevant to eligibility, compliance, taxation, service delivery, or organizational management; firms collect information relevant to production, customers, risk, or control; platforms record events that can be captured through their technical architecture. These records can be highly informative, yet their coverage follows the operational needs of the institution. Relations that matter economically can remain weakly observed when no reporting system has reason, authority, or technical capacity to record them.

The limitation is also distributed. Hayek's account of dispersed knowledge emphasized that economically relevant knowledge exists in incomplete and frequently contradictory fragments across many participants rather than as a single integrated dataset available to one observer (Hayek 1945). Contemporary digital infrastructures can aggregate quantities that were previously unavailable, but aggregation does not eliminate dispersed local knowledge. Tacit routines, contextual expectations, unrecorded obligations, local meanings, and strategic interpretations can remain distributed even in data-rich environments.

Observation can also be asymmetric. Powerful organizations may observe workers, consumers, suppliers, or users more extensively than those participants can observe the organizations that classify and act upon them. Regulators may receive disclosures unavailable to ordinary market participants; platforms may infer behavior from traces that users cannot inspect; organizations can combine datasets across domains while individuals encounter only the immediate interface. Relational knowledge therefore has a distribution as well as a quantity. The question concerns who can observe which relations, at what resolution, and under what rights of access.

Partial observation does not imply that relational claims are arbitrary. It requires explicit evidential scope. A study can state which relations are directly observed, which are inferred, which are represented through proxies, which are inaccessible, and which may be missing systematically. Section 1.22 showed that contemporary evidence infrastructures make such distinctions increasingly tractable. The epistemic discipline is to treat improved observation as an expansion of access rather than as completion of the object.

1.25.2 Representation and Model Dependence

Observed traces become relational knowledge only after they are represented. A representation identifies the entities or positions to be distinguished, the relations to be recorded, the attributes attached to them, the temporal resolution of observation, and the boundary within which the description is constructed. This dependence is present in statistical tables, legal categories, network graphs, field models, agent-based simulations, and qualitative relational maps alike. Relational analysis therefore inherits the epistemic problem already identified for economic categories in Section 1.1: analytical objects become visible through historically and methodologically specific forms of description.

Statistical and administrative classifications provide an obvious case. Desrosières showed historically how statistical reasoning depends on conventions of classification, coding, equivalence, and aggregation that make heterogeneous cases comparable (Desrosières 1998). Hacking likewise emphasized that categories and styles of reasoning have histories and can participate in the formation of the objects they classify (Hacking 2002). For GRE, the implication is that a relational dataset never contains relations in an entirely pre-analytical form. It contains observations organized through decisions about what counts as an actor, event, tie, transaction, household, firm, sector, location, or period.

Formal relational models make these decisions especially explicit. A network representation requires nodes and edges; a higher-order representation requires specification of group interactions; a field representation requires a domain, variables, locality, and boundary conditions. Newman and Battiston and colleagues show how different relational formalisms preserve different structures and support different dynamical questions (Newman 2003; Battiston et al. 2020). A pairwise graph can be appropriate for one problem and lose essential information for another in which an interaction exists only through a group or institutional configuration.

Model dependence therefore concerns the conditional character of inference. A conclusion can be robust within one representation and change when the same empirical material is organized differently. The appropriate response is comparison rather than the search for a representation free of assumptions. Where several defensible models exist, GRE can ask which distinctions each preserves, which it suppresses, and which conclusions survive translation across representations. Later methodology chapters develop this principle through triangulation, sensitivity analysis, and model plurality.

Representation also feeds back into practice. Once a model becomes an administrative category, performance indicator, credit classification, eligibility rule, or platform score, it can change behavior and institutional treatment. Model dependence then becomes generative as well as epistemic: the representation partly enters the relational system it was designed to describe. This possibility strengthens the requirement that GRE state the standing of its models precisely. A model can be descriptively useful without being ontologically exhaustive, and its institutional use can create consequences not contained in its original evidential purpose.

1.25.3 Causal Underdetermination

Relational association does not by itself identify the mechanism that generated it. Two organizations may display similar network positions for different historical reasons; a strong association between membership and outcome may reflect selection, common institutional exposure, reciprocal influence, or an unobserved relation; a policy intervention may coincide with change while several other processes evolve simultaneously. The problem becomes more demanding in generative systems because relations, subjects, institutions, and constraints can coevolve, allowing causes and conditions to change while the observed process unfolds.

The econometric identification literature provides a disciplined language for this limitation. Manski argues that empirical analysis should distinguish what the available data identify from what follows only after additional assumptions are introduced, and develops methods for learning under incomplete data and partially

identified treatment responses (Manski 2008). The relevance to GRE is methodological rather than doctrinal. Rich relational data can narrow the space of plausible explanations while leaving several mechanisms compatible with the observations. Stronger causal claims require stronger design, temporal evidence, institutional knowledge, or assumptions whose credibility must be stated rather than hidden inside the model.

Generative analysis adds historical underdetermination. Path-dependent systems can reach similar visible states through different sequences, and similar interventions can produce different consequences when they enter different institutional trajectories. North's account of institutional change and Arthur's treatment of increasing returns both make historical sequence analytically consequential (North 1990; Arthur 1989). The present state therefore need not uniquely reveal the path that generated it, while a path reconstructed from records may still admit competing mechanism accounts.

Causal underdetermination is especially important for relational intervention. An observed improvement after strengthening one relation can coexist with changes in resources, expectations, network position, institutional recognition, or external conditions. A claim that the relation generated the improvement should therefore identify the mechanism, timing, relevant alternatives, and evidence that discriminates among them. Where the evidence supports only contribution, enablement, or association, the language of the claim should remain correspondingly limited.

This limitation does not reduce GRE to causal skepticism. It specifies an evidential gradient. Some cases support strong identification; others support partial identification, mechanism plausibility, process evidence, or bounded counterfactual claims. The research task is to align claim strength with evidential strength. A generative framework is most useful when it makes additional mechanism questions visible, while remaining willing to leave several explanations open when the evidence does not discriminate among them.

1.25.4 Boundary and Scale Dependence

Relational descriptions depend on where the system boundary is drawn and at what scale the system is observed. An organization's internal network can appear dense when suppliers, regulators, households, and infrastructures are excluded, while the same organization can occupy a peripheral or dependent position in a wider production network. A household can appear as one allocation unit in national accounts and as a differentiated set of care, income, authority, and dependency relations at a finer resolution. Neither description is automatically defective. Each answers a different question by preserving a different set of distinctions.

The statistical literature provides a classic warning against transferring relationships across levels of aggregation. Robinson demonstrated that correlations calculated for grouped populations can differ materially from corresponding relationships among individuals and that aggregate associations therefore do not license direct inference about individual behavior (Robinson 1950). The lesson extends beyond ecological correlation. Relations observed at one scale can be generated by compositions, constraints, or interactions that disappear when the analysis moves to another scale.

Complex-systems research supplies a complementary perspective. Bar-Yam's multiscale framework treats structure as scale-dependent and emphasizes that the organi-

zation visible at one resolution can differ from that visible at another (Bar-Yam 2004). Network analysis likewise depends on the population of nodes and ties admitted to the graph (Newman 2003). Centrality, clustering, brokerage, modularity, and dependency can all change when the boundary expands, when a layer is added, or when a higher-order interaction is represented explicitly.

Boundary selection also has normative and political consequences. A firm-level productivity analysis can exclude unpaid household labor on which workers depend; a project-level cost calculation can exclude environmental effects outside the administrative jurisdiction; a platform-level analysis can omit alternative infrastructures that determine user exit; a national analysis can externalize transnational labor or ecological relations. The boundary therefore determines which effects become internal to evaluation and which remain external to it.

GRE should consequently treat boundary and scale as reportable analytical choices. Robust relational claims should indicate whether their conclusions persist across plausible alternative boundaries and resolutions. Where conclusions change, the variation is itself informative: it identifies the scale or relational neighborhood at which the mechanism appears. This discipline makes multiscale disagreement a source of knowledge rather than a defect to be concealed by choosing one preferred level.

1.25.5 Temporal Limits of Generative Evaluation

Generative evaluation faces a temporal limit because the object of evaluation includes consequences that have not yet fully emerged. A transfer can alter capacity only after training, trust, infrastructure, or institutional learning accumulates. A new dependency can remain invisible while short-run output rises. A legal or organizational reform can change incentives immediately while its effects on membership, bargaining position, or future options unfold over years. The evaluation window therefore participates in the result.

Historical economics already contains several mechanisms that make timing consequential. North emphasizes that institutions shape subsequent incentives and paths of change, while Arthur shows how early events can be amplified through increasing returns and produce later lock-in (North 1990; Arthur 1989). These mechanisms imply that a present intervention may acquire significance through a trajectory whose later stages are unavailable at the moment of decision. The evaluator observes a prefix of the process rather than the completed process.

The problem is sharper for generative value because later effects can include changes in the capacity to generate further relations and options. An educational opportunity may alter later learning relations; infrastructure can generate complementary investment; institutional access can create future membership and information; extraction can weaken capacities whose loss becomes visible only after repeated use. Short observation windows can therefore favor effects that manifest quickly and discount effects whose causal pathway is delayed or distributed across scales.

Long-horizon evaluation also encounters changing contexts. The institutional environment, technology, value structure, and subject positions relevant to an intervention can change while the intervention's effects unfold. A model calibrated to the initial context can therefore lose adequacy before the trajectory ends. This is one

reason why adaptive evaluation and institutional learning, discussed in Sections 1.22 and 1.24, are historically important: they permit judgments to be revised as later evidence arrives rather than treating the first evaluation as final.

Temporal incompleteness places a limit on certainty rather than on evaluation itself. GRE can distinguish immediate outcomes from delayed effects, preserve the assumptions under which projections are made, identify indicators of intermediate mechanism, and reopen judgments when new stages of the trajectory become observable. Intergenerational and environmental evaluation makes this requirement especially visible because the subjects affected by present action can include persons who cannot participate in present evidence production or decision procedures (World Commission on Environment and Development 1987).

The five limits developed in this section define an epistemic boundary around the contemporary opening reconstructed in the chapter. More data leave observation partial; richer formalisms remain representation-dependent; relational patterns can support several causal accounts; boundaries and scales shape what becomes visible; and generative evaluation remains temporally incomplete while the future is still being produced. These limits do not cancel the case for GRE. They determine the form that a responsible relational economics must take: explicit about observation, conditional about models, disciplined about causal language, transparent about scale and boundary, and revisable across time. Section 1.26 extends the argument from knowledge to governance by examining the practical constraints that arise when institutions attempt to act within systems they can only partially know.

1.26 Contemporary Limits of Relational Governance

This section identifies the practical limits that remain when relational knowledge is translated into governance. Its role in the chapter is to complement the epistemic limits developed in Section 1.25: even when relevant relations can be observed with reasonable confidence, governing them requires administrative categories, legally actionable statuses, computationally tractable representations, normative judgments, and institutional authority over observation and classification. The objective is to specify five recurrent constraints on relational governance: administrative reification, legal dependence on stable categories, computational complexity, normative plurality, and asymmetries in the power to observe and classify. The discussion is institutional and diagnostic. It does not develop a general governance theory, which belongs to the later GRG programme; it clarifies why richer relational knowledge does not automatically yield frictionless or normatively determinate intervention.

1.26.1 Administrative Reification

Relational governance requires administrative action, and administrative action requires objects that can be named, compared, recorded, assigned responsibility, and linked to procedures. This requirement creates a recurring tension. Relations are often continuous, overlapping, historically variable, and distributed across more than one institution, while administrative systems operate through discrete records, statuses, eligibility categories, reporting units, and decision rules. Governance therefore converts a relational field into administratively actionable objects. The conver-

sion is necessary for implementation, but it can also stabilize the representation more strongly than the underlying relation warrants.

Modern statistical and administrative systems provide a clear illustration. Statistical practice depends on conventions that establish equivalence, coding, classification, and aggregation among heterogeneous cases (Desrosières 1998). Standardized quantitative procedures also became institutionally attractive because they support impersonal and transportable judgment (Porter 1995). These achievements make large-scale administration possible. They also establish a practical grammar in which only some aspects of relational life become legible enough to govern.

The problem can be described as administrative reification: a representation introduced to make a relation governable can acquire the practical standing of the relation itself. A household category may become the unit through which eligibility is determined; an employment status may determine access to benefits; a reporting entity may define which transactions are consolidated; a statistical sector may determine how economic activity is aggregated. The administrative object then influences the distribution of resources and responsibilities, so its boundary has causal consequences even when the underlying relational configuration remains more complex.

Hacking's historical ontology is useful for specifying the feedback involved. Classifications can become part of the conditions under which people and institutions understand, organize, and respond to the classified object (Hacking 2002). The point for GRE is not that every category mechanically creates what it names. It is that classificatory schemes can enter the relations they describe through eligibility rules, compliance procedures, accounting boundaries, organizational incentives, and social recognition. Administrative representation can therefore become one component of the generative environment.

Relational governance cannot remove this problem simply by adding more categories. Finer classification increases descriptive resolution, but it also increases administrative complexity and may create additional boundaries whose practical effects require justification. Nor does replacing discrete categories with continuous scores eliminate reification. A score can become an equally powerful administrative object when access, risk, priority, or surveillance is tied to it. The central governance question concerns how a representation is used, how contestable its boundary remains, and how easily the institution can revise it when the relations it governs change.

The practical implication is a discipline of representational modesty. Administrative categories should be treated as instruments with stated scope, provenance, and revision procedures. Where a category carries high-stakes consequences, governance should preserve some capacity to inspect cases that fit the administrative representation poorly. This principle does not dissolve the need for categories. It recognizes that governance acts through abstractions whose convenience can otherwise conceal their generative effects.

1.26.2 Legal Dependence on Stable Categories

Law intensifies the demand for stability because rights, duties, liabilities, ownership claims, contracts, jurisdiction, and procedures require sufficiently determinate subjects and objects. Economic relations may change rapidly, yet legal institutions must decide who bears an obligation, who controls an asset, which entity enters a contract,

which claimant has standing, and which boundary determines responsibility. Relational governance therefore encounters a second limit: the more fluid the underlying relations become, the more difficult it is to preserve both relational sensitivity and legal determinacy.

Organizational law illustrates the productive side of stable legal categories. Hansmann and Kraakman show how organizational forms create standardized legal entities and partition assets and creditor claims, making complex collective activity governable through relatively stable legal boundaries (Hansmann and Kraakman 2000). Trust law can likewise separate control, benefit, and claims against assets in ways that organize relations among trustees, beneficiaries, settlors, and third parties (Hansmann and Mattei 1998). These forms do more than describe economic relations. They constitute durable positions through which those relations can be coordinated over time.

The same stability can become constraining when relational reality changes more quickly than legal form. A firm may reorganize production across contractors, platforms, subsidiaries, and algorithmic systems while liability remains attached to formally recognized entities. A worker may occupy economically dependent positions that fall imperfectly within inherited employment categories. A digital platform may mediate transactions across jurisdictions whose legal classifications do not align. The governance problem is therefore temporal as well as conceptual: legal categories need enough persistence to support expectation and accountability, while economic relations continue to evolve.

Accounting and statistical systems reveal analogous tensions. The IFRS Conceptual Framework treats the reporting entity as a boundary constructed for financial reporting and allows that boundary to include a single entity, part of an entity, or multiple entities (IFRS Foundation 2018). The System of National Accounts similarly relies on institutional units capable of owning assets, incurring liabilities, entering contracts, and making economic decisions (European Commission et al. 2009). Such frameworks show that institutional practice already works with analytically constructed boundaries. Relational governance can therefore revise boundaries, but it must do so through procedures that preserve comparability, responsibility, and legal intelligibility.

The limit is consequently structural rather than merely conservative. Governance cannot continuously redefine every subject and relation at the speed of the underlying economy without destabilizing the expectations that institutions themselves sustain. Legal and administrative forms have characteristic revision times. Their relative slowness can support coordination by making obligations predictable. The same slowness can generate mismatch when new relations become economically consequential before the corresponding legal categories evolve.

GRE should therefore treat legal stability and relational sensitivity as jointly necessary institutional properties whose balance varies by domain. Some contexts require durable categories because responsibility must remain traceable across time. Others require flexible recognition because fixed categories systematically omit economically dependent or newly mediated relations. The analytical task is to identify which features require continuity, which can be revised, and what institutional process governs the transition. Systematic theories of legal change belong outside GRE, but the economic consequences of such temporal and classificatory mismatch remain central to relational analysis.

1.26.3 Computational Complexity

Relational governance also faces a computational limit. As the number of relevant actors, ties, higher-order interactions, temporal states, institutional constraints, and possible interventions increases, the space of relationships that could matter expands rapidly. Contemporary computation makes much richer analysis possible, as Section 1.21 established, yet increased computational capacity does not remove the need to simplify. Governance decisions must operate with finite models, finite observation windows, and finite time for deliberation.

Network analysis already demonstrates how relational structure creates analytical burdens absent from isolated-unit models. Newman surveys methods for representing large systems through networks, while higher-order network research shows that pairwise edges can fail to preserve interactions that exist only at the level of groups or simplicial structures (Newman 2003; Battiston et al. 2020). Adding temporal variation increases the problem further because the relevant structure is then a sequence of changing relational configurations rather than a single graph. The computational object can become very large before uncertainty in measurement or causality is even considered.

Complex-systems analysis adds another difficulty: local interventions can propagate through feedback, adaptation, and reorganization. Bar-Yam's multiscale treatment emphasizes that different structures become visible at different scales and that organization at one scale cannot be inferred straightforwardly from another (Bar-Yam 2004). A governance model that represents only one scale may therefore miss interactions that dominate elsewhere. A model that attempts to include every scale can become too complex to interpret, calibrate, or use within a decision process.

Computational complexity is consequently also a problem of model selection. Governance must choose which relations to resolve, which to aggregate, which time horizon to simulate, which behavioral responses to include, and which uncertainty to represent. Agent-based models can explore heterogeneous interaction, while dynamical and network models can reveal trajectories, feedback, and topological dependence. Each representation reduces the system differently. Richer models may expose mechanisms hidden by simpler ones, yet they can also become harder to validate and easier to overfit to assumptions rather than evidence.

The practical limit becomes especially visible when a model is used for intervention. Decision makers often need an answer before exhaustive computation, data collection, or model comparison is possible. In such settings the relevant standard is not maximal descriptive detail but sufficient robustness for the decision at hand. A relational governance process should therefore identify which conclusions survive plausible changes in boundary, scale, representation, and parameter assumptions. Later chapters develop this through sensitivity analysis, model plurality, and adaptive revision.

Computational capacity thus changes the frontier of feasible governance without eliminating incompleteness. The historical significance of contemporary computation lies in making previously inaccessible relational structures analyzable. The corresponding discipline lies in refusing to treat computational resolution as equivalent to causal certainty or institutional wisdom. The more complex the model, the greater the need to state what it omits, which assumptions drive its results, and which decisions would change if another representation were adopted.

1.26.4 Normative Plurality

Relational governance is further limited by normative plurality. A relational description can show that an intervention changes access, dependence, capability, trust, participation, risk, ecological conditions, or future possibilities. The description does not by itself determine how these consequences should be ranked. Relations can support several legitimate values simultaneously, and changes that improve one dimension can burden another. Governance therefore requires normative judgment in addition to relational knowledge.

The capability approach provides one important illustration. Sen shifts attention from resources alone toward the substantive opportunities people possess to achieve valued ways of living (Sen 1999). This move makes conversion conditions and heterogeneous circumstances analytically visible, but it does not reduce all valued functionings to a single universally fixed metric. Human-rights traditions introduce another vocabulary centered on recognition, equality, participation, and protected claims (United Nations General Assembly 1948; United Nations General Assembly 1966). Environmental and intergenerational frameworks extend evaluation to conditions affecting future persons and ecological systems (World Commission on Environment and Development 1987). Commons scholarship adds concerns with collective rule making, participation, and durable institutional arrangements (Ostrom 1990). These frameworks overlap, yet they are not interchangeable.

Normative plurality becomes particularly demanding when consequences are distributed across time and scale. An intervention can improve immediate output while reducing long-horizon ecological resilience. A classification can improve administrative consistency while excluding a minority whose circumstances fit poorly. A platform policy can increase average efficiency while concentrating dependence on an intermediary. A commons institution can protect collective resources while imposing participation burdens unevenly. Relational analysis reveals these connections more clearly, but greater descriptive richness can increase the number of values that enter evaluation.

This is a limit on optimization rather than a rejection of it. Optimization is appropriate where the objective, constraints, and metric are sufficiently specified and normatively legitimate for the local problem. The difficulty arises when governance projects heterogeneous values into a single scale without examining what the conversion suppresses. GRE therefore needs to distinguish between locally commensurable objectives and domains in which value translation remains partial, contested, or institutionally imposed. The later chapters on heterogeneous value and justice develop this problem directly.

Normative plurality also limits claims about generativity. A system capable of generating more relations, options, or future capacities is not therefore morally superior. Generativity describes a capacity of a system; goodness requires additional normative premises. A relation can be highly generative while reproducing domination, environmental harm, or exclusion. Conversely, some constraints can be ethically justified precisely because they limit what may be generated. Relational governance must therefore keep generative evaluation and normative evaluation analytically connected without collapsing one into the other.

The governance implication is procedural as well as philosophical. Where values cannot be reduced credibly to one metric, institutions need ways to expose the rel-

evant dimensions, represent affected positions, preserve disagreement, and revise decisions as consequences become clearer. Participation, rights, public reasoning, and institutional contestability become important partly because normative plurality cannot be resolved by data alone. GRE can analyze the economic effects of these arrangements while leaving the choice among comprehensive moral theories open.

1.26.5 Power over Observation and Classification

The final limit concerns power over the production of governable reality. Relational governance depends on observation, categorization, measurement, and model construction. The actors controlling these processes can influence which relations become visible, which subjects are recognized, which outcomes are measured, and which interventions appear administratively available. Observation and classification therefore have a political economy of their own.

The history of statistical reasoning makes this visible. Desrosières shows that statistical categories depend on conventions that make heterogeneous cases comparable, while Porter demonstrates how quantitative standards acquire authority through institutional practices of objectivity (Desrosières 1998; Porter 1995). Hacking adds that classifications can participate in shaping the objects and persons to which they are applied (Hacking 2002). Together, these traditions imply that the infrastructure of observation is not a neutral window placed outside economic relations. It is itself composed of institutions, technologies, standards, professional roles, and access rights.

Contemporary data infrastructures intensify this issue because observational capacity is unevenly distributed. Section 1.25 noted that platforms, firms, regulators, public agencies, researchers, and individuals can possess very different access to the same relational system. The World Bank's treatment of data-governance ecosystems explicitly emphasizes that data use depends on institutional arrangements, interoperability, safeguards, and relations among multiple actors (World Bank 2021). OECD work on data-driven public sectors similarly treats data governance as a system-wide institutional problem rather than a purely technical matter (Ooijen et al. 2019). The ability to combine, interpret, and operationalize data is therefore itself an economic capability.

Power can enter at several points. An institution may determine which categories are officially recognized; a platform may define the events its interface records; a rating system may choose the variables that enter a score; an employer may observe worker performance at greater resolution than workers can observe organizational decision rules; a public authority may possess administrative records unavailable to the persons classified by them. These asymmetries affect both knowledge and action because the observing institution can convert its representation into eligibility, pricing, ranking, surveillance, resource allocation, or enforcement.

Classification power should nevertheless be distinguished from arbitrary control. Institutions often require standardized categories to coordinate at scale, preserve legal equality, maintain comparability, and administer scarce resources. The relevant GRE question concerns the relational conditions under which classificatory authority becomes accountable. Important dimensions include transparency about category construction, rights to correction or appeal, separation between measurement and automatic sanction where appropriate, access to provenance, and the possibility of revising categories whose consequences diverge from their intended scope.

The same point applies to models. A relational model used only for research has one kind of influence; the same model embedded in a decision system can acquire allocative power. The transition from description to intervention changes the normative and institutional burden carried by the model. Governance therefore needs to track who constructs the representation, who can inspect it, who bears its errors, and who possesses authority to revise it. These questions connect epistemology directly to economic power without implying that every act of measurement is domination.

Taken together, the five limits of this section qualify the practical promise of relational governance. Administrative systems require simplification; law requires stability; computation requires tractable models; normative plurality requires judgment; and observational infrastructures distribute classificatory power unevenly. None of these limits makes relational governance impossible. They determine the conditions under which it can remain accountable, revisable, and proportionate to what is actually known. The historical opening identified in the preceding sections is therefore accompanied by a corresponding discipline: greater relational visibility expands the space of possible intervention while also making the institutional consequences of representation harder to ignore.

1.27 The Double Character of Contemporary Technical Capacity

This section synthesizes the technical and institutional developments examined in Sections 1.19–1.26 by identifying their double character. Contemporary infrastructures expand the capacity to observe relations, predict outcomes, simulate alternatives, and assist decision-making. The same infrastructures can also intensify surveillance, behavioral steering, infrastructural dependence, and concentration of analytical power. The objective is to state this duality without assigning technology an intrinsic political direction. The discussion proceeds through five coupled developments: observation and surveillance, prediction and behavioral intervention, computational assistance and concentration, artificial intelligence as both analytical capacity and economic power, and the relation between technical capability and epistemic humility. The method is historical and institutional: technical affordances are treated as capacities whose economic consequences depend on ownership, access, authority, institutional embedding, and the relations through which technical outputs become actionable.

1.27.1 Observation and Surveillance

Contemporary data infrastructures make a wider range of economic relations observable at finer temporal and organizational resolution. Administrative records can be linked longitudinally; platforms record interaction histories; firms collect transaction and workflow data; sensors and digital systems produce machine-generated traces; and public institutions increasingly organize data across previously separated administrative domains. These developments provide important conditions for relational analysis because relations that once appeared only through episodic surveys or retrospective reconstruction can increasingly be observed as evolving patterns (Einav and Levin 2014; World Bank 2021; Ooijen et al. 2019).

Observation acquires a different institutional character when visibility is asymmetric and linked to consequential action. A platform may observe participants' transactions and interactions at a level of detail unavailable to the participants themselves. An employer may observe task timing, communication patterns, or performance indicators while workers possess limited visibility into the models used to evaluate them. A public authority may combine administrative sources that no individual subject can assemble. In these cases, expanded observation becomes part of a relation between observer and observed rather than a purely epistemic improvement.

The distinction between observation and surveillance therefore turns on relational conditions as much as on the technical act of data collection. Relevant conditions include who observes whom, whether visibility is reciprocal, which purposes authorize collection, who controls the resulting records, whether subjects can inspect or correct representations, and which decisions can be made from the collected data. The same technical infrastructure can support accountability in one configuration and disciplinary control in another. OECD and World Bank work on data-driven public systems accordingly places institutional safeguards, governance arrangements, and relations among data holders and users alongside the expansion of analytical capacity (Ooijen et al. 2019; World Bank 2021).

Algorithmic management provides a concrete economic illustration. Kellogg, Valentine, and Christin document how computational systems can participate in directing, evaluating, and disciplining work, showing that the relevant technology is embedded in organizational relations of authority rather than operating as a detached measurement device (Kellogg et al. 2020). The observational capacity is economically consequential because it can be converted into scheduling, performance evaluation, task assignment, or sanction.

For GRE, the important historical change is therefore an increase in the resolution at which economic relations can be rendered observable together with an increase in the asymmetry with which such observation may be distributed. Relational visibility creates new possibilities for research and governance while also making control over observation itself an economic resource. The analytical task is to trace the institutional relation that converts visibility into action.

1.27.2 Prediction and Behavioral Intervention

The second development concerns the coupling of prediction with intervention. Improvements in data availability and computational modeling allow institutions to estimate future outcomes at a scale and frequency that would previously have been impractical. Prediction can support screening, forecasting, risk assessment, resource prioritization, and other decisions in which action depends on expectations about future states. Manski's treatment of prediction and decision emphasizes the importance of distinguishing what data identify from what follows only after additional assumptions, a distinction that remains central when predictive systems enter practical decision processes (Manski 2008).

Prediction becomes economically generative when the predicted classification changes the conditions under which the subject subsequently acts. A risk score may alter access to credit or insurance. A ranking may alter visibility in a marketplace. A forecast may change inventory, investment, or staffing. A recommendation system may reorganize attention. A workplace model may alter assignments, targets, or

evaluation. The technical output therefore participates in the relational system that produces the next round of data.

This feedback means that predictive performance and causal understanding occupy different analytical positions. A model may rank future outcomes accurately while leaving the mechanism producing those outcomes only partially specified. Once a prediction is used to intervene, the intervention can alter incentives, opportunities, expectations, and observed behavior. The subsequent data then reflect both the underlying process and the institution's prior decisions. Relational governance therefore requires attention to the pathway through which prediction becomes action rather than treating predictive accuracy as a complete account of policy or organizational adequacy.

Algorithmic control in organizations illustrates this coupling. Systems that predict performance or classify workers can also structure the tasks, metrics, and incentives through which later performance is produced (Kellogg et al. 2020). The distinction is especially important in settings where subjects adapt strategically to measures or where institutional decisions affect the opportunities that later appear in the data. Prediction can then become one component of a recursively generated environment.

The double character of predictive capacity lies in this recursion. Better prediction can reduce local uncertainty and improve the timing or targeting of decisions. The same capacity can intensify behavioral intervention when predictions are embedded in institutions with authority over access, ranking, work, prices, or eligibility. GRE therefore treats prediction as an epistemic capacity whose economic consequences depend on the relation between model, decision-maker, affected subject, and subsequent feedback.

1.27.3 Computational Assistance and Computational Concentration

Contemporary computation also combines diffusion of analytical assistance with concentration of upstream productive capacity. At the level of use, software, cloud services, machine-learning tools, and generative systems can reduce the time and expertise required for search, coding, drafting, simulation, and data analysis. Experimental and workplace evidence on generative AI already shows that assistance can raise productivity in bounded tasks and that gains can be heterogeneous across users (Noy and Zhang 2023; Brynjolfsson et al. 2025). These developments can broaden access to forms of analytical work that once required larger teams or more specialized training.

The upstream conditions of frontier computation display a different structure. Advanced model development depends on large-scale compute, specialized hardware, data infrastructure, engineering expertise, and substantial capital expenditure. The 2026 AI Index reports that industry produced more than ninety percent of notable AI models in 2025 and documents rapid growth together with substantial concentration in global AI compute infrastructure (Stanford Institute for Human-Centered Artificial Intelligence 2026). The diffusion of interfaces to many users can therefore coexist with concentration of the infrastructural capacity on which those interfaces depend.

These two movements should be analyzed together. A small organization may gain access to powerful analytical assistance through an external service while becoming more dependent on a small number of infrastructure providers. A researcher may gain computational capacities that would once have required institutional-scale re-

sources while losing visibility into training data, model updates, or service continuity. A firm may reduce internal analytical costs while increasing switching costs or exposure to upstream pricing and access decisions. Local capability expansion can therefore occur together with systemic dependency.

Computational concentration is not an automatic consequence of computational progress. Open models, shared infrastructure, public research institutions, interoperability, and falling hardware costs can diffuse capability. The present historical configuration nonetheless makes the relation between downstream accessibility and upstream concentration analytically important. GRE needs to distinguish the availability of a tool to users from ownership or control of the productive infrastructure that makes the tool possible.

The distinction also matters for value capture. Assistance can generate productivity gains across a broad set of users while infrastructure owners capture rents through access fees, complementary services, proprietary interfaces, data advantages, or control over standards. The distribution of gains therefore depends on the institutional pathways through which computational capacity is accessed and monetized. Technical diffusion and economic concentration can proceed simultaneously because they operate at different layers of the production structure.

1.27.4 Artificial Intelligence as Analytical Capacity and Economic Power

Artificial intelligence sharpens the double character of contemporary technical capacity because it can function simultaneously as an analytical instrument and as an economically controlled productive asset. As an analytical instrument, AI can expand the capacity to search, summarize, classify, generate hypotheses, write code, compare scenarios, and interact with complex information environments. The productivity evidence reviewed in Section 1.11 shows that these systems can complement workers and redistribute access to task-relevant expertise in specific settings (Brynjolfsson et al. 2025; Noy and Zhang 2023).

Analytical capability becomes economic power through institutional conversion. A model that can classify customers, workers, suppliers, applicants, or content has limited allocative consequence until an organization can connect its classifications to prices, access, visibility, employment, credit, procurement, or enforcement. A system capable of generating high-quality recommendations has limited bargaining power unless an actor controls the infrastructure, interface, or organizational position through which those recommendations shape decisions. The distinction between capability and power therefore remains essential.

Several conversion interfaces are especially important. Ownership links technical capacity to claims over revenue and assets. Platform position links analytical capacity to control over access and intermediation. Organizational authority links prediction to task assignment and evaluation. Infrastructure ownership links computational capacity to dependency and pricing. Data access can reinforce model quality and observational asymmetry. These relations can combine, allowing a technically capable system to become part of a durable structure of economic influence.

The concentration documented in the AI Index is therefore relevant to economic power without establishing a deterministic relation between frontier capability and social dominance (Stanford Institute for Human-Centered Artificial Intelligence 2026).

Concentrated model development and compute create one possible basis for asymmetry; law, market structure, interoperability, public infrastructure, competition, organizational design, and user exit determine how that asymmetry is converted into power. The same technical system can occupy different economic positions under different institutional arrangements.

AI also complicates the location of agency inside economic systems. A firm may delegate analysis to a model while retaining formal decision authority. Workers may rely on AI assistance while remaining responsible for output. Platforms may embed model judgments in ranking systems that influence participants without presenting the model as an independent economic subject. These arrangements distribute analytical agency across humans, organizations, and artificial systems. GRE therefore benefits from treating AI first as a relationally embedded capacity and then asking which subject positions, claims, dependencies, and responsibilities are generated around it.

This approach also preserves the distinction developed in Section 1.16 between economic subjecthood and final metaphysical personhood. An artificial system can become economically consequential through its position in productive and decision relations even where legal or moral personhood remains absent. The economic problem concerns how capability is institutionalized, who controls its deployment, who bears its errors, who captures its returns, and which forms of dependency follow.

1.27.5 Technical Capability and Epistemic Humility

The expansion of technical capacity increases the need for epistemic discipline. Richer data, larger models, faster simulation, and more capable artificial systems permit analysis of economic structures that were previously inaccessible. They also increase the number of representations, model choices, generated hypotheses, and intervention pathways that researchers and institutions must evaluate. Technical capability can reduce some forms of uncertainty while creating new dependencies on complex systems whose limitations are difficult to observe directly.

The distinction between symbolic performance and epistemic adequacy remains central. Bender and colleagues caution that fluent language generation should not be treated as equivalent to understanding, and the argument applies more broadly to the interpretation of machine-generated analytical output (Bender et al. 2021). A system can produce coherent classifications, explanations, forecasts, or policy drafts whose evidential basis, causal adequacy, or domain validity still requires independent examination. The lower marginal cost of producing analysis can therefore increase the scarcity of verification and judgment.

Contemporary AI evaluation provides a second illustration. The 2026 AI Index documents rapid capability gains together with declining transparency for some frontier systems and growing difficulty in maintaining benchmarks that remain informative as model performance changes (Stanford Institute for Human-Centered Artificial Intelligence 2026). Improved technical performance does not remove the need to ask what a benchmark measures, how training and evaluation data relate, which failure modes remain hidden by aggregate scores, and how results transfer into institutional settings.

Relational and generative systems add another source of uncertainty because observation and intervention can change the system being analyzed. A model embed-

ded in allocation, ranking, or governance can alter the behavior that later supplies its evidence. A classification can reshape the subject position it describes. A successful intervention can transform the relation that made the original model valid. The practical value of a model therefore depends partly on whether institutions can detect when the conditions supporting it have changed.

Epistemic humility in GRE is consequently a positive methodological discipline. It includes calibrated claim strength, explicit model assumptions, provenance, validation against alternative representations, preservation of uncertainty, rights of contestation where models affect subjects, and willingness to revise conclusions as relations evolve. Computational and AI assistance can strengthen each of these practices when used to compare models, search evidence, test sensitivity, and document provenance. Their contribution is greatest when technical capacity expands the range of questions that can be examined while institutional arrangements preserve the capacity to recognize error.

The double character of contemporary technical capacity can now be stated in the terms required by this chapter. The same historical developments that make relational and generative economics increasingly possible also increase the capacity to observe, classify, predict, intervene, and concentrate control over the infrastructures through which economic reality is represented. Technical progress therefore widens both the epistemic reach of economic inquiry and the institutional stakes of economic representation. This combination supplies an important part of the historical opening for GRE developed in the next section: the contemporary economy is simultaneously more relationally observable and more dependent on the governance of the very instruments that make such observation possible.

1.28 Historical Opening for Generative Relational Economics

This section draws together the historical argument developed across Sections 1.1–1.27. Its role is to explain why Generative Relational Economics becomes intelligible as a distinct research programme under the present historical configuration. The objective is narrower than a claim of historical inevitability. GRE is treated as one possible theoretical response to a conjunction of transformations in productive forces, inherited relations of production, scarcity, allocation, subjecthood, scientific representation, computation, evidence, and institutional form. The discussion therefore proceeds through six linked developments: transformation of productive forces, tension within inherited relations of production, transformation of scarcity and allocation, reorganization of productive dependence, destabilization of entity-centered subjecthood, and the emergence of economic problems whose object is increasingly relational and generative. The method is historical-material and reconstructive. It asks which material and institutional changes make certain economic questions more difficult to contain within inherited abstractions, while preserving the possibility that other theoretical responses to the same historical condition remain available.

1.28.1 Transformation of Productive Forces

The contemporary opening for GRE begins with a transformation in productive forces. Marx's historical-material formulation linked changes in productive forces to tensions within existing relations of production, while leaving open the concrete form through which such tensions are resolved (Marx 1859). Chapter 1 has used this formulation as a historical orientation rather than as a deterministic law. The relevant contemporary change is the expansion of productive capacity through digital networks, data infrastructures, automated cognition, machine learning, large-scale computation, and globally distributed organizational systems.

Digitalization lowers important costs of search, copying, communication, tracking, and verification, thereby changing which transactions and forms of coordination are economically feasible (Goldfarb and Tucker 2019). Artificial intelligence extends this transformation into cognitive and symbolic tasks. Task-based analyses of automation emphasize that technologies can displace some forms of labor while creating complementary or reinstated tasks elsewhere, so technological change should be studied through changing task structures rather than through a simple substitution narrative (Acemoglu and Restrepo 2019). Experimental and workplace evidence on generative AI similarly indicates substantial productivity effects in bounded cognitive tasks, with gains distributed unevenly across workers and contexts (Noy and Zhang 2023; Brynjolfsson et al. 2025).

The historical significance of these developments lies in the kind of productive capacity they make increasingly available. Earlier mechanization primarily expanded the scale and speed of physical production. Contemporary systems also expand the production, recombination, classification, translation, and circulation of symbols. They therefore intervene in domains previously associated with expertise, communication, research, administration, and professional judgment. The result is a productive system in which material, informational, symbolic, organizational, and computational capacities are more tightly coupled than in earlier industrial configurations.

The transformation is also uneven. Access to advanced analytical interfaces can diffuse rapidly while upstream infrastructures remain highly concentrated. Frontier model development depends on capital-intensive compute, specialized hardware, data infrastructure, and organizational capability, and recent AI-industry evidence documents continuing concentration in frontier model production and compute capacity (Stanford Institute for Human-Centered Artificial Intelligence 2026). Productive expansion therefore coexists with new dependencies on infrastructure providers, model developers, platforms, and institutions able to finance and govern high-cost computational systems.

This combination matters for GRE because it changes the analytical object of production. Productive capacity is increasingly difficult to locate within a single worker, firm, machine, or asset. It emerges from relations among human expertise, software, models, data, platforms, organizational routines, legal permissions, energy and compute infrastructures, and transnational supply networks. The transformation of productive forces therefore creates a historical setting in which relational configuration becomes more directly productive and in which the capacity of relations to generate later capabilities becomes economically salient.

1.28.2 Tension within Inherited Relations of Production

The transformation of productive forces becomes theoretically consequential when it is placed beside inherited relations of production. Modern economic institutions developed around property, contract, firms, employment, administratively recognizable recipients, and relatively stable categories of productive contribution. These forms remain indispensable. They organize responsibility, allocate rights, structure investment, and make complex economies legally and administratively actionable. Their historical effectiveness is one reason entity-centered economic analysis became so powerful.

Contemporary productive organization places increasing pressure on the assumption that productive contribution can be attributed cleanly to bounded entities. Firms remain important, yet production may depend on platform ecosystems, contractual networks, external research communities, data contributors, open-source infrastructures, cloud providers, supply chains, and distributed knowledge relations. Coase's analysis of firms already treated organizational boundaries as an institutional response to the comparative costs of using markets and internal direction rather than as a natural partition of economic reality (Coase 1937). Granovetter's account of embeddedness later emphasized that economic action is situated within ongoing social relations rather than exhausted by atomized actors or anonymous markets (Granovetter 1985). Contemporary digital production intensifies the practical relevance of both observations.

A second tension concerns employment. Wage labor historically connected productive contribution, income, organizational membership, and social recognition. Automation and AI can loosen these connections by altering which tasks require human labor and by changing the relative productive advantage of workers across tasks (Acemoglu and Restrepo 2019; Korinek and Stiglitz 2019). The resulting problem is not reducible to the quantity of employment. It concerns the institutional architecture through which access to income, insurance, training, status, and participation has been attached to employment. A productive transformation can therefore become an allocative and recognitional transformation even when total output rises.

A third tension concerns ownership and control. Productivity gains generated by collective infrastructures can be appropriated through legally concentrated claims. Evidence on the rise of highly productive "superstar" firms provides an important structural precedent: technological and organizational changes can increase aggregate productivity while simultaneously increasing concentration and altering labor shares (Autor et al. 2020). The specific mechanisms of AI-era concentration remain empirical questions, but the broader analytical point is already established. Productive abundance does not determine the distribution of control over productive assets or the claims on the surplus they generate.

These tensions do not imply that inherited relations of production have become obsolete. They indicate that the mapping from productive contribution to recognized ownership, income, authority, and participation becomes increasingly mediated by institutional relations. GRE enters this space by asking how economic relations convert productive capacities into claims, dependencies, exclusions, and future possibilities. The historical opening therefore lies in the growing explanatory importance of the conversion architecture connecting productive forces to institutional positions.

1.28.3 Transformation of Scarcity and Allocation

The same historical transformation alters the structure of scarcity. Classical and neo-classical economics developed powerful languages for problems in which scarce resources must be allocated among competing uses. That problem remains fundamental. Material resources, energy, land, housing, time, specialized labor, compute, and institutional capacity remain scarce. Contemporary technical change therefore does not abolish scarcity. It changes its distribution across domains and, in some domains, the relation between abundance at one layer and scarcity at another.

Symbolic production provides the clearest example. The marginal cost of producing text, images, code, summaries, and other representations can fall dramatically when generative systems are available. Yet the abundance of symbols increases the burden placed on attention, verification, interpretation, provenance, and trust. Simon's formulation that an abundance of information consumes attention becomes more important as the production of candidate messages, claims, and artifacts becomes cheaper (Simon 1971). Arrow's analysis of trust as an economically consequential institution likewise indicates why systems of exchange cannot be understood through information volume alone (Arrow 1972). Where provenance and authenticity become uncertain, the capacity to verify and trust may become more valuable precisely because symbolic supply has expanded.

Allocation problems therefore move beyond the transfer of a nominally scarce resource to a recognized recipient. Access to attention, institutional gateways, trusted channels, computational infrastructure, and relations capable of generating later opportunities may become decisive. Sen's capability approach is relevant here because it distinguishes possession of resources from the substantive opportunities a person can actually realize under specific conversion conditions (Sen 1999). GRE extends this concern temporally: present allocations can change the relations and capacities through which later opportunities are generated.

This temporal extension changes the meaning of scarcity. A resource can be abundant at the point of production while the relations required to convert it into learning, recognition, authority, or participation remain scarce. Knowledge artifacts can be plentiful while trustworthy epistemic communities remain difficult to build. Computational tools can be widely accessible while frontier compute remains concentrated. Information can be abundant while institutional attention remains rationed. A system can therefore experience simultaneous abundance and scarcity at different relational layers.

The historical opening for GRE lies partly in this layered structure. Allocation remains central, but the analytically relevant object increasingly includes the relation through which a resource becomes effective and the downstream conditions the allocation helps reproduce. The question shifts from the amount transferred to the generative pathway through which a transfer becomes capacity, dependence, participation, exclusion, or future option. This shift provides the historical bridge from an allocation-centered economics toward a generative relational one.

1.28.4 Reorganization of Productive Dependence

The development of artificial generativity introduces a further historical possibility. Political economy has long examined societies in which persons depend on goods and

services generated through the activity of others and in which division of labor, property, employment, exchange, and monetary claims organize access to those outputs. This description is not offered as an exhaustive origin theory of markets or money. It identifies a persistent structural problem: subjects are not materially self-sufficient, and access to socially generated capacities and products must therefore be organized through institutions. Marx's later political writings are relevant here because they connect distributive arrangements to the organization of the conditions of production rather than treating consumption shares as an isolated problem (Marx 1994).

Artificial intelligence, especially when considered together with robotics and automated infrastructures, makes it possible to ask how this structure changes when an expanding range of useful outputs can be generated without another person's direct labor. The present evidence concerns bounded tasks rather than a fully autonomous productive system, and task-based analyses caution against treating automation as a single process of total substitution (Acemoglu and Restrepo 2019; Korinek and Stiglitz 2019). The historical significance lies instead in the possibility opened by the trajectory: some forms of instrumental dependence on another human's productive activity may weaken as artificial systems become capable of producing, coordinating, or mediating a wider range of goods and services.

Such a development would not by itself dissolve political-economic dependence. Dependence can migrate. A subject who no longer requires another person's labor may still require access to models, compute, energy, data, robotic systems, land, networks, standards, legal permissions, or organizational infrastructures controlled by others. Productive abundance at the level of output can therefore coexist with scarcity at the level of access. The replacement of a human generator by an artificial generator does not constitute a transformation of the underlying relation when the capacity to use, modify, maintain, or redirect the generative system remains strongly conditioned by asymmetric claims or permissions.

This distinction reveals three analytically different layers. One concerns access to what has already been generated. A second concerns access to the capacity through which new outputs can be generated. A third concerns participation in shaping the conditions under which generation becomes possible and develops over time. Those conditions include material infrastructures, legal rules, knowledge, education, technical standards, organizational forms, relational networks, trust, institutional recognition, and increasingly the computational systems through which productive possibilities are opened or closed. The layers interact, but distribution at one layer does not determine distribution at the others.

The historical implication is that a reduction in necessary human labor need not produce a post-political-economic society. It can instead move the political-economic problem toward the organization of access to generative capacity and toward the formation, opening, closure, and reproduction of generative conditions. A society could become less dependent on human labor while remaining highly dependent on infrastructures whose use and evolution are unequally controlled. Conversely, broad access to productive outputs would remain incomplete if subjects had little capacity to participate in shaping the systems on which that access depends.

GRE treats this reorganization as an opening rather than as a technological destiny. It does not infer a particular institutional order from advances in artificial intelligence, nor does it assume that labor, exchange, money, or property disappear when artificial productive capability increases. The narrower historical claim is that AI

makes a deeper political-economic question increasingly visible: who can enter, mobilize, influence, maintain, and alter the processes through which future economic possibilities are generated? Later parts of the book develop the implications for capital, power, exploitation, access, and governance. At this point, the question matters because it helps explain why the economic object of inquiry can no longer be exhausted by the distribution of already generated outputs.

1.28.5 Destabilization of Entity-Centered Subjecthood

The transformation of productive forces and scarcity also destabilizes inherited forms of economic subjecthood. Modern economic institutions became organized around subjects that could be recognized as workers, owners, consumers, households, firms, creditors, debtors, and public authorities. These roles were never exhaustive descriptions of the persons or organizations occupying them. They were nevertheless sufficiently stable for contract, taxation, accounting, employment, welfare provision, and statistical administration.

AI complicates this architecture because systems without settled legal or moral personhood can perform economically significant tasks, generate outputs, mediate decisions, and participate in organizational workflows. Bender and colleagues' critique of large language models remains important precisely because fluent symbolic performance does not settle questions of understanding, agency, or personhood (Bender et al. 2021). GRE therefore has reason to distinguish economic participation from final ontological status. A system may have economic effects without thereby receiving the standing of a human person, legal subject, or moral patient.

Human subjecthood is destabilized from the opposite direction. If productive tasks once central to employment can be performed more efficiently by artificial systems, the relation among work, contribution, income, recognition, and membership becomes less secure. Becker's human-capital framework captured an industrial and post-industrial world in which investments in education and skill were strongly connected to productive capacity and earnings (Becker 1964). Contemporary AI can alter the return structure of particular skills, and the social consequences depend on how institutions reorganize work, ownership, training, access, and participation.

The relevant distinction is between productive contribution, productive necessity, and subject worth. A person can contribute without being comparatively necessary for a task; a person can lose comparative productive advantage without losing the capacity for experience, relation, learning, care, judgment, or participation. Sen's emphasis on substantive freedom helps expose the insufficiency of reducing social standing to productive superiority (Sen 1999). The economic problem is therefore institutional as much as technological: inherited systems may continue to allocate income and recognition through roles whose historical relation to productive necessity is changing.

A relational account of subjecthood becomes useful under these conditions because it asks how economic positions are generated and stabilized through relations of recognition, responsibility, membership, dependence, and access. Such an account does not deny persons, firms, or organizations as entities. It asks which relations make those entities economically actionable and how changes in those relations alter the subject positions available in the economy. The destabilization of entity-centered subjecthood thus becomes one route by which contemporary conditions open space

for a relational economic framework.

1.28.6 Emergence of Generative Relational Economic Problems

The preceding transformations converge in a class of problems whose object is neither a static entity nor a fixed relation. The central question becomes how economic relations generate later subjects, capacities, institutions, constraints, dependencies, and possibilities. This is the specifically generative dimension of the historical opening.

Several developments make such questions increasingly visible. Networked production means that the productivity of an actor can depend on the configuration of relations in which it is embedded. Institutional change means that rules can alter incentives while also changing the categories and relations through which later action occurs (North 1990). Evolutionary economics provides a language for routines, search, innovation, and changing populations of organizational practices (Nelson and Winter 1982). Path-dependent models show how early contingencies and increasing returns can shape later feasible trajectories (Arthur 1989). Contemporary network and multiscale methods provide additional tools for representing changing relational structures across levels (Newman 2003; Bar-Yam 2004).

The economic significance of generativity appears when present arrangements change the conditions of later generation. Education can alter future capabilities. Employment can generate professional networks and institutional access. Ownership can generate collateral, bargaining power, and future investment capacity. Platform participation can generate reputation and dependence simultaneously. Research infrastructures can generate new knowledge while concentrating access to data or compute. Allocation can therefore be evaluated partly through the futures it makes easier, harder, or impossible.

These problems exceed a static relational description because the relation itself may change through use. A cooperative relation can build trust or exhaust it. A labor relation can generate skill, dependence, identity, or exit capacity. A credit relation can expand productive capacity while changing future claims and bargaining positions. An institutional category can stabilize participation while reifying the boundary it recognizes. Generative analysis therefore asks how relations reproduce, transform, or dissolve the conditions under which later relations become possible.

GRE emerges historically at the intersection of necessity and possibility. It becomes more necessary because productive forces, scarcity, subjecthood, and power are increasingly organized through complex relations whose downstream effects matter economically. It becomes more possible because scientific, computational, evidential, and institutional capacities make such relations more observable and analyzable than before. Neither movement is complete. Relations remain partially observed, causal structures remain underdetermined, formal models remain selective, and governance remains constrained by law, normativity, computation, and power.

The historical opening should therefore be read as an invitation rather than as a conclusion. Contemporary conditions make a generative relational economics increasingly thinkable and potentially useful. They do not establish its superiority in advance. GRE must still demonstrate that relational and generative descriptions improve explanation, comparison, evaluation, or practical understanding in concrete economic problems. Section 1.29 therefore closes the chapter by stating the possibili-

ties and limits under which this historically situated research programme proceeds.

1.29 Historical Possibilities and Limits of Generative Relational Economics

This section closes Chapter 1 by stating the historical possibility conditions, analytical scope, and persistent limits under which Generative Relational Economics proceeds. Its role is to convert the chapter's historical reconstruction into a disciplined statement of theoretical standing. The objective is to specify what contemporary conditions make GRE increasingly feasible, which forms of analysis those conditions enable, which institutional developments permit relational and generative questions to become actionable, and which epistemic and normative limits remain constitutive. The discussion proceeds through relational observability, generative analytic capacity, institutional possibility, epistemic and normative limits, and the historical situatedness of GRE itself. The method is synthetic and reflexive. It draws on the chapter's historical, institutional, methodological, and normative analyses while treating GRE as one historically generated response among possible responses to the contemporary economic condition.

1.29.1 Relational Observability

A relational economics becomes practically possible only to the extent that economically relevant relations can be observed, reconstructed, or responsibly inferred. Contemporary economies generate a density of traces that earlier periods could rarely sustain at comparable scale. Administrative records, transaction logs, platform interactions, longitudinal surveys, organizational databases, supply-chain records, machine-generated telemetry, and public statistical infrastructures can preserve sequences of interaction rather than only isolated outcomes. Data infrastructures therefore enlarge the empirical space in which economic relations can be studied over time.

This expansion of observability matters because relations are rarely exhausted by the attributes of the entities they connect. A firm may possess a given stock of capital while occupying a highly dependent position in a supply network. A worker may have a given qualification while lacking access to the institutions through which that qualification becomes economically effective. A platform may mediate exchange while simultaneously structuring search, ranking, reputation, and access. Network analysis, longitudinal linkage, and higher-order relational models make some of these structures increasingly representable (Newman 2003; Battiston et al. 2020). Public-data frameworks likewise increasingly recognize administrative, survey, citizen-generated, and machine-generated data as complementary sources within wider evidence ecosystems (World Bank 2021; Ooijen et al. 2019).

Relational observability remains mediated. Data are produced through classifications, measurement conventions, legal permissions, technical architectures, and institutional incentives. Desrosières and Porter show in different ways that statistical objects depend on conventions of classification and comparability rather than emerging as transparent copies of the world (Desrosières 1998; Porter 1995). A database may therefore make a relation visible by first deciding what counts as an actor, event,

category, transaction, or boundary. The resulting representation can be highly useful while remaining historically and institutionally constructed.

The distinction between a relational trace and the relation itself is therefore essential. Repeated communication may indicate collaboration, dependence, supervision, conflict, or routine administration depending on context. A contractual tie may formalize only part of the effective relation. Absence of recorded interaction may reflect genuine absence, informal coordination, inaccessible records, strategic concealment, or a measurement system designed around different categories. Section 1.25 therefore treated partial observation and representation dependence as persistent epistemic conditions rather than temporary technical inconveniences.

GRE consequently treats contemporary observability as a historical opening rather than as epistemic completion. More relations can be followed across time, organizations, and scales than was previously feasible, and this makes relational economic questions empirically more tractable. The same evidential expansion also increases the need to document provenance, classification, missingness, boundary choice, and the institutional production of data. Relational observability becomes scientifically valuable when the conditions of observation remain part of the analysis.

1.29.2 Generative Analytic Capacity

Relational observation supplies a map of connections and configurations; generative analysis requires an additional capacity to investigate how those relations produce later states, structures, constraints, and possibilities. Contemporary scientific and computational developments make this second task more feasible by allowing trajectories, endogenous change, feedback, heterogeneous interaction, and historical dependence to become explicit analytical objects.

Several methodological developments contribute to this capacity. Dynamical systems provide languages for trajectories and stability; complex-systems approaches examine emergence under heterogeneous local interaction; network and higher-order models represent changing relational topology; agent-based models permit heterogeneous actors and institutions to coevolve; and multiscale approaches make it possible to distinguish structures visible at different levels of aggregation (Strogatz 2024; Holland 2012; Newman 2003; Battiston et al. 2020; Tesfatsion 2006; Bar-Yam 2004). Evolutionary economics adds a specifically economic vocabulary for routines, search, innovation, and changing organizational populations, while path-dependent models clarify how early contingencies and increasing returns can alter later feasible trajectories (Nelson and Winter 1982; Arthur 1989).

These developments allow GRE to ask a stronger class of questions. A labor relation can be studied through the skills, networks, bargaining positions, and exit capacities it generates over time. An allocation can be studied through the institutional access or dependence it creates downstream. A platform relation can be studied through reputation, lock-in, and future option structure. A legal category can be studied through the subject positions and claims it makes actionable. Generative analysis therefore concerns the transformation of conditions under which later economic action occurs, rather than only the immediate output associated with a present state.

Contemporary computation expands the feasible scale of this inquiry. Large simulations, temporal-network computation, differentiable pipelines, and hybrid empirical-modeling systems allow analysts to explore model families that would

once have been prohibitively costly (Holme and Saramäki 2012; Baydin et al. 2018). Yet computational capacity changes the size of the model space more quickly than it resolves the problem of model adequacy. A simulation can represent a mechanism precisely while representing the wrong mechanism. A dynamic network can reproduce observed patterns while omitting the institutional meaning of the links. A path-dependent model can generate lock-in without establishing that the empirical case follows the proposed feedback process.

Generative analytic capacity must therefore remain tied to evidential discipline. The relevant gain is the ability to formulate, compare, and interrogate richer mechanisms, not the ability to eliminate historical contingency or uncertainty. Manski's distinction between what data identify and what additional assumptions contribute remains especially important when models become more elaborate (Manski 2008). GRE uses expanded analytic capacity to sharpen questions about generation, propagation, and transformation while preserving explicit uncertainty about mechanism, boundary, scale, and historical transfer.

1.29.3 Institutional Possibility

A theoretical framework becomes economically consequential only when institutions can recognize at least some of the objects it describes. Contemporary institutional development provides partial precedents for treating collective relations, shared assets, fiduciary responsibilities, capabilities, common resources, environmental constraints, and adaptive revision as legitimate objects of economic organization. These precedents do not constitute a ready-made GRE institutional order. They show that modern *nomos* already contains forms through which economic action can be organized around structures more complex than isolated ownership by a single bounded recipient.

Trust law, for example, can partition assets and organize claims among trustees, beneficiaries, and third parties through a durable legal structure (Hansmann and Mattei 1998). Cooperative institutions can connect economic participation to jointly owned and democratically controlled organizations (International Cooperative Alliance 1995). Commons scholarship demonstrates that groups can construct rule systems for governing shared resources under conditions that vary across successful and unsuccessful cases (Ostrom 1990). Human-development approaches shift evaluative attention from resource possession alone toward substantive capability and opportunity (Sen 1999). Environmental and intergenerational frameworks extend the relevant horizon beyond present output toward the conditions inherited by future participants (World Commission on Environment and Development 1987).

These institutional forms matter for GRE because they demonstrate several kinds of possibility. Economic claims can be attached to collective arrangements. Decision rights can be distributed. Stewardship can be distinguished from unrestricted alienation. Beneficial interests can differ from formal control. Rules can be revised when ecological or social conditions change. Resources can be evaluated partly through the capabilities they enable. None of these arrangements is intrinsically generative or just; each can succeed, fail, exclude, or produce unintended dependencies. Their significance lies in demonstrating that the institutional grammar of economic life is historically variable.

Adaptive and evidence-informed governance provides a further possibility. Con-

temporary public-governance frameworks increasingly emphasize monitoring, evaluation, evidence updating, and institutional learning across policy cycles (OECD 2020a; OECD 2020b; OECD 2020c). Such arrangements create institutional space for decisions to be revised as downstream effects become visible. For GRE, this is particularly relevant because generative evaluation is temporally incomplete. If an intervention changes capabilities, relations, constraints, or option spaces over time, institutional arrangements require procedures for observing those effects and reopening prior judgments.

Institutional possibility therefore concerns the capacity to make relational and generative objects actionable without assuming that every relation should be formalized. Legal recognition can stabilize a relation while also reifying it; measurement can make a collective visible while narrowing its meaning; adaptive governance can increase responsiveness while also expanding surveillance or administrative reach. GRE consequently treats institutional development as an enabling condition whose design remains normatively and politically contestable.

1.29.4 Epistemic and Normative Limits

The historical possibility of GRE is inseparable from limits that cannot be removed by greater technical sophistication alone. Relations remain partially observable, causal mechanisms remain underdetermined, boundaries and scales remain analytically consequential, and generative trajectories remain temporally incomplete. Section 1.25 established these limits at the level of knowledge, while Section 1.26 showed how they reappear in governance through administrative abstraction, legal categories, computational tractability, normative plurality, and unequal power over observation and classification.

The first limit concerns inference. Rich relational data do not automatically distinguish causation from selection, common causes, strategic adaptation, or unobserved structure. Longitudinal evidence can improve temporal reconstruction without guaranteeing identification. Larger models can represent more mechanisms while creating additional degrees of freedom. The appropriate response is calibrated claim strength: association, mechanism evidence, historical reconstruction, counterfactual support, and formal plausibility should be distinguished rather than compressed into a single language of proof. Manski's analysis of identification provides a useful discipline for this restraint (Manski 2008).

The second limit concerns scale and boundary. An observed relation can change meaning when the analytical boundary expands. A cooperative relation within one organization may depend on extraction elsewhere in a supply chain. A beneficial local intervention may transfer risk across jurisdictions or generations. Robinson's demonstration that aggregate and individual correlations may differ remains a classic warning against treating patterns at one scale as direct evidence at another (Robinson 1950). GRE therefore treats multiscale analysis as a source of additional questions rather than a guarantee of a privileged final scale.

The third limit is normative. Generativity does not establish goodness. A relation can generate capability while also generating dependence; an institution can stabilize trust while excluding outsiders; an innovation can expand aggregate option space while closing options for particular groups. Sen's capability framework is useful precisely because evaluative questions depend on the substantive freedoms

available to differently situated persons rather than on resource totals alone (Sen 1999). Rights, participation, recognition, historical responsibility, and intergenerational consequences introduce normative dimensions that cannot be inferred mechanically from system dynamics.

The fourth limit concerns power. Observation, classification, prediction, and intervention are themselves relational capacities. Actors able to define categories, control data infrastructures, set model assumptions, allocate compute, or determine which evidence enters institutional processes can shape the reality that governance subsequently treats as given. Contemporary technical capacity therefore has the double character developed in Section 1.27: it can widen analytical access while concentrating the infrastructures through which economic reality is represented and acted upon.

These limits define GRE's practical discipline. The framework requires sufficiently strong claims to be useful and sufficiently explicit limits to remain revisable. Relational and generative analysis should be introduced where it changes explanation or evaluation, and its additional complexity should be justified by the economic problem under study. Epistemic humility is therefore an operational condition of the framework rather than a concluding disclaimer.

1.29.5 Generative Relational Economics as a Historically Situated Theory

GRE is itself part of the historical process it seeks to analyze. Its concepts arise within a period marked by global production networks, digital intermediation, artificial intelligence, symbolic abundance, transformed scarcity, intensified data infrastructures, expanding computational capacity, new forms of concentration, and growing concern with capabilities, commons, environment, and intergenerational effects. The framework therefore has no privileged position outside history from which to describe an economy that remains historically dynamic.

This situatedness clarifies the status of the chapter's central claim. Relations have always mattered in economic life. Earlier economic theories were not simply deficient because they often foregrounded entities, prices, resources, or allocation. Those abstractions were historically powerful because property, firms, households, employment, contracts, accounts, and administrative categories made many economic processes tractable through relatively stable units. Chapter 1 has therefore reconstructed entity-centered economics as historically intelligible before identifying the contemporary conditions that expose some of its limits.

GRE emerges when several developments converge. Productive capacity becomes increasingly distributed across relations among humans, organizations, software, data, platforms, and infrastructures. Scarcity becomes layered across material, informational, attentional, institutional, and generative domains. Economic subjecthood becomes less securely tied to inherited productive roles. Scientific and computational languages make dynamic relational structures more representable. Evidence infrastructures make some trajectories more observable. Legal and institutional forms provide partial precedents for collective, capability-based, fiduciary, cooperative, and adaptive arrangements. At the same time, uncertainty, normative plurality, surveillance, concentration, and classification power remain unresolved.

A historically situated theory must therefore remain open to historical revision.

Concepts developed for the present configuration may lose explanatory value as productive forces, institutions, and social relations change. New evidence may show that a proposed generative mechanism is weak, domain-specific, or incorrectly specified. Other economic traditions may explain a problem more parsimoniously or reveal dimensions GRE has obscured. The framework's commitment to revisability follows from the same historical reasoning used to study economic categories themselves: a theory that treats economic forms as historically generated cannot coherently exempt its own categories from historical development.

This position also limits GRE's disciplinary ambition. The framework is proposed as a language and research programme for economic problems in which relational constitution, generative transformation, heterogeneous value, multiscale dynamics, and downstream possibility are analytically consequential. It does not require every economic problem to be reformulated relationally, and it does not claim to replace theories that perform well within their domains of adequacy. Its contribution must be demonstrated through comparative explanation, empirical research, formal development, historical interpretation, and practical analysis.

Chapter 1 has established the historical condition under which such a programme becomes thinkable. The next task is intellectual rather than chronological. The following chapter reconstructs the philosophical, social-theoretical, economic, and scientific lineages from which the conceptual resources of GRE can be assembled. The movement from historical conditions to intellectual genealogy preserves the chapter's central discipline: GRE is approached as a historically situated theoretical formation whose concepts require both ancestry and justification, and whose future development remains open to criticism, counterevidence, and revision.

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Chapter 2

Intellectual Lineages and Theoretical Foundations

This chapter reconstructs the intellectual lineages and theoretical resources through which Generative Relational Economics (GRE) becomes conceptually possible. Its role within Part I is mediating. Chapter 1 located GRE within a historically changing economic, institutional, scientific, and technical environment; Chapter 3 will state GRE's disciplinary constitution and research programme. The present chapter occupies the interval between those tasks. Its objective is to identify the philosophical, social-historical, economic, normative, and formal traditions that supply GRE with concepts, distinctions, problems, and representational resources, while preserving the differences among those traditions.

The chapter therefore uses intellectual genealogy in a deliberately non-exclusive sense. A lineage may contribute a concept, a problem-form, a method of abstraction, a critique, or a formal language without becoming a direct ancestor of every GRE claim. The presence of a comparable relational, processual, historical, or generative idea in two traditions does not establish theoretical identity. Several of the traditions examined here disagree about ontology, value, agency, evidence, historical change, and normativity. Those disagreements are part of the theoretical material of GRE rather than obstacles to be removed in advance. The chapter accordingly treats comparison as a practice of locating convergences, differences, translation possibilities, and unresolved tensions.

Because several economic traditions reconstructed here return in Chapter 21, the division of analytical labor between the two chapters requires explicit statement. Chapter 2 is genealogical. It asks which concepts, problems, distinctions, methods, and disputes made GRE intellectually possible, and what may be inherited without erasing provenance, historical specificity, or disagreement. The traditions examined here are therefore reconstructed primarily within their own intellectual contexts, while later GRE questions enter only where they clarify inheritance, unresolved tension, or a limit of translation. Chapter 21 begins only after GRE's substantive architecture has been developed. Its task is reciprocal theoretical dialogue rather than renewed genealogy: it tests domains of adequacy, evidential warrants, partial translations, non-equivalences, and corrections to GRE. Historical exposition there should consequently be limited to what a comparative mechanism, evidential distinction, or

translation boundary requires.

The discussion is organized through progressive concretization. It begins with the most abstract conceptual conditions of inquiry: ontology, epistemology, appearance, perception, aesthetic judgment, curiosity, subjectivity, interpretation, relation, process, and emergence. These topics establish the vocabulary required to ask what kinds of realities economic analysis presupposes, how those realities become accessible, how subjects orient attention, and how relatively stable objects can arise within processes of change. The aim is methodological discipline. GRE should not allow a convenient formal model to determine its ontology implicitly, nor should it treat relation, process, or emergence as self-explanatory terms.

The next movement turns toward social and normative reality. Social facts, habits, norms, legal and governance facts, subject formation, value, justice, and *nomos* provide resources for understanding how economic objects become stabilized through collective practice and institutional recognition. This layer is especially important because GRE examines realities whose causal efficacy may depend on recognition, classification, expectation, authority, and historically reproduced relations. The discussion therefore moves from abstract philosophical questions toward social forms in which relations acquire persistence and practical consequence.

The economic and political-economic sequence then reconstructs traditions that illuminate different dimensions of economic life. Classical political economy contributes problems of social wealth, production, labor, distribution, and social order. Marginalist and neoclassical economics contribute rigorous analyses of scarcity, choice, equilibrium, welfare, information, and allocation. Marxian and historical-material traditions foreground historically specific relations of production, accumulation, reproduction, contradiction, and transformation. Institutional economics, economic sociology, relational sociology, capability approaches, care and feminist economics, commons traditions, evolutionary economics, ecological economics, circular and regenerative thought, relational-value approaches, and justice theory each enlarge the field of economic questions in different directions. GRE draws from this plurality while retaining the possibility that a neighboring tradition may explain a particular problem more precisely than GRE does.

A further movement examines scientific and formal lineages. Systems theory, cybernetics, dynamical systems, complexity science, network and higher-order models, field-based and background-sensitive representations, and information or computational approaches provide languages for describing feedback, trajectories, multiscale organization, changing topology, distributed conditions, and computational limits. These resources are important for GRE because relational and generative claims often concern structures that evolve through time. Their use remains representational and problem-dependent. Formal similarity with a physical, biological, or computational system does not by itself establish that an economic system shares the same ontology or mechanism.

The chapter closes by locating Generative Relational Theory (GR) within this heterogeneous intellectual landscape and by identifying both convergences and unresolved theoretical problems. GR supplies the immediate meta-framework from which GRE develops, including ontological suspension, relational and representational layers, generative systems, trajectories, fields, and endogenous transformation of generative rules. The present book nevertheless develops only the GR foundations required for economics. GRE remains a domain-specific research programme whose claims must

be justified within economic inquiry and remain open to correction from existing economics, adjacent disciplines, and later GR developments.

The resulting genealogy is therefore neither a catalogue of influences nor an argument for theoretical unification. It is an architecture of conceptual possibility. Its purpose is to show how a set of historically accumulated philosophical questions, economic traditions, normative concerns, and scientific formalisms can be placed into disciplined relation without being collapsed into a single vocabulary. The first section establishes that architecture explicitly; the sections that follow then examine its components in progressively more concrete form before returning, at the end of the chapter, to the theoretical position of GRE.

2.1 Architecture of the Intellectual Genealogy

This section establishes the organizing architecture for the chapter's intellectual genealogy. Its role is to specify how heterogeneous philosophical, social-historical, economic, normative, scientific, and formal traditions will be related before the chapter examines them individually. The objective is to provide a reading structure that preserves theoretical differences while making cumulative movement toward GRE visible. The discussion proceeds through four families of intellectual resources and then explains the principle of progressive concretization that connects them. The method is reconstructive and comparative: each lineage is approached according to the conceptual work it can perform, the questions it makes visible, and the limits that remain when it is translated into a generative relational framework.

2.1.1 Philosophical Foundations and Conceptual Primitives

The philosophical layer supplies the most abstract distinctions required by the rest of the book. Economic analysis ordinarily operates with entities, properties, states, relations, processes, events, values, subjects, observations, and representations. These terms can appear sufficiently familiar to function as background vocabulary, yet different theories assign them substantially different meanings. An entity may be treated as ontologically prior to its relations, as constituted through relations, or as a relatively stable configuration within an underlying process. A property may be intrinsic, relational, institutional, or representational. A state may describe an object at a moment, while a process may concern the transformations through which states, boundaries, or even the object itself change.

GRE requires these distinctions because its substantive claims depend on movement among several analytical levels. A firm can be treated as an administratively recognized entity, as an organization constituted by internal and external relations, and as a participant in generative processes that alter later capacities and institutional conditions. These descriptions can coexist, yet they answer different questions. The philosophical genealogy therefore provides conceptual discipline for deciding when a given description is appropriate and what commitments follow from using it.

Ontology and epistemology form one part of this foundation. Ontological questions concern the status of the realities invoked by analysis; epistemological questions concern the conditions under which those realities can be observed, inferred, represented, and revised. GRE's later use of ontological suspension depends on keep-

ing these questions distinct. A model can operate effectively without resolving the ultimate metaphysical status of every object it contains, provided that its practical ontological commitments are explicit enough for the inquiry at hand.

Appearance, perception, salience, aesthetics, curiosity, phenomenology, and hermeneutics extend the philosophical foundation beyond ontology and epistemology in a narrow sense. Economic inquiry begins within a field of selective attention: some phenomena become visible, some relations become salient, and some questions are judged worthy of sustained inquiry. Aesthetic judgment is relevant here in its broad philosophical sense of orientation toward form, coherence, surprise, elegance, or generative promise. Curiosity concerns the movement from encounter to question formation. Phenomenology and hermeneutics add problems of lived experience, situatedness, interpretation, language, and historically variable horizons of meaning. These topics matter because GRE eventually asks how subjects, values, knowledge, and economic possibilities become significant within relational systems.

Relation, process, becoming, and emergence then provide the conceptual bridge toward generative analysis. A relational vocabulary can describe constitution, dependence, position, and interaction; a processual vocabulary can describe continuity and transformation; emergence concerns relatively stable properties or structures that arise through interactions without being adequately specified by isolated components alone. GRE does not treat any one of these vocabularies as a final metaphysics. Their role in the genealogy is to provide alternative conceptual resources for economic objects that are constituted, reproduced, and transformed through time.

2.1.2 Social-Historical and Political-Economic Lineages

The second family of lineages moves from abstract philosophical categories toward historically organized social reality. Social facts, institutions, norms, legal forms, habits, conventions, fields, roles, and relations of production provide vocabularies for explaining how recurrent patterns become durable enough to organize conduct. These traditions are important for GRE because many economically consequential objects possess causal efficacy through historically reproduced recognition and coordination. Property, contract, money, employment, corporate organization, administrative classification, and market participation all depend on institutional conditions that exceed the isolated characteristics of individual actors.

Historical-material traditions contribute a particularly important orientation. They direct attention toward the relation between material conditions, productive forces, relations of production, institutions, and historically specific categories of economic thought. Chapter 1 used this orientation to reconstruct why entity-centered allocation became a powerful economic abstraction and why contemporary transformations reopen questions of relation and generation. The present chapter turns from that historical diagnosis to the intellectual resources through which materiality, social relations, contradiction, accumulation, reproduction, and historical transformation have been theorized.

Institutional economics and economic sociology supply related resources from different directions. Rules, conventions, embeddedness, trust, reciprocity, path dependence, and organizational forms make visible the institutional conditions under which economic action becomes possible and intelligible. Relational sociology and social field theory shift attention toward positions, networks of dependence, fields

of power, and the constitution of actors through relations. These traditions help GRE avoid treating economic relations as a thin layer added after independently completed subjects have already been defined.

The social-historical lineage also constrains the generality of GR concepts. A relational pattern observed in one historical formation does not automatically become a universal structure. Institutions can stabilize different subjects, classifications, and normative orders at different times. The same formal relation may therefore acquire different social meanings and causal consequences across historical settings. GRE's relational language must remain sensitive to this historical specificity.

2.1.3 Economic and Normative Lineages

The third family contains economic and normative traditions that specify the substantive problems to which GRE must respond. Classical political economy foregrounds social wealth, production, labor, distribution, and the organization of economic order. Marginalist and neoclassical traditions develop powerful analyses of scarcity, preferences, choice, equilibrium, welfare, information, incentives, and allocation. Marxian traditions emphasize historically specific production relations, accumulation, social reproduction, exploitation, and structural transformation. GRE does not acquire coherence by selecting one of these traditions as a complete predecessor. Its theoretical problem-space emerges partly from their different strengths and unresolved tensions.

Later approaches widen the range of economically relevant objects. Capability and human-development approaches distinguish resources from the substantive opportunities into which persons can convert them. Care, feminist, and social-reproduction economics foreground dependency, care relations, reproductive labor, and forms of value that market accounting can underrecognize. Commons, cooperative, and solidarity traditions examine collective ownership, reciprocity, shared infrastructure, and governance arrangements that differ from both isolated private ownership and centralized administration. Evolutionary economics emphasizes variation, innovation, retention, routines, and coevolution. Ecological economics places economic activity within material, energetic, ecological, and intergenerational constraints.

Circular and regenerative approaches introduce questions of recirculation, retention, restoration, and the conditions under which productive activity sustains or transforms the systems on which it depends. Relational-value and relational-goods traditions provide vocabulary for forms of value located partly in relations themselves rather than solely in separately possessed objects. Justice theory adds distributive, procedural, relational, historical, and intergenerational questions. These lineages are especially important for GRE because generativity alone does not establish normative desirability. A process can generate capacities for some actors while generating dependence, exclusion, or ecological degradation for others.

The normative genealogy therefore accompanies the economic genealogy rather than appearing only after positive theory has been completed. Questions of value selection, recognition, participation, return, power, and justice influence which economic transformations are considered significant and how they are evaluated. GRE will later develop its own account of heterogeneous value and generative justice, but that development remains dependent on distinctions already elaborated in neighboring normative and economic traditions.

2.1.4 Scientific and Formal Lineages

The fourth family concerns scientific and formal languages capable of representing systems whose states, relations, and transformation conditions change through time. Systems theory and cybernetics contribute concepts of system-environment relations, feedback, regulation, control, self-organization, and adaptation. Dynamical-systems theory contributes state spaces, trajectories, attractors, bifurcations, and time-dependent dynamics. Complexity science contributes nonlinearity, emergence, adaptation, multiscale organization, and coevolution. Network science makes relational topology explicit, while hypergraph, higher-order, and multilayer approaches provide representations for interactions that exceed pairwise ties or occur across several relational layers.

Field-based formalisms provide another way to represent distributed conditions that influence actors across space, position, or configuration. Gauge and background-sensitive ideas supply more specialized conceptual resources for distinguishing meaningful structure from representational redundancy and for asking whether the background conditions of a model are fixed or themselves dynamic. GRE uses these ideas cautiously. Their value lies in the kinds of structural questions they make expressible, while their physical origins provide no automatic warrant for importing their ontology into social analysis.

Information theory, computation, simulation, and formal model construction add another dimension. They clarify limits on representation, tractability, inference, and experiment within complex systems. Computational methods can explore heterogeneous agents, evolving networks, counterfactual trajectories, and multiscale interactions that are difficult to analyze analytically. They also introduce dependencies on data, parameterization, algorithms, and model architecture. Formal capacity therefore enlarges the space of possible inquiry while preserving the need for empirical, historical, and interpretive validation.

The scientific lineage is consequently plural by design. GRE does not require every economic problem to be expressed through one universal formalism. Dynamical, network, field, categorical, geometric, algebraic, statistical, and computational representations can illuminate different structures. Their suitability depends on the object of inquiry, the available evidence, the scale of analysis, and the kind of claim being made.

2.1.5 Progressive Concretization toward Generative Relational Economics

The architecture of the chapter moves through progressive concretization rather than through a hierarchy in which later traditions supersede earlier ones. Philosophical foundations clarify the concepts with which inquiry begins. Social-historical traditions show how those concepts acquire institutional and historical form. Economic and normative traditions specify substantive problems of production, allocation, value, capability, reproduction, ecology, power, and justice. Scientific and formal traditions provide representational languages for structures and processes that may be difficult to express in ordinary prose alone. Generative Relational Theory then brings selected elements of these lineages into a provisional meta-framework from which GRE develops as a domain-specific economic programme.

This movement preserves several kinds of difference. Conceptual similarity does not imply common ontology. Comparable mathematical structures do not imply common mechanisms. Shared concern with relation does not mean that embeddedness, relations of production, network ties, care relations, legal relations, and field positions are interchangeable. Shared concern with generation does not make evolutionary selection, ecological regeneration, social reproduction, institutional emergence, and generative value instances of one already-settled process. The chapter therefore uses convergence as an invitation to comparison and further specification.

Progressive concretization also leaves room for reverse correction. Economic problems can expose weaknesses in abstract philosophical distinctions. Historical cases can reveal that a supposedly general relation is domain-specific. Empirical evidence can constrain a formal analogy. Normative analysis can show that a generative mechanism produces outcomes that require restriction or institutional counteraction. Existing economic theories may offer more precise accounts of particular mechanisms than GRE presently possesses. The genealogy therefore runs in more than one direction: inherited concepts make GRE possible, while the development of GRE can also reveal where those inherited concepts require revision.

The final movement toward GRE is accordingly integrative without aspiring to total theoretical synthesis. The chapter will first examine philosophical and social foundations, then political-economic and normative traditions, then scientific and formal lineages, before returning to GR and the unresolved integration of relation, value, and generativity. The resulting structure prepares Chapter 3 to define GRE as a research programme with explicit objects, commitments, limits, and open problems. Intellectual genealogy thus functions here as a map of conceptual possibility and theoretical constraint rather than as a claim of intellectual ownership or final unification.

2.2 Ontology, Metaphysics, and the Status of Reality

This section establishes the ontological vocabulary required by the remainder of Chapter 2 and by GRE's later substantive arguments. Its role is conceptual rather than adjudicative: the chapter needs a disciplined way to speak about entities, properties, states, relations, processes, and events without converting one useful description into a final metaphysical doctrine. The objective is therefore to reconstruct several major ontological orientations, identify the analytical work each can perform, and specify the limited commitments GRE requires from them. The discussion proceeds from substance and entity, through property and state, to relation, process, and event, before closing with the distinction between practical ontological commitment and ontological suspension. The method is comparative and reconstructive. Historical positions are treated as intellectual resources whose differences remain visible, while GRE adopts only those commitments required for economic inquiry.

2.2.1 Substance and Entity

The language of substance provides one of the longest-standing ways of organizing questions about what exists and what persists through change. Aristotle's *Metaphysics* gives substance a privileged place in the investigation of being and repeatedly asks what it is for something to count as a relatively primary bearer of predicates,

change, and explanation (Aristotle 2016). The Aristotelian tradition is internally complex, especially once matter, form, essence, and actuality enter the analysis. Its importance for the present genealogy lies less in a single doctrine than in the durable analytical image it helped stabilize: a world can be described through relatively identifiable things that possess characteristics, persist through some changes, and provide subjects about which further claims are made.

Economic analysis inherits a practical version of this image whenever it begins from persons, households, firms, assets, states, or organizations as identifiable units. Such entities can be counted, assigned rights, endowed with properties, observed at successive times, and entered into models as variables or agents. Chapter 1 showed why modern legal, accounting, administrative, and statistical institutions made this entity-centered mode of analysis especially productive. The metaphysical lineage therefore helps explain the conceptual ease with which economic inquiry can move from an observed unit to questions about what that unit owns, chooses, produces, owes, or receives.

An entity concept does not require the claim that the entity is metaphysically self-sufficient. A firm can be treated as one unit for accounting purposes while remaining internally differentiated by contracts, authority relations, knowledge flows, technologies, and organizational routines. A household can function as a statistical unit while its internal distribution and dependency relations remain economically consequential. Entity-level description is therefore best understood in GRE as a resolution of analysis: it identifies a relatively stable unit whose internal complexity can be bracketed when that complexity does not materially alter the question under study.

This distinction separates analytical entityhood from strong substance metaphysics. GRE requires entities because economic institutions and empirical methods frequently operate through them. It does not follow that entities are always ontologically prior to the relations through which they are constituted. The relevant question is local: whether treating a configuration as a unit preserves the structure needed for the explanation, comparison, or intervention at hand. Entity-centered analysis remains legitimate where that condition is satisfied, and relational analysis becomes necessary when the omitted constitution materially affects the result.

2.2.2 Property and State

Properties and states provide two further ways of describing relatively stable economic objects. A property attributes some characteristic to an entity or configuration: ownership status, income, liquidity, productive capacity, contractual position, or institutional membership may all be represented in this form. A state describes the configuration of an object or system at a specified moment or over a specified interval. In empirical and formal work, the distinction is often practical rather than metaphysically exhaustive. A property may be one component of a state, while a state may summarize a larger set of properties and relations relevant to subsequent change.

Analytical metaphysics provides one influential example of a more structured account. Armstrong's theory of states of affairs treats particulars, properties, and relations as constituents of facts or states of affairs rather than treating a world of bare things as sufficient in itself (Armstrong 1997). The importance of this position for GRE is illustrative. It shows that even within a broadly realist and entity-compatible meta-

physics, analysis can shift from isolated things toward structured configurations in which properties and relations are integral to what obtains.

Economic states are usually more modest constructions. A balance sheet, an employment status, a market position, or a network location is defined through a representational scheme that selects some dimensions and leaves others outside the immediate description. The state therefore depends on a choice of variables, categories, temporal resolution, and boundary. This dependence does not make the state arbitrary. A well-constructed state can preserve precisely those distinctions needed to explain an economic transition. The important requirement is that the representation remain explicit about what has been included and what has been suppressed.

GRE consequently treats property and state as analytically useful without granting either automatic ontological primacy. Some properties are intrinsic enough for a local purpose; others are relational or institutional. Ownership, for example, cannot be reconstructed adequately as a physical feature of an object because its economic force depends on a recognized normative and institutional relation. Likewise, a firm's "state" at a moment may include internal capabilities, external obligations, and network dependencies that cannot be assigned to the firm independently of its relations. The ontology appropriate to an economic state therefore follows the structure required by the question rather than a universal presumption that all economically relevant properties reside inside isolated entities.

2.2.3 Relation and Relational Reality

Relational approaches become necessary when the identity, capacity, meaning, or causal efficacy of an economic object depends materially on its connections to other objects or structures. The intellectual lineage for this shift is diverse. Cassirer's *Substance and Function*, for example, reconstructs a movement in modern scientific thought from thing-concepts toward functional and relational forms of conceptualization (Cassirer 1923). GRE does not inherit Cassirer's epistemology wholesale, yet the contrast is valuable because it makes visible a recurrent theoretical possibility: explanatory priority can move from the isolated bearer of properties toward the system of relations through which an object is determined.

Relation in GRE is correspondingly broader than an observed social tie. Exchange, ownership, credit, employment, authority, recognition, dependence, membership, care, trust, informational access, and institutional obligation can all have relational structure. Some relations are dyadic, while others involve organizations, publics, fields, or higher-order configurations. A relation may also be partly symbolized through contracts, accounts, classifications, or digital records while extending beyond any single representation of it.

The notion of *relational reality* adds a further claim. GRE uses the term for configurations that are generated and sustained through relations, acquire sufficient persistence to participate in subsequent causal processes, and can in turn modify the relations through which they are reproduced. Money, organizational authority, a corporate role, a recognized entitlement, or a durable relation of trust can be economically real in this sense even when their existence depends on institutional recognition and collective practice. The criterion concerns persistence and causal participation within the relational system; it does not settle the ultimate metaphysical category to which the phenomenon belongs.

This formulation is important because social dependence does not imply causal insignificance. An institutional object can be historically contingent and still organize behavior, access, expectation, and resource flow. Conversely, repeated observation of a category does not by itself establish that the category corresponds transparently to a deeper relational structure. The distinction between relational reality and its manifestation will be developed in Chapter 4. At the present genealogical stage, the relevant point is that relation can be constitutive rather than merely external, while the strength and type of that constitutive claim remain open to domain-specific argument.

Relational analysis therefore does not require a universal doctrine that relations are more real than entities. It requires the weaker methodological possibility that some entities, properties, and capacities are intelligible only through the relations that sustain them. GRE adopts this possibility because economic institutions routinely create objects whose practical reality depends on recognition, obligation, access, classification, and coordinated expectation. The later philosophy-of-relation sections of this chapter will examine internal and external relations in greater detail; the present subsection establishes only the ontological space in which relational constitution can be taken seriously.

2.2.4 Process and Event

Process-oriented metaphysics shifts attention from what a thing is at one moment toward the activity through which relatively stable forms arise, persist, and change. Whitehead's *Process and Reality* offers one of the most systematic twentieth-century examples, organizing its metaphysics around event-like “actual occasions” and the processes through which they become determinate (Whitehead 1929). Process philosophy more broadly treats becoming, activity, and temporal development as philosophically fundamental resources rather than secondary modifications of a fully given world of static things.

GRE uses this lineage selectively. Economic entities often possess histories that matter to their current capacities. A firm is shaped by accumulated routines, investments, contracts, personnel, technologies, and past decisions. A credit relation develops through sequences of obligation and repayment. Institutional trust can strengthen or erode through repeated interaction. In such cases, a snapshot can be descriptively correct while remaining explanatorily incomplete because the path through which the current state was generated affects what can happen next.

An event provides a complementary analytical unit. Events mark changes that are localized enough to distinguish within a trajectory: entry into a contract, bankruptcy, a regulatory decision, a technological adoption, a strike, a merger, or a market disruption can all function as economic events. Event analysis becomes generative when the significance of the event is assessed through the relations and conditions it changes. The same nominal event may produce different consequences when it occurs in different institutional, historical, or relational configurations.

Process and event therefore permit a different organization of economic explanation. An entity can be reconstructed as a relatively persistent outcome within ongoing processes; a state can be understood as a temporal cross-section of a trajectory; an event can be treated as a transformation within that trajectory; and relations can themselves form, strengthen, weaken, or dissolve over time. None of these descrip-

tions requires GRE to adopt Whitehead's complete speculative metaphysics. The intellectual contribution lies in making temporal generation analytically primary when persistence and transformation cannot be understood from static attributes alone.

This processual orientation also prepares the later distinction between relational and generative analysis. Relational analysis can reconstruct which connections constitute a system at a given time. Generative analysis asks how those relations participate in producing later states, capacities, subjects, constraints, and possibilities. Process language therefore becomes especially useful when the object of analysis includes transformation of the conditions under which subsequent transformation occurs.

2.2.5 Ontological Commitment and Ontological Suspension

Every economic inquiry makes some ontological commitments, even when it does not present itself as metaphysics. To model households, preferences, firms, expectations, institutions, network ties, capabilities, or fields is to treat some distinctions as sufficiently real for the purposes of the inquiry. Quine's classic discussion of ontology helped make this problem explicit by linking theory to the question of what it says there is (Quine 1948). GRE accepts the practical force of this insight: a model or explanation cannot operate without specifying the objects, relations, properties, or processes over which its claims range.

The relevant commitments can nevertheless remain local and revisable. A researcher may commit to the existence of firms as administratively and causally meaningful units without resolving whether firms possess an ultimate metaphysical status independent of law, practice, and recognition. A network model may commit to particular actors and relations for one research question while acknowledging that another representation could redraw the relevant boundary. A field representation may be useful for describing distributed influence without establishing that a literal field constitutes the fundamental ontology of economic reality.

GRE names this discipline *ontological suspension*. The term has a family resemblance to the phenomenological practice of suspension associated with Husserl's epoché, in which the natural attitude toward objects is bracketed so that another mode of analysis becomes possible (Husserl 2012). GRE's use is narrower and domain-specific. It does not reproduce Husserl's transcendental project. Ontological suspension in GRE means withholding stronger metaphysical conclusions than the economic inquiry requires while preserving enough provisional commitment for explanation, measurement, comparison, and action.

Ontological suspension therefore differs from ontological indifference. The researcher must still state what is being treated as an entity, relation, property, process, event, subject, or institutional fact. The suspension concerns the escalation from a successful analytical commitment to a universal metaphysical claim. A model that represents organizations as nodes may be adequate for one task without proving that organizations are fundamentally node-like entities. A process model may illuminate path dependence without proving that all economic reality is process. A relational account may explain subject formation without proving that relation is the ultimate substance of the world.

This position also creates room for theoretical pluralism. Armstrong's states of affairs, Cassirer's functional concepts, Whitehead's process metaphysics, Quine's ac-

count of ontological commitment, and Husserl's practice of suspension arise from different philosophical projects and cannot be merged into a single doctrine without substantial loss (Armstrong 1997; Cassirer 1923; Whitehead 1929; Quine 1948; Husserl 2012). GRE draws a methodological lesson from their juxtaposition: different ontological vocabularies can disclose different structures, while the strength of commitment should follow the explanatory burden of the local problem.

The resulting ontological stance is deliberately modest. Entities remain available where stable units matter; properties and states remain available where attributes and configurations matter; relations become constitutive where identity or capacity depends on connection; processes and events become central where histories and transformations matter. GRE begins from this plurality and suspends the demand for a final metaphysical settlement. The next section turns from the status of these proposed realities to the epistemic problem that follows immediately from them: the conditions under which any of them can be observed, inferred, justified, and revised.

2.3 Epistemology and the Limits of Knowing

This section establishes the epistemic vocabulary through which GRE can later distinguish observation, evidence, inference, interpretation, representation, and justified economic claims. Its role is to connect the ontological plurality developed in Section 2.2 with the practical problem of knowing a world that is only partially accessible through records, measurements, models, institutions, and situated observers. The objective is to recover several major epistemological lineages without treating any single one as a complete theory of economic knowledge. The discussion proceeds from knowledge, evidence, and justification to partial observation, inferential underdetermination, perspectival representation, and finally epistemic humility and revisability. The method is reconstructive and comparative: each lineage is read for the analytical discipline it contributes to GRE, while stronger claims about the ultimate nature of knowledge remain open.

2.3.1 Knowledge, Evidence, and Justification

Epistemology begins from a distinction that is elementary in form and demanding in practice: possessing a belief, receiving evidence, and being justified in a conclusion are different epistemic achievements. Economic inquiry depends on this distinction because almost every substantive claim passes through layers of mediation. A price series is a record generated by a measurement and institutional system; a household category is produced through definitions and sampling procedures; a causal estimate is obtained through a model that combines observations with assumptions; a historical interpretation is reconstructed from traces that survived unevenly. Evidence therefore enters inquiry through procedures that determine what is observed, how it is represented, and what inferential work it can legitimately support.

The classical analysis of knowledge in terms of justified true belief provided one influential way to organize the relation among truth, belief, and justification. Gettier's short 1963 paper became important because it demonstrated that justified true belief can arise in cases where the connection between justification and truth is epistemically defective (Gettier 1963). GRE does not require a resolution of the Gettier problem.

The relevance of this episode lies in the discipline it imposes: a conclusion can appear well supported and happen to be correct while the route connecting evidence to conclusion remains inadequate. In economic analysis, similar caution applies whenever a model fits observed outcomes for the wrong structural reason, a proxy tracks a target only under a temporary institutional configuration, or a classification produces apparently accurate aggregate patterns while obscuring the mechanism that generated them.

Evidence also acquires meaning only in relation to a claim. The same observation can bear differently on different hypotheses, and the same dataset can support descriptive, predictive, causal, or normative arguments with different strengths. Longino's account of scientific inquiry places particular emphasis on this contextual relation between evidence and hypothesis, arguing that evidential relevance depends on background assumptions and that objectivity is strengthened through critical interaction within a community of inquiry (Longino 1990). This perspective is valuable for GRE because relational economic claims often depend on background choices about boundaries, scales, categories, temporal windows, and what counts as a consequential relation.

The epistemic problem is therefore structured rather than binary. GRE needs to ask what has been observed, what has been inferred, what assumptions mediate the inference, what alternative interpretations remain live, and what degree of confidence the available support warrants. These questions become especially important when economic phenomena are relationally distributed or generatively extended through time. A claim about present allocation may be well evidenced at the level of immediate transfers while remaining weakly evidenced at the level of long-run capability formation. A claim about institutional membership may be directly documented while its effect on participation is inferred through a more contestable model. Epistemic discipline requires keeping these evidential layers distinct.

Knowledge in GRE is consequently treated as warranted enough for a specified analytical purpose rather than as a license for unrestricted extrapolation. The required warrant varies with the claim. Describing an observed relation, attributing a generative mechanism, predicting a future trajectory, and recommending an intervention place different burdens on evidence and justification. This graded view prepares the later methodological distinction between evidence for relational claims and evidence for generative claims, while preserving a more general philosophical principle: the strength of a conclusion should track the strength and structure of the route by which it is justified.

2.3.2 Observation and Partial Access

Observation provides the empirical contact through which economic inquiry becomes answerable to a world beyond its concepts, yet observation is always selective in resolution, timing, instrumentation, and accessibility. An economy cannot be observed from a position outside all of its institutions. Researchers encounter transaction records, surveys, contracts, prices, administrative files, interviews, archives, digital traces, and behavioral measurements. Each source makes some relations visible while leaving others indirect, latent, strategically concealed, historically lost, or outside the chosen boundary.

Van Fraassen's constructive empiricism gives one influential philosophical form to

the distinction between empirical adequacy and stronger realist commitment. In *The Scientific Image*, the aim of science is reconstructed around empirical adequacy, with careful attention to the distinction between observable phenomena and claims that extend beyond them (Fraassen 1980). GRE does not inherit constructive empiricism as a complete epistemology. Its relevance lies in the caution it provides against treating successful representation of observed manifestations as automatic disclosure of every underlying structure. A model may organize observable economic regularities effectively while several different relational mechanisms remain compatible with those regularities.

Observation is also mediated by instruments and representational systems. Giere's scientific perspectivism develops this point by treating both human observation and instrument-mediated observation as perspectival, while models represent selected aspects of the world for specific purposes (Giere 2006). The term *perspective* here should not be reduced to personal opinion. A perspective can be technically disciplined, collectively stabilized, and highly reliable within its domain. Its epistemic significance is that every observation has a standpoint defined by what the apparatus can register, how outputs are transformed, and which differences are preserved.

This perspective-sensitive view maps directly onto relational economic inquiry. A network dataset observes relations that have been operationalized as edges; an accounting system observes transactions within a reporting boundary; a legal record observes relations recognized by a legal category; an ethnography observes situated practices through prolonged participation; a satellite or platform dataset observes patterns through a technical sensing and classification architecture. None of these accesses the economic system in the same way. Their differences can be productive because convergent, divergent, or complementary observations expose different aspects of the same relational configuration.

Partial access also has a temporal dimension. Some economic relations are visible only retrospectively because their significance emerges through later consequences. Others disappear before systematic observation begins. Still others become observable only after an institution creates a category, reporting requirement, or technical infrastructure capable of recording them. Chapter 1 already showed how administrative and statistical systems expand observability while participating in the construction of the objects they measure. The epistemological consequence is that absence from a dataset can reflect nonexistence, nonrecognition, nonmeasurement, concealment, archival loss, or a mismatch between the phenomenon's timescale and the observation window.

GRE therefore treats observability as a relation among phenomenon, observer, instrument, category, institution, and historical moment. This formulation supports empirical realism about the consequences of observed relations while preserving caution about completeness. Partial access can yield strong knowledge when the domain of the claim is explicit. It becomes misleading when a partial representation is silently expanded into a total description of the relational system.

2.3.3 Inference and Underdetermination

Inference extends inquiry beyond what is directly observed. Economic reasoning routinely moves from records to latent variables, from associations to mechanisms, from samples to populations, from observed histories to counterfactual alternatives,

and from present states to future trajectories. These movements are indispensable because economically consequential structures are often distributed across relations or expressed through effects that cannot be read directly from any single observation. Their legitimacy depends on the assumptions connecting evidence to conclusion.

Duhem's analysis of physical theory provided an early and influential account of the difficulty of testing a single hypothesis in isolation. Experimental consequences depend on a wider theoretical and instrumental setting, so recalcitrant evidence can leave open several possible revisions within the system of assumptions (Duhem 1954). Quine later generalized a holistic orientation in his critique of reductionism, emphasizing that statements confront experience within wider webs of belief rather than as independently testable units (Quine 1951). The subsequent literature distinguishes several forms and strengths of underdetermination; the durable epistemic point is that a body of evidence can be compatible with more than one explanatory or theoretical reconstruction (Stanford 2023).

The economic relevance is immediate. An observed decline in labor share can be compatible with technological change, market concentration, institutional change, globalization, sectoral composition, measurement shifts, or combinations of these processes. A correlation between institutional membership and economic security can reflect causal protection, selection into membership, common background conditions, or reciprocal reinforcement. Relational settings add further ambiguity because interference, feedback, and higher-order dependence can make isolated-unit inference inadequate. Generative settings deepen the problem when several trajectories can produce similar present manifestations.

Underdetermination does not make inference futile. It changes the form of epistemic responsibility. Researchers can make assumptions explicit, compare rival mechanisms, seek discriminating evidence, report partial identification, and state which conclusions remain invariant across plausible alternatives. Manski's work on identification offers a particularly useful economic analogue: when data and weak assumptions identify a set of possible conclusions rather than a unique point, the identified set itself can be the appropriate empirical result (Manski 2008). This approach is compatible with GRE's broader commitment to preserving uncertainty when stronger precision would depend on assumptions the evidence cannot sustain.

The distinction between underdetermination and arbitrariness is essential. Evidence can rule out many explanations while leaving several serious alternatives. Historical knowledge, institutional detail, qualitative evidence, formal structure, and comparative cases can narrow the space further. Methodological plurality therefore becomes epistemically substantive: different methods may constrain different parts of an inferential problem. A statistical model can quantify a regularity, process tracing can test an intermediate mechanism, archival evidence can reconstruct sequence, and ethnographic observation can clarify categories that a dataset treats as given.

GRE consequently treats inference as a structured movement from evidence through assumptions to claims whose scope and uncertainty remain visible. Strong generative claims require more than temporal succession or association. They require evidence for the mechanism, conditions, trajectory, and alternative explanations appropriate to the problem. This burden will later become a central feature of the methodology of generative relational inquiry.

2.3.4 Observer, Representation, and Perspective

Economic knowledge is produced by observers who occupy positions within the world they study and who rely on representational systems that select, aggregate, and stabilize features of that world. The observer can be an individual researcher, a statistical agency, a court, a firm, a platform, a community, or an automated sensing and classification system. Each operates through capacities and constraints that affect what can be registered and how observations become evidence.

Giere's perspectivism is useful here because it treats perspectival representation as compatible with disciplined scientific knowledge. Scientific models do not reproduce reality in exhaustive form; they represent selected aspects under conditions of use, and their adequacy is evaluated relative to the purposes and systems through which they are applied (Giere 2006). For GRE, this suggests a way to avoid two symmetrical errors. One error treats a representation as a transparent duplicate of relational reality. The other treats perspectival mediation as eliminating the possibility of objective constraint. A representation can be selective and still be empirically accountable.

Longino adds a social dimension to this account. Scientific objectivity, on her contextual empiricist view, is strengthened through publicly accessible criticism, uptake of criticism, shared standards, and sufficiently distributed authority within communities of inquiry (Longino 1990). GRE draws from this lineage a procedural insight rather than a complete sociology of knowledge. Because economic representations carry institutional consequences, their reliability depends partly on whether assumptions and classifications can be contested by differently situated observers who possess relevant evidence.

Representation also participates in economic reality. A credit score, unemployment category, property title, accounting classification, risk rating, or eligibility status can begin as a representation and then alter access, pricing, obligations, behavior, and future data. The observer–representation relation is therefore potentially reflexive: observing and classifying can modify the relational system that later observations attempt to describe. Hacking's work on historical ontology and classificatory practices provides an important intellectual precedent for treating classifications as historically situated and potentially consequential for the objects and practices organized around them (Hacking 2002).

Perspective in GRE must therefore be indexed at several levels. There is a spatial and institutional position from which observation occurs, a representational scheme through which differences are encoded, a temporal position from which a trajectory is interpreted, and a normative position that influences which outcomes are judged salient. These dimensions can overlap without being identical. A statistical agency and an affected community may observe the same institution through different evidential infrastructures; a later historian may possess evidence unavailable to participants; an automated model may detect regularities while lacking contextual knowledge needed to interpret their significance.

The epistemic task is to preserve these perspectival conditions as part of the claim rather than erase them after analysis. Doing so improves comparison across representations, clarifies disagreements, and makes later re-epistemization possible when new observers, methods, or historical positions reveal structures that earlier representations could not register.

2.3.5 Epistemic Humility and Revisability

Epistemic humility follows from the preceding structure of inquiry. Evidence is mediated, observation is partial, inference depends on assumptions, representations are perspectival, and economic systems can change while they are being studied. Humility in this context concerns calibration rather than generalized skepticism. A claim should state the domain in which it is warranted, the uncertainty that remains, and the conditions under which revision would become appropriate.

Popper's philosophy of science supplied one influential twentieth-century model of disciplined revisability. His account of falsifiability and critical testing rejected the treatment of scientific theories as finally verified and emphasized the continuing exposure of theoretical systems to severe tests (Popper 2002). GRE does not adopt falsificationism as a universal methodology. Historical, interpretive, institutional, and relational claims often interact with evidence in ways that cannot be reduced to a single decisive test. The broader lesson retained here is that a research programme should specify how evidence can challenge its claims and should preserve the possibility of correction.

Revisability operates at more than the level of propositions. New evidence can change an estimate; a new method can change what becomes observable; a new institution can change the meaning of a category; a historical rupture can invalidate a previously stable relation; a new theoretical language can reorganize the object of inquiry. Hacking's historical ontology makes this temporal dimension especially salient by examining how categories, possibilities of description, and objects of knowledge emerge within historically changing styles of reasoning (Hacking 2002). Economic knowledge therefore needs versioned concepts as well as updated data.

Longino's social account of objectivity adds another form of revisability: criticism can originate from differently positioned participants whose experiences expose assumptions that a homogeneous research community leaves unexamined (Longino 1990). This is particularly relevant for relational inquiry because the observer may occupy only one position within a network of dependence, authority, care, or institutional access. Incorporating contestability into research practice can expand the evidential field without implying that every perspective has equal support for every claim.

For GRE, epistemic humility has three practical consequences. First, claim strength should remain proportional to evidential reach. Second, competing representations and unresolved alternatives should be preserved when they remain materially plausible. Third, research records should retain enough provenance for future investigators to reconstruct how a conclusion was produced. These commitments prepare the later emphasis on historical re-epistemization: a claim may become weaker, stronger, or differently interpretable when methods, evidence, categories, or historical position change.

The section therefore closes with an epistemology suited to an open research programme. Knowledge remains possible because evidence constrains inquiry, methods can be criticized, representations can be compared, and claims can be tested against consequences. Knowledge remains revisable because access is partial and the objects of economic inquiry are themselves historically dynamic. GRE's epistemic stance is consequently neither certainty nor indifference. It is disciplined commitment under conditions that remain explicit enough for later correction.

2.4 Appearance, Perception, and Salience

The preceding section examined how knowledge is constrained by partial observation, inference, representation, and perspective. The present section moves one conceptual step earlier and asks how something becomes available to an observer as an object of perception, attention, or recognition at all. Its role in the intellectual genealogy is therefore reconstructive rather than primarily constructive: it surveys several traditions that have treated appearance, perception, attention, salience, visibility, and recognition as structured phenomena instead of neutral transmission from an already given world to an isolated subject. Phenomenology, ecological psychology, classical psychology, behavioral economics, political philosophy, and recognition theory provide different answers to this problem. They should not be collapsed into a single relational theory, because they differ in object, method, and ontological commitment. Taken together, however, they establish an important condition of possibility for later GR inquiry: what becomes available for judgment depends on relations among phenomena, perceivers, practices, institutions, and historical conditions of access. The discussion proceeds from appearance and manifestation, through perception and world-disclosure, to selective attention, social visibility, and finally a limited synthesis of the relational conditions of appearance.

2.4.1 Appearance and Manifestation

A long philosophical problem precedes contemporary theories of perception: what appears need not be identical with what exists, and what exists need not appear in the same way from every position. The distinction is elementary, yet it structures much later epistemology. An appearance is never merely an additional object placed beside reality. It is the manner in which something is given, disclosed, presented, or made available under determinate conditions. The philosophical importance of appearance therefore lies in the relation between what is encountered and the conditions under which it can be encountered.

Phenomenology gives this problem one of its most systematic modern formulations. In Merleau-Ponty's *Phenomenology of Perception*, perception is approached through the phenomenal field, embodiment, figure-ground organization, spatial orientation, and the practical involvement of the perceiving subject in the world (Merleau-Ponty 2012). The perceived object is consequently not reconstructed as a bundle of independent sensory data to which meaning is added only afterward. It appears within a field whose organization already matters for what becomes determinate. Background and foreground, orientation and movement, familiarity and ambiguity are constitutive features of perceptual experience.

This line of thought is important for the present genealogy because it weakens a simple picture in which reality first exists as a complete set of determinate objects and perception subsequently copies those objects into consciousness. Phenomenological accounts instead direct attention to modes of givenness. The same physical configuration can appear differently as bodily position, practical orientation, prior familiarity, or surrounding context changes. Such variability does not by itself imply arbitrariness. It indicates that appearance has conditions.

The term *manifestation* can be used more cautiously as an analytical companion to appearance. A process, relation, institution, or condition may become accessible

through traces, effects, expressions, or events without being exhausted by them. An observed price movement can manifest a change in expectations without uniquely identifying the process that generated it; an archival record can manifest a historical practice without preserving every relation through which the practice acquired meaning; a statistical disparity can manifest an inequality while leaving its generative history open to further inquiry. This distinction is consistent with the epistemic restraint established in Section 2.3: manifestation provides evidence, while the route from manifestation to explanation remains inferential.

Political philosophy adds another meaning of appearance. Arendt's account of the public realm in *The Human Condition* gives appearance a specifically human and political significance. Human plurality becomes worldly through speech and action before others; appearance is connected to a common world in which persons become manifest to one another and in which action can initiate processes whose consequences exceed the actor's control (Arendt 1958). Arendt's concern is not perceptual psychology, and her vocabulary should not be identified with phenomenological appearance. Her work nevertheless adds an important dimension to the genealogy: appearing can be socially and politically organized. A person or action may be physically present while lacking the public conditions under which that presence becomes consequentially visible.

These philosophical lineages leave several distinctions available for later use. Reality, manifestation, perceptual appearance, and public appearance need not coincide. What is real can remain unmanifested; what is manifested can remain unnoticed; what is perceived can remain socially insignificant; and what becomes publicly visible can do so through institutions that shape the terms of visibility. The significance of these distinctions for GR is preliminary at this stage. They establish that access to a relational world is itself structured and that the conditions under which something appears deserve analysis alongside the thing that appears.

2.4.2 Perception and World-Disclosure

Theories of perception differ sharply over the relation among sensory information, the perceiving organism, the environment, and practical action. For the intellectual genealogy developed here, two traditions are especially useful because each rejects a purely atomistic picture of perception while doing so in a different way: phenomenology emphasizes embodied and situated experience, whereas ecological psychology emphasizes organism–environment structure and the information available within it.

Merleau-Ponty's phenomenology locates perception in embodied orientation. The body is not treated merely as one object among others that subsequently supplies data to an observing mind. Bodily capacities, habitual orientation, movement, and spatial involvement participate in the disclosure of a meaningful world (Merleau-Ponty 2012). A chair appears as sittable, a corridor as traversable, a familiar room as already organized around possible movement. Such examples should not be reduced to propositions consciously inferred by the subject. Their philosophical role is to show that practical significance can be present in the organization of perception itself.

Gibson's ecological approach reaches a related but theoretically distinct conclusion. His account of affordances emphasizes what environments offer animals relative to their capacities, thereby treating organism and environment as complemen-

tary terms in perceptual analysis (Gibson 1979). The affordance of a surface, opening, object, or path depends neither on an isolated list of physical properties nor on unconstrained subjective attribution. It depends on relations between environmental structure and the capabilities of an organism. Gibson's theory of direct perception differs from phenomenology in method and theoretical commitments, yet both traditions make it difficult to regard practical perceptual significance as a property of isolated objects considered independently of a perceiver's mode of access.

The expression *world-disclosure* is useful for organizing this part of the genealogy if it is kept conceptually modest. A mode of perception or practice can disclose a domain of relevant objects, possibilities, and obstacles without implying that this disclosed world is metaphysically self-contained or epistemically complete. A trained radiologist, a novice reader of an image, and an automated classifier can confront the same visual field while discriminating different structures. A lawyer, accountant, worker, and regulator can encounter the same institution while different possibilities, constraints, and categories become practically salient to each. Training, authority, instrumentation, bodily capacity, language, and institutional position all affect what can be distinguished and acted upon.

This point becomes particularly important when perception is technologically mediated. Maps, dashboards, interfaces, rankings, diagnostic systems, search engines, and models do not simply add information to an unchanged field of perception. They reorganize what can be made present, at what resolution, and in what order. A dashboard may disclose deviations that unaided observation could not track while concealing the processes through which the underlying variables were constructed. A recommendation interface may disclose an enormous cultural archive while arranging that archive through selection criteria invisible to the user. The genealogy of world-disclosure therefore extends naturally toward the study of technical and institutional mediation.

No single theory surveyed here establishes the later GR position. Phenomenology is concerned with lived and embodied perception; Gibson develops an ecological theory of perception; technical mediation introduces additional problems that neither vocabulary alone resolves. Their contribution is instead foundational. They make available the idea that perception is structured through relations among capacities, environments, practices, and mediating arrangements. Later GR analysis can inherit that problem without claiming that these traditions already contain GR in implicit form.

2.4.3 Attention and Salience

Even within what is perceptually available, only some differences become focal. Theories of attention and salience therefore introduce another layer between perception and judgment. Their common problem is selective orientation, but the term *salience* changes meaning across psychology and economics. A careful genealogy must preserve those differences.

William James offered one of the canonical psychological formulations of attention. In *The Principles of Psychology*, attention concerns the mind's taking possession of one among several simultaneously possible objects or trains of thought (James 1890). His treatment links attention to selection, interest, habit, voluntary effort, and the practical impossibility of attending equally to everything. The importance of this account

is not a timeless theory of cognitive selection. It is the recognition that experience is organized through selective emphasis and that what occupies focal awareness is partly dependent on prior interests and acquired habits.

Later uses of salience often formalize a more specific mechanism. In behavioral economics, Bordalo, Gennaioli, and Shleifer develop a salience theory of choice under risk in which attention is drawn toward payoff states whose attributes stand out relative to alternatives, and this differential salience affects decision weights (Bordalo et al. 2012). Their model is not a general philosophy of appearance, nor does it imply that all socially salient objects obey the same mechanism. Its relevance to this genealogy lies in showing that selective prominence can be incorporated into formal accounts of economic choice rather than treated as an incidental psychological disturbance around an otherwise complete representation of alternatives.

The difference between James and contemporary salience theory is theoretically productive. James's account is broad, psychological, and closely connected to interest and habit. The economic model is narrower and specifies how comparative contrast can alter the weighting of choice-relevant states. Neither alone explains public visibility, cultural attention, or aesthetic salience. Together they show that selection can occur at several levels: what enters focal awareness, which features dominate comparison, and which alternatives become practically decision-relevant.

Institutions and technologies can participate in each level. A market interface can order goods by price, popularity, sponsorship, or predicted relevance. A news system can repeatedly foreground one class of events. A scientific visualization can amplify a pattern that is difficult to detect in raw observations. An administrative category can render one form of deprivation measurable while leaving another dispersed across incompatible records. These examples extend beyond the theories cited above, but they make clear why attention cannot be treated only as an internal property of an isolated decision maker. Environments can be organized to solicit, stabilize, or redirect attention.

This is one point at which the AI era gives the older genealogy renewed importance. Search, recommendation, ranking, summarization, and generative systems increasingly intervene before conscious human selection. They can expand the range of accessible material while also pre-ordering that material according to learned or institutionally chosen criteria. The conceptual issue is prior to any normative conclusion about whether this is beneficial or harmful. Classical attention theory and modern salience theory already establish that selection matters; contemporary AI makes the organization of that selection increasingly explicit as an object of inquiry.

For later GR development, the main inheritance is therefore not a single definition of salience. It is a layered problem: perceptual availability does not guarantee attention, attention does not guarantee importance, and importance can be shaped by comparison structures, habits, institutions, and technical mediation. These distinctions become necessary once inquiry turns to how curiosity, aesthetic attraction, economic choice, or political recognition emerge from a field containing far more possible objects than any subject can engage at once.

2.4.4 Recognition and Visibility

Attention concerns selection among available objects, whereas recognition introduces an explicitly social relation. To recognize another person is not merely to

detect that person's physical presence. Recognition theories examine how persons become socially acknowledged in ways connected to standing, identity, respect, or participation. This adds a normative and institutional dimension to the genealogy of appearance.

Honneth's discussion of invisibility is especially useful because it distinguishes perceptual visibility from social recognition. A person can be seen in the ordinary sensory sense while being treated as socially nonexistent or unworthy of acknowledgement. Honneth reconstructs invisibility as a failure of recognition rather than a failure of visual registration (Honneth 2001). The distinction clarifies why increased informational visibility does not automatically produce social presence. Individuals can be counted, tracked, classified, or represented in administrative systems while remaining unrecognized in the practices through which social standing is expressed.

Arendt's political account of appearance offers a different but complementary problem. Public action takes place in a space of appearance constituted among plural persons; the actor becomes manifest through words and deeds whose meaning is inseparable from the presence and responses of others (Arendt 1958). Arendt is not developing recognition theory in Honneth's later sense. Her account nevertheless emphasizes that human appearance is relational and worldly. The possibility of appearing as an actor depends on a public realm, and the consequences of action unfold through relations that no individual controls completely.

The two lineages should therefore remain separate. Honneth concerns recognition and its denial; Arendt concerns plurality, action, and public appearance. Their convergence is limited but significant: social visibility cannot be reduced to physical observability. Institutions, practices, and other persons participate in whether someone appears as a participant, claimant, author, citizen, worker, expert, or member of a common world.

Economic analysis supplies many situations in which this distinction matters. Unpaid care can be indispensable to social reproduction while remaining weakly visible in conventional economic accounting. Informal workers can be materially active yet lack categories through which their claims become institutionally legible. A community can appear in a dataset only after an administrative classification is created. Platform workers can be intensely measurable in operational terms while having little standing in the governance of the systems that evaluate them. These examples do not all instantiate the same theory of recognition. They illustrate why perceptual, statistical, institutional, and normative visibility should not be conflated.

The distinction is particularly important under expanding digital mediation. Being visible to a machine can mean being identifiable, classifiable, rankable, or predictable. Being visible to a market can mean becoming a target of pricing or recommendation. Being visible in public can mean something else again: possessing the conditions to speak, be heard, make claims, and affect shared interpretation. The traditions reconstructed here therefore caution against measuring human appearance simply by the quantity of information available about a person.

For later GRE, this provides an important conceptual resource. Economic relations do not merely distribute material goods; they also participate in the production of categories, positions, and channels through which subjects and activities become visible or invisible. Yet that claim belongs to later substantive analysis. At the level of foundations, recognition theory and political theories of appearance establish that visibility has multiple forms and that social visibility is itself relationally constituted.

2.4.5 Relational Conditions of Appearance

The traditions reviewed in this section can now be compared without being synthesized into a single doctrine. Phenomenology treats appearance and perception through embodied, situated experience. Ecological psychology emphasizes relations between organismic capacities and environmental affordances. Classical psychology analyzes attention as selective orientation. Behavioral economics formalizes one mechanism through which comparative salience can alter choice. Recognition theory distinguishes sensory visibility from social acknowledgement. Political philosophy examines the public conditions under which persons appear to one another through action and speech. These are different research programmes addressing different objects.

Their limited convergence concerns the inadequacy of an unmediated picture of appearance. Across these traditions, what becomes available to a subject depends on conditions: bodily orientation, environmental structure, habit, interest, comparison, public institutions, social recognition, and technologies of mediation. None of these conditions is sufficient by itself. Their relevance varies with the kind of appearance under investigation.

This convergence provides one condition of possibility for a later generative relational treatment. GR can ask how the conditions of appearance are themselves formed, stabilized, altered, and transmitted through relations. Such a question goes beyond the theories reconstructed here, but it does not begin from nothing. Phenomenology already makes situated access central; ecological psychology makes organism–environment fit central; attention research makes selection central; recognition theory makes social acknowledgement relational; political theories of appearance make public presence dependent on plurality and worldly institutions. GR inherits a problem-space in which access is already conditioned.

A further possibility follows once these conditions are regarded historically. What enables a phenomenon to appear in a particular encounter can precede that encounter without being timeless. A perceptual habit can be learned; a category can be institutionalized; a canon can be formed; a technical interface can be redesigned; a vocabulary of recognition can emerge historically. The conditions of appearance can therefore have their own trajectories. Later GR sections will ask more explicitly how conditions of generation can themselves be generated. At this point, the intellectual genealogy establishes only that such recursive inquiry is philosophically and theoretically intelligible.

This is also where the existential question raised by contemporary AI can be located without turning the present section into a theory of AI. If human experience is partly constituted through what can appear, interrupt expectation, solicit attention, and become recognizable as significant, then systems that increasingly mediate encounter participate in conditions historically associated with human orientation to a world. Existing theories of perception and attention do not by themselves determine what human existence requires under AI mediation. They do show why the issue cannot be reduced to whether an artificial system supplies correct information. The organization of appearance and encounter is itself theoretically significant.

The section therefore leaves GR with a carefully delimited inheritance. Appearance is not identical with reality; perception is situated; attention is selective; salience is structured; recognition exceeds detection; and public visibility depends on social con-

ditions. These distinctions prepare the following inquiry into aesthetics. Aesthetic experience presupposes that something has appeared with enough force, form, or significance to solicit judgment, yet the traditions of aesthetics ask a further question: how does an encountered object, relation, event, or form come to be experienced and judged as beautiful, harmonious, sublime, strange, elegant, or otherwise aesthetically significant?

2.5 Aesthetics and Aesthetic Judgment

The preceding section reconstructed theories of appearance, perception, attention, salience, and recognition as conditions under which something can become available for judgment. The present section turns to a distinct but connected lineage: philosophical, sociological, psychological, and scientific accounts of aesthetic experience and aesthetic judgment. Its purpose is not to supply a new GR theory of beauty at this stage of the book. It is to recover several ways in which existing traditions have explained how beauty, harmony, elegance, sublimity, strangeness, surprise, and taste become intelligible. These traditions differ substantially. Hume emphasizes cultivated judgment and comparison; Kant analyzes judgments of beauty and sublimity through a critical philosophy of judgment; Dewey locates aesthetic experience within transactions between organism and environment; Bourdieu reconstructs taste through social position and cultural competence; empirical aesthetics investigates processing, appraisal, expertise, and the stages through which aesthetic responses develop; and philosophy of science examines the role of aesthetic criteria in theory choice. The section proceeds through these lineages before identifying the limited conceptual space they make available for later GR development, especially the historical formation of aesthetic judgment, its relation to contingency, and its possible coupling with epistemic and normative judgment.

2.5.1 Beauty and Aesthetic Experience

Modern aesthetics contains a persistent tension between two questions. One asks what makes an object beautiful or aesthetically valuable. The other asks what occurs in a subject or community when something is experienced and judged aesthetically. Theories differ according to how they distribute explanatory weight among properties of the object, capacities of the perceiver, practices of judgment, social formation, and historically available standards.

Hume's essay on the standard of taste is an important early statement of this problem. Hume begins from the evident diversity of taste while resisting the conclusion that every aesthetic judgment has equal standing. Practice, comparison, freedom from prejudice, delicacy of sentiment, and the joint verdict of qualified judges play a central role in his account (Hume 1985). The theory does not reduce beauty to a simple property located independently in objects, yet neither does it make judgment wholly arbitrary. Aesthetic competence is cultivated through repeated encounter and comparison.

Kant gives aesthetic judgment a different philosophical structure. In the *Critique of Judgment*, judgments of beauty are connected to disinterested pleasure and to a claim to a form of universal communicability that is not grounded in a determinate

concept of the object (Kant 1987). The judgment of taste therefore occupies a distinctive position between merely private liking and concept-governed cognition. Kant's account is central to later aesthetics precisely because it attempts to explain how aesthetic judgment can be subjective in its basis while nevertheless making a demand that reaches beyond idiosyncratic preference.

Dewey's *Art as Experience* shifts attention from isolated judgments toward the organization of experience. Aesthetic experience is treated in continuity with interactions between organism and environment, becoming distinctive through the consummatory integration of doing and undergoing rather than through separation from ordinary life (Dewey 1934). Dewey's position differs sharply from Kant's transcendental project, but it adds a resource that later relational theories find especially important: aesthetic significance can be analyzed through temporally organized experience and interaction rather than only through an isolated object–subject pair.

These three lineages already prevent a simple definition of beauty. Hume directs attention to cultivated capacities of comparison; Kant to the form and communicability of aesthetic judgment; Dewey to the organization of experience across interaction and time. Their disagreements remain substantial. They nonetheless make available several components that later GR can inherit without conflating them: judgment has conditions, those conditions can involve practice and comparison, aesthetic experience unfolds within an encounter, and aesthetic significance cannot be reduced without remainder to instrumental utility.

This last point is important for the place of aesthetics in the genealogy of GRE. Economic analysis often treats preference as given for the purpose of a model. Aesthetics reminds us that valuation can also involve experiences whose significance is not exhausted by possession, exchange, or expected utility. The question of how such evaluative capacities arise belongs to later sections. Here, the philosophical lineage establishes that aesthetic judgment has long been treated as a distinctive form of orientation whose standards, communicability, and cultivation require explanation.

2.5.2 Harmony, Elegance, and Form

Aesthetic discourse frequently uses terms such as harmony, proportion, order, simplicity, unity, and elegance. Their recurrence can create the impression that they name timeless and self-evident properties. Existing theories instead show that these terms acquire meaning within practices of perception, comparison, criticism, and disciplinary evaluation.

Kant's analysis of beauty gives form an important role without reducing beauty to the possession of a fixed geometrical property. His account of purposiveness without a determinate purpose concerns the way form can be judged as if organized purposively for our cognitive faculties even when no concept supplies the purpose that would determine the judgment (Kant 1987). Whatever later uses of harmony or elegance retain from Kant, they cannot therefore be represented simply as measurements of objective regularity.

Hume's emphasis on practice and comparison offers another way to understand why judgments of form can become discriminating. The experienced critic does not merely possess stronger feelings than the novice. Repeated exposure, comparison among works, and the cultivation of perceptual discrimination alter the capacity to notice relations that would otherwise remain coarse or undifferentiated (Hume

1985). Harmony and elegance can accordingly function as vocabularies through which trained perceivers articulate organized relations they have learned to distinguish.

Empirical aesthetics provides more specific hypotheses. Reber, Schwarz, and Winkielman propose processing fluency as one contributor to aesthetic pleasure, arguing that features that facilitate perceptual or conceptual processing can produce positive affect that may be attributed to the stimulus (Reber et al. 2004). The fluency account is not a general theory of beauty. Its importance lies in demonstrating how an apparently immediate aesthetic response can be studied through mechanisms relating properties of a stimulus to processing conditions in a perceiver. The same formal property need not yield the same experience when expertise, expectation, familiarity, or context changes.

The multi-stage model proposed by Leder and colleagues offers a broader psychological framework for visual aesthetic appreciation. It distinguishes stages involving perceptual analysis, implicit memory integration, explicit classification, cognitive mastering, and evaluation, while allowing expertise and context to affect the process (Leder et al. 2004). The model is substantially different from philosophical theories of taste or judgment. Its contribution to the genealogy is methodological: aesthetic appreciation can be decomposed into interacting processes rather than treated as an unanalyzable immediate response.

The language of elegance also has an important life outside art. Scientists and mathematicians often use aesthetic predicates when evaluating theories, proofs, equations, or representations. McAllister's *Beauty and Revolution in Science* examines the historical role of aesthetic preferences in scientific theory appraisal and argues that the weight attached to aesthetic properties can change through the history of successful theories (McAllister 1996). This literature is especially important for the later discussion of curiosity and epistemic orientation because it shows that aesthetic judgment can participate in knowledge practices without becoming identical with evidential confirmation.

The resulting lesson is not that harmony and elegance are merely subjective or merely social. Existing theories distribute their explanation differently among form, perceptual processing, expertise, comparison, and historical disciplinary practice. For GR, the importance of this plurality is foundational: what is experienced as organized or elegant may depend on relations between encountered structure and a historically formed capacity for discrimination. That formulation remains a bridge rather than a completed GR theory.

2.5.3 Sublimity, Strangeness, and Surprise

Aesthetics is not confined to experiences of easy harmony. Traditions of the sublime, theories of interest, and empirical work on aesthetic emotion show that difficulty, vastness, novelty, incongruity, and partial resistance to comprehension can themselves become aesthetically significant. This broadens the genealogy beyond accounts in which positive aesthetic response follows only from smooth fit between object and expectation.

Kant's analysis of the sublime provides a classical philosophical example. The sublime concerns experiences in which imagination confronts magnitude or power that exceeds its ordinary capacity for sensible presentation, while reason supplies another

dimension through which the subject relates to that inadequacy (Kant 1987). The sublime is therefore structurally different from the beautiful in Kant's account. It makes aesthetic experience possible through tension and limit rather than through the harmonious form characteristic of judgments of beauty.

Dewey likewise allows aesthetic experience to include resistance, tension, and transformation. An experience acquires unity through the temporal organization of doing and undergoing; difficulty can become part of a consummatory experience when tensions are developed and resolved rather than merely eliminated in advance (Dewey 1934). This makes aesthetic significance compatible with encounter, struggle, and temporal development.

Empirical work on interest offers another vocabulary. Silvia's appraisal account relates interest in visual art to appraisals of novelty–complexity and coping potential (Silvia 2005). Something can attract interest because it is new, complex, unfamiliar, or initially difficult, provided that the perceiver also has some possibility of making sense of it. This framework is useful because it explains why neither pure familiarity nor pure incomprehensibility necessarily maximizes aesthetic engagement. Interest can arise in a region where expectation is disturbed without the object becoming wholly inaccessible.

The distinction is significant for the role of contingency in the present book. Aesthetic experience need not be generated only by objects already predicted to fit established criteria. Unexpected encounters can reorganize attention because they disclose a relation, form, or possibility that was not included in the subject's prior anticipations. The philosophical and psychological traditions cited here explain this in different ways: through sublimity, temporal tension, appraisal of novelty, or the relation between complexity and coping. None supplies a general theory of contingency. Together they make it intelligible that surprise and partial resistance can contribute positively to aesthetic experience.

This point will later matter for inquiry. A mathematical conjecture, empirical anomaly, unfamiliar cultural form, or unexpected theoretical connection can be experienced as beautiful or compelling before its epistemic value has been established. The aesthetic response can orient further attention without functioning as evidence that the proposition is true. Existing scientific practice makes this distinction especially important: elegance can motivate investigation, while proof, evidence, and explanatory adequacy remain separate requirements.

The AI era adds a new context to an old issue. Generative systems can produce vast numbers of objects that conform to learned regularities and can also produce unfamiliar combinations. Existing theories of fluency, surprise, expertise, and interest suggest that aesthetic significance cannot be inferred simply from novelty or from conformity to preference. The relation between expectation and encounter remains theoretically important. This observation is a contemporary application of the lineage rather than an independent aesthetic theory.

2.5.4 Aesthetic Judgment and Selective Attention

Aesthetic judgment does more than register a response after an object has already received sustained attention. It can participate in the organization of future attention by determining what is revisited, compared, preserved, taught, imitated, criticized, or used as a standard. Existing theories provide several ways to understand this feed-

back without treating aesthetic judgment as a single psychological mechanism.

Hume's account already contains a temporal structure of this kind. Practice and comparison improve judgment, while improved judgment changes how later works are perceived and compared (Hume 1985). Aesthetic competence is therefore cumulative. The critic's present response carries the effects of earlier encounters, and each new encounter can refine the repertoire through which subsequent works are apprehended.

Leder and colleagues give a psychological model in which prior knowledge, expertise, classification, and cognitive mastering affect aesthetic evaluation (Leder et al. 2004). The implication is not that judgments are completely determined by training. Rather, what can be discriminated and how an object is processed depend partly on acquired repertoires. Expertise can redirect attention toward formal relations that remain unavailable to a novice, while a surprising work can require revision of previously adequate classifications.

Bourdieu places this learning within a much wider social structure. In *Distinction*, taste is connected to class position, habitus, cultural capital, and socially differentiated competencies (Bourdieu 1984). Aesthetic judgment is therefore implicated in practices of social classification and distinction. Bourdieu's analysis challenges accounts that treat taste as a purely private response detached from education, social trajectory, and access to legitimate culture. It also raises a question that more psychological models do not answer on their own: who acquires the opportunities and competencies required for particular forms of aesthetic discrimination?

McAllister's account of scientific aesthetics provides a disciplinary analogue. If scientific communities come to associate certain aesthetic properties with historically successful theories, those associations can influence which later theories attract attention and initial confidence (McAllister 1996). Scientific aesthetics thereby shows how judgments can become selective devices inside organized inquiry. The process is neither purely individual nor infallible. Aesthetic criteria can guide attention productively and can also become conservative when inherited standards favor forms associated with prior success.

These lineages together support a distinction that will become important for GRE. Aesthetic judgment can orient attention without determining epistemic or normative validity. What appears elegant may deserve examination but can be false. What appears harmonious may be unjust. What appears strange may be epistemically fertile or merely unfamiliar. Aesthetic selection therefore belongs to the conditions of inquiry and valuation without replacing the standards internal to those other domains.

Technological systems increasingly enter this selective process. Recommendation systems, cultural platforms, rankings, and generative models can amplify some aesthetic regularities while reducing exposure to others. The theoretical importance of this mediation follows from older accounts rather than superseding them: if taste develops through exposure, comparison, expertise, and social classification, then the infrastructures that organize exposure become part of the historical environment in which taste is formed. This point prepares the final subsection's discussion of historical and relational formation.

2.5.5 Historical and Relational Formation of Aesthetic Judgment

The strongest contribution of the preceding traditions to the intellectual possibility of GR lies in their shared refusal, for different reasons, to treat aesthetic judgment as an isolated instantaneous preference without history. Hume gives judgment a history of practice and comparison. Dewey places aesthetic experience within temporal transactions between organism and environment. Bourdieu reconstructs taste through social trajectory, habitus, cultural competence, and institutions. Empirical aesthetics treats expertise, memory, classification, and appraisal as conditions of response. McAllister shows how aesthetic criteria in science can acquire historically changing weights. These theories do not amount to one account of aesthetic formation, but each makes some form of antecedent conditioning theoretically legitimate.

This allows the apparent paradox of aesthetic emergence to be stated more carefully. A particular experience of beauty can be genuinely new for a subject even though capacities that make the experience possible already exist. Prior comparison, perceptual training, inherited vocabularies, embodied habits, institutional canons, expectations, and technical media can precede the local judgment. Their antecedence does not require them to be timeless. Bourdieu's sociology and McAllister's historical account make especially clear that standards which appear immediate at one moment can themselves have histories (Bourdieu 1984; McAllister 1996).

For GR, this opens a recursive question that the existing literature does not need to have formulated in GR's terms. If the conditions enabling judgment are historically produced, later judgments can also participate in altering those conditions. A work enters a canon; a style becomes teachable; a scientific representation becomes exemplary; a community learns to discriminate a previously unfamiliar form; a new medium changes what can be encountered and compared. The local event of judgment and the historical formation of the conditions of judgment can therefore be investigated at different temporal scales. This is a preliminary GR translation of resources supplied by earlier theories, not a claim that those theories are equivalent to GR.

A second possibility concerns the relation between aesthetic and normative judgment. The traditions surveyed here give strong reasons to keep them analytically distinct. Kant's aesthetic judgment does not establish moral rightness; Bourdieu's sociology shows that socially legitimate taste can participate in hierarchy rather than moral justification; scientific elegance does not prove a theory. Yet historical practice also shows that aesthetic and normative orders can become entangled. Institutions determine what is preserved, displayed, taught, protected, censored, monumentalized, or funded, and those decisions alter the field in which aesthetic sensibilities develop. Aesthetic attachments can in turn influence what communities come to regard as worthy of preservation, dignity, reverence, or collective identification.

GR can later describe this relation in terms of coupling and co-evolution while preserving non-equivalence. Normative judgment can reshape the conditions under which aesthetic judgment develops; aesthetic judgment can influence the formation and persistence of normative orientations. The direction and strength of coupling can change historically. Such a formulation should be treated as a research programme rather than a completed theory. It requires empirical work on institutions, education, cultural transmission, media, and power, as well as philosophical work on the distinct standards appropriate to each domain.

The existential concern raised by AI belongs here in the same restrained way. If aesthetic judgment is formed through encounter, comparison, surprise, cultivated discrimination, and historical participation, then a world of abundant machine-generated objects changes more than the quantity of available cultural material. It can change the conditions under which encounters occur and the routes through which sensibilities are formed. Yet existing aesthetics does not support a simple conclusion that machine generation either destroys or secures human aesthetic existence. The more defensible question concerns participation: how human beings continue to encounter contingency, become affected, judge, revise their standards, remember prior encounters, and contribute to the future conditions under which significance can emerge.

This question connects aesthetics to the broader issue of human existence without resolving it here. The possibility that an encounter with an unanticipated relation can matter to a person's sense of existing in a world will be developed later through phenomenology and theories of subjectivity. The present section supplies only the aesthetic foundation. Aesthetic experience can involve being addressed by something not fully contained in prior expectation, while aesthetic judgment can transform the subject's later orientation toward what deserves attention.

Chapter 2 therefore does not yet need a finished GR aesthetics. Its task is to establish why such an aesthetics can be formulated. Hume provides the cultivation and comparison of taste; Kant the distinctive structure of aesthetic judgment and the beautiful–sublime distinction; Dewey the temporal and transactional organization of experience; Bourdieu the social formation of taste; empirical aesthetics the mechanisms of processing, appraisal, and expertise; and philosophy of science the historical operation of aesthetic criteria in inquiry. From these heterogeneous foundations, GR can later ask how aesthetic capacities and standards emerge, how they become self-reinforcing or transformable, how they couple with normative and epistemic orders, and how encounters with contingency participate in the formation of human orientation. The next section follows the final connection directly by turning from aesthetic significance to curiosity, the formation of questions, and the selection of what becomes worth knowing.

2.6 Curiosity, Inquiry, and Epistemic Orientation

The preceding sections established that what becomes available for judgment is shaped by conditions of appearance, perception, salience, and aesthetic discrimination. The present section turns from what attracts or organizes attention to the further question of how attention becomes inquiry. Its role in the intellectual genealogy is to reconstruct traditions that have treated wonder, curiosity, problem formation, epistemic interest, and research selection as conditions of knowledge production rather than as incidental psychological preliminaries. The discussion is deliberately plural. Classical philosophy connects wonder with the beginning of inquiry; pragmatism locates inquiry in doubt and problematic situations; psychology studies curiosity as a response to novelty, uncertainty, and perceived knowledge gaps; educational theory examines the development of sustained interest; formal epistemology gives questions an explicit place in inquiry; and the history and sociology of science show that communities do not investigate every possible problem. These traditions differ in object, scale, and method, and they should not be treated

as interchangeable. Together, however, they make one foundational point available for later GR development: knowledge generation depends not only on the quality of answers but also on the historically and relationally structured formation of what becomes worth asking, pursuing, and preserving. The section proceeds from wonder and curiosity, through question formation and epistemic orientation, to non-instrumental inquiry and the institutional selection of what becomes known.

2.6.1 Wonder and Curiosity

Wonder occupies an old place in philosophical accounts of inquiry. In Plato's *Theaetetus*, Socrates associates wonder with the beginning of philosophy, while Aristotle's *Metaphysics* similarly presents wonder and perplexity as conditions from which philosophical questioning develops (Plato 1921; Aristotle 2016). These passages do not amount to a modern psychology of curiosity. Their significance is genealogical. They identify a disturbance in an existing orientation toward the world—an experience in which something is no longer simply taken for granted—as a possible beginning of inquiry.

The classical connection between wonder and ignorance is especially important. Aristotle does not describe inquiry as the mechanical accumulation of additional information. Wonder arises because something presents itself as puzzling and thereby discloses a limitation in what is understood. The movement from obvious perplexities toward larger questions gives inquiry a direction: ignorance becomes partially determinate because the inquirer encounters something whose explanation is missing. The unknown is therefore not merely an undifferentiated absence of knowledge. It can acquire form through an experienced discrepancy, anomaly, surprise, or incompleteness.

Pragmatist traditions later give this transition a more explicit account. Peirce's *The Fixation of Belief* treats inquiry as a response to genuine doubt rather than to the merely grammatical production of questions. His insistence on a “real and living doubt” distinguishes the existence of an interrogative sentence from the existence of an inquiry that matters to the inquirer (Charles S. Peirce 1877). A person can utter a question without being unsettled by it, just as a discipline can contain formally open problems that attract little actual attention. Inquiry begins when an unsettled condition has sufficient force to orient further activity.

Dewey develops a related but broader account of reflective thought. In *How We Think*, curiosity, perplexity, suggestion, observation, and inference belong to the cultivation of reflective inquiry rather than to separate mental compartments (Dewey 1910). For Dewey, a problematic or doubtful situation does not automatically determine a solution. It must be clarified, interpreted, and transformed through inquiry. This approach is valuable for the present genealogy because it connects curiosity to habits of investigation and to education. Curiosity can be supported, disciplined, redirected, or suppressed by the environments in which thinking occurs.

Twentieth-century psychology shifts the scale of analysis. Berlyne's work treats curiosity and exploratory behavior in relation to properties such as novelty, complexity, uncertainty, and conflict (Berlyne 1954). This research does not reproduce the classical concept of wonder. It asks instead which stimulus conditions elicit exploratory orientation and how curiosity can be studied experimentally. The shift is theoretically important: a phenomenon that philosophy had often discussed as an existen-

tial or intellectual beginning becomes available for psychological differentiation and measurement.

Loewenstein's information-gap account gives curiosity another influential formulation. Curiosity can arise when a person becomes aware of a gap between what is known and what one wants to know, creating a deprivation-like motivation to obtain the missing information (Loewenstein 1994). This account helps explain why curiosity is often strongest neither under complete knowledge nor under total ignorance. A gap must in some sense become represented. If a person has no conception that relevant information exists, there may be no experienced gap to close. Curiosity therefore depends partly on the relation between present knowledge and an intelligible possibility of further knowledge.

Subsequent work complicates any single-gap model. Litman, Hutchins, and Russon distinguish patterns of epistemic curiosity associated with feeling-of-knowing, uncertainty, exploratory behavior, and different affective orientations toward missing information (Litman et al. 2005). Their results support the broader conclusion that curiosity is not a unitary response to ignorance. Some forms are connected to tension and deprivation; others involve positive interest in exploration. The theoretical implication for this chapter is modest but important: the movement toward knowledge can be motivated by different configurations of uncertainty, anticipated understanding, affect, and prior knowledge.

These lineages also clarify the relation between curiosity and the aesthetic phenomena examined in Section 2.5. Surprise, strangeness, complexity, and elegance can attract attention without necessarily generating inquiry, while curiosity can arise in cases that lack strong aesthetic experience. Psychological and philosophical traditions nevertheless provide reasons to expect interaction. An unexpected pattern can first become salient, then interesting, then puzzling, and finally an object of sustained inquiry. The transitions are contingent rather than automatic. Salience, aesthetic attraction, curiosity, epistemic interest, and justified belief therefore remain analytically distinct even when they occur in a connected sequence.

For later GR work, the most useful inheritance from this literature is not a universal definition of curiosity. It is the recognition that inquiry can have a prehistory. Something must become capable of disturbing, attracting, or orienting an inquirer before a formal research process begins. Classical wonder, pragmatist doubt, experimental curiosity, and information-gap theories offer different accounts of this prehistory. Their differences should be preserved because they identify different mechanisms and scales at which an orientation toward the unknown can emerge.

2.6.2 Formation of Questions

A theory of inquiry remains incomplete if it begins only after a question has already been given. The formation of questions concerns how an indeterminate concern becomes articulated as a problem, how boundaries are placed around what is unknown, and how some interrogative forms become actionable while others remain diffuse. Several intellectual traditions have approached this issue from different directions, ranging from pragmatist accounts of problematization to formal logics of questions and empirical studies of problem finding.

Peirce's distinction between real doubt and merely verbal questioning provides an early constraint. The presence of a question mark does not itself establish inquiry

(Charles S. Peirce 1877). This point shifts attention from grammatical form to the conditions that make a question epistemically operative. A genuine question must arise within some background of belief, expectation, uncertainty, or practice. Its force depends on what is at stake in resolving it and on what kinds of answers could count as resolving the doubt.

Dewey's account of reflective thought places greater emphasis on the transformation of an initially confused difficulty into a defined problem. A problematic situation is not yet a well-formed research question. Inquiry requires work that determines what the difficulty consists in, which observations matter, and what possible explanations or courses of investigation deserve consideration (Dewey 1910). This makes problem definition part of inquiry rather than a neutral preliminary supplied from outside. The quality of investigation can therefore depend on the quality of problem formation.

Creativity research gives this distinction an empirical form. Getzels and Csikszentmihalyi's longitudinal study of artists made *problem finding* a central object of analysis, distinguishing creative work in which the problem must be discovered or formulated from tasks in which a well-defined problem is simply assigned (Getzels and Csikszentmihalyi 1976). Their study concerns artistic production rather than scientific inquiry in general, so its conclusions should not be universalized. Its broader contribution is to make visible a stage that solution-centered models often suppress: selecting, constructing, or reframing the problem can itself be part of creative achievement.

The logic of questions approaches the same broad issue from a very different direction. Hintikka's interrogative model treats inquiry through sequences of questions and answers, including questions addressed to nature through observation and experiment (Hintikka 1999). Here the question is not primarily a psychological event or a creative disposition. It has a logical and strategic role in the growth of knowledge. Different questions can open different paths through an inquiry, and strategies of questioning matter for what information can be obtained.

The contrast among these traditions is instructive. Dewey emphasizes the reconstruction of problematic situations; Getzels and Csikszentmihalyi emphasize problem finding in creative practice; Hintikka formalizes inquiry as an interrogative process. None can substitute for the others. A formal logic of questions does not by itself explain why a particular question becomes salient to a historical community. A psychological account of problem finding does not determine the logical conditions of answerability. A pragmatist account of problematic situations does not provide a complete sociology of research agendas. Their conjunction nevertheless establishes that questions have structure, histories, and conditions of formation.

Question formation also depends on available concepts. A community cannot easily ask a question for which it lacks any discriminating vocabulary, measurement practice, or representational form. New concepts can therefore create new interrogative possibilities. The emergence of a category may turn previously dispersed experiences into a recognizable problem; a new instrument may make a difference measurable; a new archive may permit a previously inaccessible historical question; a new mathematical representation may allow a relation to be posed with greater precision. This claim does not require that language completely determine thought. It requires only the weaker conclusion that the resources of inquiry affect which questions can be stably formulated and communicated.

Institutional settings add another condition. Research questions are formed within disciplines, professions, schools, laboratories, funding systems, legal categories, and political conflicts. The same phenomenon can be posed differently depending on whether it is approached as a scientific anomaly, a policy problem, a legal injury, an economic inefficiency, an ethical concern, or an aesthetic disturbance. Different question forms direct attention toward different objects and standards of relevance. Question formation is therefore already partly a process of framing.

This is one place where the transition toward GR can be made visible without replacing the reviewed theories. A later generative-relational account may ask about the histories and relations through which questions themselves become possible: which encounters supplied the anomaly, which concepts made it nameable, which institutions sustained attention, which prior judgments made it valuable, and which exclusions left alternative questions unformed. Chapter 2 does not yet need to answer those questions. Its task is to establish that major traditions already give strong reasons not to treat questions as costless, context-free inputs into a knowledge-producing machine.

2.6.3 Epistemic Interest and Orientation

Curiosity can be episodic, while inquiry often requires persistence. The concept of epistemic orientation concerns the more durable ways in which persons and communities become disposed toward certain objects, problems, methods, or forms of understanding. The relevant literatures again operate at different scales. Psychology and education study the development of interest; critical theory examines connections between knowledge and human interests; philosophies of inquiry analyze the aims that organize investigation. These approaches should not be merged into one concept merely because they share the word *interest*.

Hidi and Renninger's four-phase model of interest development is useful precisely because it distinguishes transient attraction from more stable orientation. Their model differentiates triggered situational interest, maintained situational interest, emerging individual interest, and well-developed individual interest (Hidi and Renninger 2006). The account is educational and psychological rather than philosophical, but it supplies an important temporal insight: what begins as a momentary attraction can, under appropriate conditions, become a durable pattern of re-engagement and knowledge seeking.

This developmental perspective complicates the idea that research preferences are simply given. Repeated encounters, opportunities for re-engagement, growing knowledge, social support, and perceived value can help stabilize an interest. Conversely, the absence of opportunity or recognition can prevent a potentially significant curiosity from developing into a sustained orientation. An epistemic trajectory therefore depends partly on environments that allow a question to return, deepen, and accumulate connections.

Loewenstein's information-gap theory and Litman's work on epistemic curiosity help clarify another dimension. Interest in knowing depends on how ignorance is represented relative to existing knowledge (Loewenstein 1994; Litman et al. 2005). An expert and a novice can encounter the same phenomenon while experiencing different gaps. Expertise can reduce some forms of uncertainty while generating more refined questions in their place. Increased knowledge therefore need not monoton-

ically reduce curiosity. It can reorganize the space of what becomes intelligibly unknown.

Critical theory treats epistemic orientation at a more structural level. Habermas's *Knowledge and Human Interests* argues that inquiry can be related to knowledge-constitutive interests and criticizes views that isolate knowledge from the conditions and purposes of human activity (Habermas 1971). This vocabulary should not be equated with psychological curiosity. Habermasian *interests* concern the constitution and orientation of forms of knowledge at a level different from individual motivational states. The relevance here is that epistemic activity can have systematic orientations that are not reducible to isolated preferences for information.

Longino's social epistemology adds another distinct lineage. Scientific knowledge is produced through communities whose critical interactions, background assumptions, and social organization affect the evaluation of evidence and claims (Longino 1990). This approach directs attention from individual motivation toward the social conditions under which inquiry becomes epistemically productive. The orientation of a research community is shaped not only by what individual members find interesting but also by standards of criticism, accessible evidence, disciplinary training, and the distribution of authority.

The concept of orientation can therefore be used here in a deliberately broad but non-equivalent sense. At the psychological level, it concerns relatively durable patterns of interest and re-engagement. At the philosophical level, it concerns aims and standards that organize inquiry. At the social level, it concerns disciplinary and institutional arrangements that make some objects recurrently available for investigation. These levels can interact without being collapsed.

Aesthetic judgment can participate in this interaction. Section 2.5 showed that elegance, strangeness, harmony, or surprise can influence selective attention without determining truth. In mathematics and science, an aesthetically compelling conjecture, proof strategy, model, or pattern can become a durable object of epistemic interest. In other domains, moral shock, political urgency, personal experience, or institutional responsibility can generate the relevant orientation instead. Inquiry therefore has multiple routes of motivational and evaluative formation.

This point is particularly important for later discussion of AI. If computational systems make answers, summaries, candidate hypotheses, and formal derivations increasingly abundant, epistemic orientation does not thereby become irrelevant. The capacity to remain with a problem, to recognize which uncertainty deserves sustained attention, and to revise one's orientation through encounter may become more visible as a distinct component of knowledge work. Chapter 2 should state this only as a contemporary implication of the reviewed traditions. The psychological development of interest, the critical-theoretical analysis of knowledge interests, and the social organization of inquiry already show that knowing has an orientational dimension before any GR account is added.

2.6.4 Inquiry beyond Instrumental Utility

Not all inquiry is undertaken because its practical payoff is known in advance. The genealogy of curiosity repeatedly contains a tension between inquiry directed toward an identifiable external end and inquiry pursued because knowing, understanding, or resolving a perplexity is itself experienced as worthwhile. This distinction matters

for economics because a narrow model of inquiry as investment toward predictable utility can miss forms of knowledge generation whose future significance is indeterminate at the time of pursuit.

Aristotle provides a classical statement of this distinction. In Book I of the *Metaphysics*, the movement from wonder toward knowledge is connected to inquiry pursued for the sake of knowing rather than solely for practical utility (Aristotle 2016). The historical and metaphysical framework is far removed from modern science policy, yet the distinction survives: knowledge can be valued independently of a presently specified application.

Veblen gives the issue an especially relevant place within social and economic thought. In *The Instinct of Workmanship and the State of the Industrial Arts*, he discusses an “idle curiosity” through which human beings seek knowledge without an ordinarily utilitarian aim, while also observing that knowledge obtained in this manner can later become useful for technology and workmanship (Veblen 1914). The formulation is valuable because it separates the motivation of inquiry from the eventual uses of its results. Knowledge can acquire instrumental value without having been generated under an instrumental objective.

Pragmatism complicates any simple opposition between intrinsic and practical inquiry. Peirce treats inquiry as the effort to move from doubt toward belief, while Dewey situates reflective thinking within problematic situations and practices (Charles S. Peirce 1877; Dewey 1910). Neither view requires that every inquiry be justified by an externally priced outcome. Practical involvement can generate questions whose resolution expands understanding beyond immediate application. Conversely, apparently abstract inquiry can alter later practices in ways that were not predictable at the outset.

The distinction is therefore better understood in terms of orientation than in terms of a rigid separation between “useful” and “useless” knowledge. Inquiry can be strongly application-directed, weakly application-directed, exploratory, curiosity-driven, or directed toward understanding whose future relevance remains open. A field that supports only questions with demonstrable short-run utility may systematically exclude forms of exploration whose value cannot yet be articulated in the categories used for evaluation.

This problem appears within research policy as a difficulty of temporal evaluation. The benefits of an inquiry may be delayed, indirect, distributed across domains, or dependent on later developments. A mathematical structure developed without foreseeable application can later become foundational to technology; an archival inquiry can alter legal or historical understanding; an observational anomaly can matter only after another theory makes it intelligible. The possibility of later use does not retroactively make the original inquiry instrumentally motivated.

The same point applies to individual learning. Curiosity may lead a person into subjects that have no immediate role in a planned career or task. Those encounters can nevertheless reorganize later capacities, analogies, judgments, and possible questions. Educational environments that preserve exploratory inquiry therefore do more than provide leisure around a utilitarian core. They can enlarge the repertoire from which later understanding is generated.

None of these arguments establishes that inquiry should be insulated from questions of social cost, responsibility, or public priority. Resources are finite, and some investigations impose risks or opportunity costs. The point is narrower: instrumental

justification is one mode of epistemic valuation rather than an exhaustive account of why inquiry begins or why it may deserve support. Classical philosophy, institutional economics, pragmatism, and educational theory all provide resources for preserving this distinction.

For GR, this leaves an important but later problem. If knowledge can emerge from encounters whose future value is unknown, then a generative account of inquiry must be able to represent option value, unforeseeable recombination, and the transformation of evaluative criteria over time without simply declaring all curiosity valuable. Such questions belong to the later substantive and methodological development of GRE. Chapter 2 establishes only the intellectual basis for taking them seriously.

2.6.5 Knowledge Generation and the Selection of What to Know

The final step in this genealogy concerns selection. No individual, discipline, institution, or society can investigate every possible question. Knowledge production therefore always takes place against a much larger background of questions that remain unasked, unfunded, unmeasured, unpublished, or forgotten. Theories of curiosity explain why some unknowns attract persons; theories of question formation explain how problems become articulable; theories of epistemic orientation explain how interests become durable. The history and sociology of science add the collective question of how research agendas are structured.

Kuhn's account of normal science makes problem selection part of disciplinary organization. Paradigms do not merely provide answers; they also define legitimate problems, exemplars, methods, and standards through which scientific work proceeds (Kuhn 1962). Normal science is productive partly because inquiry is constrained. Researchers need not reopen every foundational issue before solving a disciplinary puzzle. Yet the same structure means that what counts as a significant problem is historically organized rather than determined by the universe of all logically possible questions.

Longino's social epistemology similarly emphasizes the communal conditions under which evidence and criticism become effective (Longino 1990). A research community allocates attention through publication venues, standards of relevance, disciplinary training, reputational structures, and access to criticism. These arrangements can improve knowledge production by concentrating expertise and enabling distributed scrutiny. They can also create exclusions or blind spots when background assumptions remain insulated from effective challenge.

The sociology of "undone science" makes the negative side of selection especially visible. Frickel and colleagues use the concept to analyze research that is identified as socially valuable yet remains unfunded, incomplete, or ignored, including cases in which social movements and civil-society actors contest established research agendas (Frickel et al. 2010). The concept is important because ignorance is not always merely the temporary residue left after finite investigators do as much research as possible. Patterns of non-knowledge can be socially organized.

This observation extends the problem of epistemic orientation from individuals to institutions. Funding priorities, commercial incentives, measurement infrastructures, ethical restrictions, state classifications, publication norms, and available datasets influence what can become a stable object of knowledge. A question requiring a costly instrument may remain marginal despite intellectual importance. A

phenomenon not represented in administrative categories can remain statistically invisible. A socially stigmatized population can be understudied. A commercially valuable problem can attract disproportionate attention. These are not all failures; selection is unavoidable. They show, however, that knowledge has an agenda structure.

The selection of what to know also has a historical dimension. Questions can disappear when archives are destroyed, languages are lost, practices become inaccessible, or communities capable of interpreting records no longer exist. Conversely, new instruments, digitization, legal access, conceptual innovation, or political change can reopen questions that earlier periods could not answer. The space of inquiry therefore changes with the resources available to later observers.

This historical variability connects the present section to the epistemic revisability established in Section 2.3. Revisability concerns not only the possibility that an answer will change. The questions themselves can change. Later investigators may reconstruct an earlier problem differently, discover that previously ignored evidence matters, or recognize that the categories under which a question was posed were inadequate. Inquiry has histories of re-questioning as well as histories of correction.

The AI era makes this selection problem unusually visible. Generative and retrieval systems can reduce the cost of producing candidate answers, summaries, classifications, code, proofs, and hypotheses. This does not remove scarcity from inquiry. Scarcity can move toward attention, validation, problem selection, data access, experimental opportunity, and the human or institutional capacity to decide what deserves sustained investigation. If millions of plausible research directions can be generated cheaply, the epistemic significance of choosing among them becomes greater rather than smaller.

The older literatures provide several reasons to resist a simple delegation model. Peirce distinguishes living doubt from merely verbal questions. Dewey treats problem definition as part of reflective inquiry. Getzels and Csikszentmihalyi make problem finding visible as a component of creative work. Hidi and Renninger show that sustained interest develops through histories of engagement. Kuhn and Frickel and colleagues show that communities organize research agendas and omissions. None of these theories was written to analyze contemporary generative AI, and they should not be retrofitted into one anticipatory theory. Together, however, they imply that a system capable of answering questions is not thereby equivalent to a process capable of generating the human, social, and historical conditions under which questions acquire significance.

This distinction bears on the existential concern that will be developed more directly in the following section. Human participation in knowledge generation may involve more than originating text or solving a predefined problem. It can include encountering contingency, becoming puzzled, learning to care about an uncertainty, forming a question, sustaining an interest, revising the question through inquiry, and allowing the resulting knowledge to transform subsequent orientation. The point is not to reserve these capacities metaphysically for humans. It is to identify a sequence of phenomena that existing philosophies and sciences of inquiry already treat as significant and that cannot be reduced to answer production alone.

A restrained GR synthesis can now be stated. The traditions reviewed in this section make it plausible to investigate the *generative history of epistemic orientation*: how encounters, prior knowledge, aesthetic and normative judgments, conceptual resources,

institutions, technologies, and social relations participate in producing the questions that later organize inquiry. They also make it possible to ask how successful inquiries feed back into future orientation by changing what can be perceived, named, valued, and questioned. This is a research direction rather than a result established by the present genealogy. GR's contribution, if developed successfully, would lie in tracing relations among these levels without claiming that classical wonder, psychological curiosity, pragmatist inquiry, critical-theoretical interest, and institutional research agendas are instances of one already unified mechanism.

The chapter's immediate purpose is therefore foundational. Existing traditions already show that knowledge has antecedent conditions of selection. What becomes known depends partly on what can appear as puzzling, what can be formulated as a question, what can sustain interest, what institutions will support, and what communities regard as worth investigating. The next section turns to phenomenology, subjectivity, and existence, where the relation between inquiry and the lived experience of being situated in a world can be examined more directly.

2.7 Phenomenology, Subjectivity, and Existence

The preceding sections reconstructed traditions concerned with appearance, aesthetic judgment, curiosity, and the formation of inquiry. The present section turns to the philosophical lineages that made lived experience, subjectivity, embodiment, situatedness, finitude, and existence into explicit objects of analysis. Its role in the chapter is foundational rather than doctrinal. Phenomenology and existential philosophy supply several of the conceptual conditions through which later relational and generative approaches can ask how subjects inhabit worlds, encounter others, form projects, and experience their own existence without reducing those questions to an isolated mental interior. The discussion proceeds through five related movements: lived experience; the subject–world relation; embodiment and situatedness; meaning, finitude, and existential orientation; and relational accounts of encounter and otherness. These lineages overlap historically, but they do not constitute a single theory. Husserlian transcendental phenomenology, Heideggerian fundamental ontology, Merleau-Pontian embodiment, Sartrean and Beauvoirian existentialism, Schutzian social phenomenology, Buberian dialogue, and Levinasian ethics differ substantially in method, ontology, and normative implication. Their importance for the present genealogy lies in the conceptual problems they make available. Together they establish that subjectivity can be studied through modes of appearing, practical involvement, embodiment, temporal projection, social situation, and relation, thereby opening a space in which later GR work can examine the historical and relational formation of subjective continuity while retaining ontological suspension.

2.7.1 Lived Experience

Phenomenology gave twentieth-century philosophy a disciplined vocabulary for treating experience as an object of inquiry without reducing experience either to an inventory of private sensations or to a third-person causal description. Husserl's project is central to this lineage. In *Ideas*, phenomenological reduction suspends the ordinary commitment to the independently existing world in order to investigate how objects, meanings, and relations are given in experience (Husserl 2012). The

methodological emphasis falls on intentionality: consciousness is directed toward something, and the structure of that directedness becomes available for analysis. The phenomenological object is therefore not an inward mental item detached from the world. It is the experienced relation in which something is presented under a particular mode of givenness.

This move changes the status of lived experience in philosophical inquiry. Experience becomes analytically structured. Perceiving, remembering, imagining, anticipating, valuing, and judging are distinguishable intentional acts with different temporal and evidential profiles. An object can also be given through multiple perspectives without being exhausted by any single presentation. The importance of this framework for later social and economic inquiry is methodological: the way a phenomenon is experienced can matter even where the same phenomenon admits a different physical, statistical, institutional, or legal description. A wage, debt, workplace, price, institution, or technological system may have objective characteristics while also entering lived experience through fear, familiarity, expectation, obligation, possibility, or indifference. Phenomenology supplies conceptual resources for keeping those modes of access analytically visible.

Husserl's later account of the lifeworld expands this problem. In *The Crisis of European Sciences and Transcendental Phenomenology*, scientific idealization is traced back to a pretheoretical world of experience, practice, language, and inherited meaning that scientific abstraction presupposes (Husserl 1970). The lifeworld is not simply a collection of subjective impressions. It is the historically sedimented horizon within which objects, practices, and scientific questions already have intelligibility. Scientific concepts can emerge from this world and subsequently transform it. The relation between everyday experience and formal knowledge is therefore historically recursive: abstraction depends on a world of practice and meaning, while successful abstractions can later reorganize how that world is understood and inhabited.

This later Husserlian movement is especially relevant to the architecture of the present chapter. Sections 2.3–2.6 have already distinguished observation, salience, aesthetic judgment, curiosity, and inquiry. The lifeworld tradition adds a further condition. The subject who observes or inquires is already situated within inherited practices of relevance, language, expectation, and embodied familiarity. The appearance of a problem therefore takes place within a world that has been partially organized before explicit reflection begins. Phenomenology makes this background available for philosophical analysis without requiring that every background condition be made fully explicit.

Schutz carries these questions into the social sciences. His *Phenomenology of the Social World* attempts to clarify the subjective meaning of action and the structures through which actors understand one another in everyday life (Schutz 1967). Schutz's project is particularly important for an economic genealogy because it places phenomenological analysis in direct conversation with Weberian social science. Social actors do not encounter an unclassified social field. They rely on typifications, stocks of knowledge, expectations of relevance, and practical understandings of what others are doing. Social-scientific constructs are therefore built upon a world in which actors have already constituted situations as meaningful.

Schutz also marks a transition from transcendental problems of constitution toward intersubjective social reality. Everyday social life ordinarily presupposes the existence of others and the possibility of mutual understanding. The analyst can re-

construct these structures without claiming transparent access to another person's inner life. This point is methodologically significant. Subjective meaning can be real and causally consequential even when it is accessible only through interpretation, action, language, institutional context, and patterns of mutual orientation. A theory of lived experience therefore need not collapse into introspection, and a theory of social structure need not erase the experiential standpoint of actors.

The phenomenological inheritance is consequently plural. Husserl provides a method for analyzing modes of givenness and intentional structure; the lifeworld concept places scientific abstraction within a historically inherited experiential horizon; Schutz extends these resources toward the intersubjective organization of social meaning. None of these positions by itself supplies a complete account of social subjectivity. Together they establish a foundational proposition for the genealogy: lived experience has structure, history, and social conditions, and those dimensions can matter for explanation even where they are not reducible to externally observable variables.

2.7.2 Subject and World

Existential phenomenology transforms the relation between subjectivity and world by challenging the image of a self-contained subject that first exists and subsequently encounters an external environment. Heidegger's *Being and Time* is decisive in this shift. Heidegger analyzes Dasein through the unitary structure of being-in-the-world, within which self, world, practical involvement, and relations with others are internally connected dimensions of existence (Heidegger 1962). The world in this framework is not primarily a container filled with neutral objects. It is a meaningful context of practices, equipment, roles, purposes, and possibilities in which entities matter through forms of involvement.

This analysis changes the philosophical status of practical engagement. Ordinary activity is not treated as an epistemically inferior layer that must be reconstructed from detached cognition. Much of everyday intelligibility is already practical. A tool is encountered through what can be done with it, a room through possibilities of movement and use, and an institution through roles, expectations, and shared practices. The meaningful world is therefore disclosed through involvement before it is converted into an object of theoretical description. Heidegger's vocabulary of readiness-to-hand, concern, and being-with provides one influential account of this pre-reflective intelligibility (Heidegger 1962).

The concept of being-with also prevents being-in-the-world from becoming an individualistic theory of practical absorption. Others are implicated in the intelligibility of equipment, norms, tasks, and social possibilities. A workplace, market, household, school, or public institution is encountered through practices whose meanings have already been socially organized. Heidegger's analysis remains distinct from sociological explanation, yet it supplies an important philosophical resource: the world in which a subject acts is already a shared world, and the subject's possibilities are intelligible through historically available modes of conduct.

Merleau-Ponty develops another route beyond a detached subject-object relation. In *Phenomenology of Perception*, perception is situated within a phenomenal field organized through bodily orientation, figure and ground, habit, movement, and practical familiarity (Merleau-Ponty 2012). Subject and world appear as correlates within

an embodied perceptual relation. The perceiver does not stand outside the world as a spectator assembling representations from atomic sensory inputs. Perception takes place from somewhere, through a body with capacities, habits, and a practical orientation toward its surroundings.

The difference between Heidegger and Merleau-Ponty should remain visible. Heidegger's analysis is organized around the question of being and the existential structure of Dasein, while Merleau-Ponty gives more sustained attention to perception, bodily motility, habit, and the phenomenal field. Both, however, weaken the plausibility of an account in which a fully constituted subject and a fully constituted world are related only after each has been independently specified. Their work makes subjectivity analyzable through modes of involvement that are already worldly.

Sartre radicalizes a different dimension of this problem. In *Being and Nothingness*, consciousness is analyzed through intentionality, facticity, transcendence, project, and situation (Sartre 1956). A situation contains conditions that the subject has not chosen, yet those conditions acquire significance within projects and possibilities. Sartre's account gives a particularly strong role to freedom and projection. The subject is not exhausted by its given characteristics because it continually relates itself to possibilities that exceed what is presently actual.

The Sartrean emphasis on projection introduces a tension that becomes important in later existential thought. If situation acquires meaning through projects, the subject can appear to carry an unusually strong burden of meaning-constitution. Merleau-Ponty gives greater weight to pre-reflective bodily structure, while Beauvoir later develops a more explicitly social and material account of situated freedom. The theoretical differences matter. They show that moving beyond a detached subject does not settle how freedom, constraint, embodiment, social structure, and meaning should be distributed within an account of subjectivity.

For the present genealogy, the principal inheritance is a change in the unit of philosophical attention. Subjectivity can be approached through a subject-world relation in which practical contexts, possibilities, others, embodiment, and inherited meanings are already operative. This makes later relational inquiry conceptually possible without establishing that all subjectivity is reducible to social relation. The foundational point is weaker and more useful: theories of the subject need not begin from an isolated bearer of internal states, and theories of the world need not begin from a neutral inventory of objects whose significance is added only afterward.

2.7.3 Embodiment and Situatedness

Embodiment gives existential phenomenology one of its most durable critiques of abstract subjectivity. Merleau-Ponty's account of the lived body treats bodily existence as the medium through which space, objects, other persons, and practical possibilities become accessible (Merleau-Ponty 2012). The body is experienced differently from an ordinary external object. It is continuously implicated in perception and action, possesses habitual capacities, and organizes a field of possible movement before explicit deliberation occurs. Embodiment therefore concerns more than the physical location of a mind. It concerns the pre-reflective organization of what a subject can perceive, reach, avoid, endure, learn, and do.

Merleau-Ponty's distinction between the present body and the sedimented habit body is especially important for a genealogy concerned with historical formation. Re-

peated activity can become incorporated into bodily capacities so that earlier learning remains operative without requiring continuous reflective reconstruction. Skill, posture, orientation, and practical familiarity exemplify forms of history carried in embodied conduct. The body thereby provides a model of continuity in which the past persists through transformed capacities rather than through explicit memory alone. This idea will later become relevant to social and institutional theories of habit, practice, and subject formation, although those theories should not be treated as simple extensions of phenomenology.

Sartre also distinguishes the lived body from the body apprehended as an object, but his analysis connects embodiment closely to facticity and the presence of others (Sartre 1956). The body is part of the given situation through which freedom is exercised, while the other's look reveals the subject's capacity to appear as an object in another perspective. This produces a distinctive analysis of interpersonal vulnerability. A subject experiences itself both through its own projects and through the possibility of being apprehended, classified, or fixed by others. Sartre's treatment of conflict in relations with others differs from dialogical or recognition-centered theories, yet it establishes an enduring problem: subjectivity includes exposure to perspectives that the subject does not control.

Beauvoir develops situatedness in a direction that gives greater weight to reciprocal freedom, material conditions, social hierarchy, and historical constraint. In *The Ethics of Ambiguity*, human existence is characterized by ambiguity: persons are finite and situated while also projecting beyond given conditions through freedom and action (Beauvoir 1948). Freedom is lived within circumstances that include other freedoms, institutions, material limitations, and political arrangements. The existence of possibility therefore depends partly on conditions that can support or obstruct the capacity to undertake projects.

This Beauvoirian move is significant because it prevents existential freedom from being treated as independent of social structure. Situatedness contains more than a descriptive fact about occupying a position in space and history. Different situations distribute vulnerability, resources, recognition, and practical possibility unevenly. The subject can transcend aspects of a situation only through capacities and relations that are themselves conditioned. Beauvoir's account does not eliminate freedom into structure; it treats freedom as something lived through concrete conditions and in relation with others.

The combined lineage also changes the status of the body in social and economic analysis. A laboring, consuming, caregiving, migrating, learning, or aging subject is embodied. Fatigue, pain, mobility, sensory access, dependency, skill, and bodily vulnerability can shape what options are practically available even where an abstract model assigns identical formal choices. Phenomenology does not by itself provide an economic theory of these differences. It supplies a reason to distinguish formally represented possibility from lived possibility and to recognize that action is mediated by capacities that are bodily and historically acquired.

Situatedness also complicates the idea of a universal observer. Section 2.3 treated perspective as an epistemic condition; existential phenomenology adds that perspectives are lived from embodied and socially located positions. A standpoint has temporal depth, practical stakes, and differential exposure to the consequences of action. This insight can support later methodological pluralism without turning every claim into an expression of position. Situated knowledge still admits criticism, comparison,

evidence, and revision. Its contribution is to make the conditions of access part of the analysis rather than treating them as automatically irrelevant.

For later GR development, embodiment and situatedness supply conceptual resources for asking how subjective capacities are formed and sustained across time. That question remains open at this stage. The literature reviewed here establishes that subjectivity is enacted through bodies, habits, situations, and possibilities, and that these dimensions can preserve traces of prior relations. It does not yet determine which relations are necessary or sufficient for subjective continuity, nor whether interpersonal recognition is the only relation capable of sustaining such continuity. Those are later generative questions that require a broader comparative analysis.

2.7.4 Meaning, Finitude, and Existential Orientation

Existential philosophy adds temporality and finitude to the analysis of subjectivity. Heidegger's account of care describes *Dasein* through an interconnected structure of thrownness, projection, and involvement in a present world (Heidegger 1962). A subject inherits conditions it did not choose, exists among already available practices and meanings, and projects itself toward possibilities that are not yet actual. Existence therefore has a temporal organization. The past persists through factual conditions, the future enters the present through possibilities and projects, and current action is structured by both.

Finitude gives this temporal organization existential significance. Heidegger's analysis of being-toward-death treats mortality as a limit on the field of possibility rather than merely as a biological event awaiting occurrence (Heidegger 1962). Because possibilities cannot all be realized, choosing and committing acquire weight. Finitude makes orientation selective. A life unfolds through paths taken and foregone, projects continued and abandoned, relations maintained and lost. This does not provide a substantive criterion for which projects deserve commitment. It explains why commitment, temporality, and the limitation of possibility become central to the structure of existence.

Sartre approaches existential orientation through facticity and transcendence. Existing conditions are given, while consciousness projects possible ways of acting and being beyond them (Sartre 1956). Meaning is therefore connected to projects. A situation becomes significant through what a subject is doing, attempting, avoiding, or becoming. Sartre's concept of bad faith analyzes forms of self-relation in which subjects attempt to evade the tension between given conditions and freedom by treating themselves as wholly fixed or wholly unconstrained. The account is philosophically demanding because it attributes strong responsibility to the subject for the meaning of its situation.

Beauvoir preserves the importance of projection while placing greater emphasis on ambiguity, reciprocity, and the conditions of freedom (Beauvoir 1948). Human beings are simultaneously factual and transcendent, finite and open to projects, subjects of their own activity and objects within the worlds of others. Meaningful action therefore unfolds without guarantees of complete control or final reconciliation. Projects extend into a world inhabited by other freedoms, and the future remains open to consequences that exceed the actor's intention.

This existential emphasis on contingency and open futurity provides a useful continuation of the preceding sections on aesthetic judgment and curiosity. An encounter

can matter because a subject is temporally oriented and because the world can disclose possibilities that were not already integrated into an established project. Surprise, wonder, anxiety, beauty, loss, and conflict can reorganize what a person experiences as significant. Existential philosophy supplies several different accounts of such reorientation. Heidegger emphasizes moods and disclosedness, Sartre projects and choice, Beauvoir ambiguity and concrete freedom, while Merleau-Ponty gives greater weight to embodied perception and sedimented habit. Their differences prevent the category of existential orientation from becoming a single mechanism.

The problem of meaning should also be separated from the claim that meaning is merely a private act of subjective assignment. Heidegger's being-in-the-world locates intelligibility in shared practices; Merleau-Ponty locates perception within an embodied field; Beauvoir places freedom among other freedoms and material conditions; Schutz analyzes socially available stocks of knowledge and typification. These lineages all weaken a picture in which an isolated individual creates meaning from an otherwise entirely neutral world. Meaning can be experienced personally while depending on inherited languages, practices, bodies, institutions, and relations.

This point is relevant to contemporary conditions of technological mediation, including artificial intelligence, without making AI the organizing framework of the section. If systems increasingly generate text, images, recommendations, analyses, and possible courses of action, the existential problem is not exhausted by whether the generated output is correct or useful. Older phenomenological and existential traditions direct attention toward how a person inhabits possibilities, encounters contingency, forms commitments, and experiences the significance of acting within a finite life. The contemporary question can therefore concern participation in meaning formation as well as access to generated representations. Chapter 2 does not resolve that question; it identifies the intellectual resources through which the question becomes philosophically intelligible.

For later GR work, the most relevant inheritance is the temporal and situated character of existential orientation. Subjects do not merely occupy states. They carry histories, project possibilities, revise commitments, and remain exposed to events that can reorganize what matters. A generative account may later ask how relations participate in the formation, stabilization, disruption, and renewal of these orientations. At this stage, the genealogy establishes the prior conceptual terrain: existence is temporally extended, finite, situated, and oriented toward possibilities whose meaning can change.

2.7.5 Relation and the Witnessing of Existence

The relation between subjectivity and otherness becomes explicit in phenomenological, dialogical, and ethical traditions that refuse to treat the other merely as another object within a subject's world. These traditions differ substantially in their accounts of intersubjectivity. Their common relevance lies in making encounter itself philosophically significant. The phrase *witnessing of existence* is used here as a provisional label for a later GR problem: the ways in which an existence can become manifest, encountered, acknowledged, or sustained within relations. It is not presented as a standard term shared by the thinkers reconstructed below.

Husserl's phenomenology makes intersubjectivity indispensable to the constitution of an objective and shared world, while Schutz relocates the problem within the ev-

everyday social world (Husserl 1970; Schutz 1967). Schutz is especially important because mutual orientation does not require direct possession of another person's consciousness. Actors encounter one another through bodily presence, action, language, typification, temporal coordination, and shared situations. Social understanding is therefore partial and structured. The other can be experienced as another subject without becoming fully transparent.

Buber gives relation a different philosophical status. *I and Thou* distinguishes I–Thou relation from I–It relation and places encounter, presence, and the “between” at the center of dialogical philosophy (Buber 1970). The distinction is not a technical taxonomy of all social relations. It articulates different modes of relating. In an I–It orientation, the other is approached through objectification, use, description, or classification. In I–Thou encounter, the other is addressed as a presence that exceeds reduction to an object of manipulation. Buber also extends the possibility of I–Thou relation beyond interpersonal human interaction to encounters with nature and the divine, although the character of reciprocity differs across these domains.

Buber's contribution is useful for the present genealogy because it places the constitution of the “I” within relational language. The self that says “I” in I–Thou is not identical to the self that says “I” in I–It. Relation therefore affects the mode in which selfhood is enacted. This claim should not be translated directly into GR terminology. Buber's dialogical philosophy carries theological, existential, and ethical commitments that differ from the ontological suspension of the present project. Its importance lies in demonstrating that a theory of subjectivity can treat relation as formative of the mode of selfhood rather than as an external connection between already complete individuals.

Levinas develops an even more asymmetrical account of relation. In *Totality and Infinity*, the encounter with the other is organized through exteriority, face-to-face relation, and responsibility (Levinas 1969). The other resists complete incorporation into the categories through which the self comprehends the world. Relation therefore includes a limit on appropriation. The other's alterity matters precisely because it cannot be exhausted by the subject's representation of it. Levinas's account gives this irreducibility an ethical priority that Buber does not formulate in the same way.

The contrast between Buber and Levinas is theoretically productive. Buber emphasizes dialogue, mutuality, and the between; Levinas emphasizes asymmetry, exteriority, and responsibility. Schutz approaches intersubjectivity through everyday social meaning, while Husserl approaches it through problems of constitution and objectivity. None of these can be treated as interchangeable formulations of relational subjectivity. Their disagreement reveals several distinct dimensions that later theories must keep apart: mutual recognition, dialogical presence, interpretive access, ethical responsibility, non-assimilability, and the shared conditions through which subjects inhabit a world together.

These traditions also complicate the assumption that subjective continuity depends exclusively on continuous interpersonal recognition. Buber's extension of dialogical relation beyond human-human encounter and phenomenology's emphasis on world-involvement suggest a broader field of possible relations through which existence can acquire continuity and significance (Buber 1970; Merleau-Ponty 2012). A mathematician may sustain a life through long involvement with mathematical objects and problems; a religious practitioner may orient existence through relations to sacred beings, practices, or traditions; a person may experience continuity through sustained

relations with landscapes, artworks, crafts, institutions, or nonhuman life. These examples do not establish that interpersonal relations are dispensable. They show why the question of which relational configurations sustain subjective continuity cannot be settled by definition alone.

The preceding point also connects carefully to the problem of contingency developed in Sections 2.5 and 2.6. An encounter can witness existence by interrupting habitual orientation and disclosing that a subject is affected by something that was not wholly produced by its prior plan. Aesthetic experience, curiosity, dialogue, loss, resistance, and unexpected recognition can each reveal this structure in different ways. The philosophical lineages reconstructed here provide conceptual resources for understanding why such encounters can matter, but they do not justify collapsing them into one universal existential mechanism.

Artificial intelligence makes this inherited problem newly visible without creating it. Increasingly mediated relations may support human agency, enlarge access to meaningful objects, and create new forms of encounter; they may also organize interaction around prediction, personalization, functional substitution, or rapid answer production. Phenomenology, existentialism, dialogical philosophy, and theories of otherness together suggest that the relevant evaluation cannot concern output quality alone. It can also concern whether forms of mediation preserve or transform the conditions under which subjects encounter otherness, exercise situated judgment, form commitments, and experience themselves as participants in a world whose meanings are not exhausted in advance.

For later GR development, these traditions open a research problem rather than deliver a settled solution. A generative-relational account of subjectivity may investigate how different relations participate in producing, stabilizing, or transforming subjective continuity; how relations with persons, institutions, practices, objects, environments, and artificial systems differ in their generative consequences; and how aesthetic, epistemic, ethical, and existential orientations can become coupled over time. Chapter 2 retains these as questions made possible by prior theory. The conceptual achievement of the present genealogy is to show why subjectivity can be investigated through lived experience, world-involvement, embodiment, situation, finitude, encounter, and otherness without presupposing that any one of those dimensions provides a complete ontology of the subject.

2.8 Hermeneutics, Language, and Interpretation

The preceding section reconstructed phenomenological and existential traditions concerned with lived experience, subjectivity, embodiment, situation, and encounter. The present section turns to the lineages through which understanding, interpretation, language, symbolic mediation, and historical meaning became explicit philosophical problems. Its role in the chapter is genealogical. Hermeneutics, philosophy of language, structural linguistics, symbolic-form theory, and ordinary-language philosophy offer different accounts of how human beings understand texts, actions, institutions, signs, and worlds whose significance is neither simply given in sensation nor exhausted by formal description. The discussion proceeds through five movements: interpretation and understanding; language and symbolic mediation; historicity and interpretive horizons; interpretive systems and the formation of syntax; and meaning

as relational and historical formation. These traditions should not be collapsed into a single theory. Schleiermacher's general hermeneutics, Dilthey's methodology of the human sciences, Heidegger's hermeneutic phenomenology, Gadamer's philosophical hermeneutics, Ricoeur's hermeneutics of text and action, Saussurean structural linguistics, Cassirer's philosophy of symbolic forms, Wittgenstein's account of language-games and rule-following, and Austin's speech-act analysis differ in object, method, ontology, and normative implication. Their relevance to the present genealogy lies in showing why meaning must be treated as mediated, situated, interpretable, and historically revisable before later GR work asks how interpretive relations themselves are generated, stabilized, and transformed.

2.8.1 Interpretation and Understanding

Modern hermeneutics develops from practices of textual interpretation into a more general philosophical problem concerning how understanding is possible. Schleiermacher occupies a decisive place in this expansion. His *Hermeneutics and Criticism* treats interpretation as a general task rather than a technique reserved for obscure passages or sacred texts. Understanding requires attention both to language as a shared system and to the particular use of language by an individual speaker or author (Schleiermacher 1998). The interpreter moves between grammatical and what Schleiermacher calls psychological or technical dimensions of interpretation: expressions belong to a language whose structures exceed any individual utterance, while an utterance also bears the marks of a particular act of composition. Interpretation therefore already involves a relation between part and whole, rule and use, inherited language and singular expression.

This account is important because it prevents understanding from being represented as simple extraction of a self-contained meaning. A sentence is intelligible through the language to which it belongs; the language is encountered through particular sentences and uses. Likewise, a passage can be interpreted through its place within a work, while an interpretation of the work depends on the passages through which it is available. What later scholarship calls the hermeneutic circle is therefore not merely a procedural inconvenience. It identifies a recursive structure of understanding in which local and larger contexts illuminate one another.

Dilthey extends hermeneutics from textual interpretation toward the epistemology and methodology of the human sciences. Historical and social life is available through what he calls objectifications or expressions of life: actions, institutions, texts, artworks, gestures, and other publicly available formations through which lived experience becomes interpretable (Dilthey 1996). Understanding is consequently neither direct access to another person's interiority nor a purely external causal account. The interpreter encounters outward expressions and reconstructs the meaningful nexus in which they belong. Dilthey's later hermeneutics thus connects interpretation with historical inquiry and with the possibility of disciplined understanding across differences of time, culture, and individual experience.

Dilthey's distinction between the natural and human sciences is sometimes summarized too sharply as explanation opposed to understanding. His mature work is more complicated. Explanation and understanding can interact, and historical inquiry can employ causal, comparative, and interpretive procedures together. What remains distinctive is the object of inquiry: human action and historical formations

are meaningful, and their intelligibility cannot be exhausted by treating them solely as externally observable events (Dilthey 1996). This point becomes foundational for later social theory. Institutions, markets, laws, organizations, and economic practices can have material consequences while also depending on categories, conventions, expectations, and interpretations that actors use to orient action.

Heidegger changes the status of hermeneutics more radically. In *Being and Time*, interpretation is no longer introduced primarily as a method for recovering the meaning of texts or historical expressions. It belongs to the structure of being-in-the-world itself (Heidegger 1962). Understanding is practical and projective before it becomes an explicit act of interpretation. A person already inhabits possibilities, roles, equipmental contexts, and shared practices through which things matter in determinate ways. Explicit interpretation articulates an intelligibility that is already operative in practical involvement.

This ontological turn has two consequences for the genealogy. First, it weakens the image of an interpreter who stands outside an object and subsequently assigns meaning to it. Interpretation proceeds from prior involvement. Second, it makes pre-understanding philosophically unavoidable. Inquiry begins from inherited concepts, expectations, concerns, and possibilities rather than from a neutral standpoint. The problem then becomes how such prior structures can be made visible, revised, or transformed without imagining that interpretation could ever begin from no horizon at all.

Gadamer develops this problem into philosophical hermeneutics. In *Truth and Method*, understanding is treated as an event situated within language, tradition, and historically formed horizons rather than as the mechanical application of an interpretive method (Gadamer 2004). Gadamer's rehabilitation of prejudice does not mean that inherited judgments are necessarily correct. It identifies prejudgments as conditions through which a subject initially encounters a question or text. Interpretation can expose these prejudgments to challenge. Understanding is therefore possible because the interpreter brings a horizon to the encounter, while the encounter can alter that horizon.

Ricoeur preserves the centrality of interpretation while resisting any simple opposition between hermeneutics and explanation. His essays collected in *From Text to Action* develop a hermeneutics in which texts acquire a degree of autonomy from the intentions and immediate situations of their authors, making explanation an important part of interpretation (Ricoeur 1991). Structural analysis, semantic clarification, and other explanatory procedures can help disclose what a text makes available for understanding. Ricoeur's movement from text toward action also widens hermeneutics beyond literary objects. Meaningful action can be interpreted because action can become detached from the immediacy of its occurrence, leave traces, enter institutions, and become available for later redescriptions.

Across these traditions, interpretation changes philosophical status several times. For Schleiermacher, it becomes a general discipline of understanding discourse. For Dilthey, it grounds inquiry into historical expressions of life. For Heidegger, understanding belongs to being-in-the-world. Gadamer emphasizes the historical event of understanding, while Ricoeur connects interpretation with textual distance, explanation, and action. Their disagreements matter. The traditions do not justify the claim that every phenomenon is merely a text, nor do they imply that causal explanation is dispensable. They establish a narrower and more durable foundation: when hu-

man phenomena depend upon meaning, understanding them requires attention to the conditions under which meaning is articulated, inherited, contested, and revised.

2.8.2 Language and Symbolic Mediation

Hermeneutics becomes inseparable from a broader problem of linguistic and symbolic mediation when language is no longer treated as a transparent vehicle for independently completed thoughts. Several twentieth-century traditions reach this result through very different arguments. Structural linguistics, symbolic-form theory, later Wittgensteinian philosophy, speech-act theory, and philosophical hermeneutics all deny, in distinct ways, that language can be understood merely as a set of labels attached to an already fully articulated world.

Saussure's *Course in General Linguistics* provides one influential structural account. The linguistic sign is analyzed through the relation between signifier and signified, while linguistic value depends on differences within a system rather than on an intrinsic bond between a word and an independently isolated concept (Saussure 1966). The consequence is methodological as well as linguistic. An element acquires value through relations of contrast and combination with other elements. Meaning cannot therefore be inferred from a sign considered entirely by itself. Saussure also distinguishes synchronic analysis of a language system from diachronic analysis of linguistic change, providing an influential vocabulary for separating the organization of a system at a given moment from the historical processes through which that organization changes.

Structural linguistics does not by itself provide a theory of interpretation. Its importance for the present genealogy lies in making relational differentiation central to signification. A monetary term, occupational category, legal status, economic indicator, or institutional label can likewise acquire practical meaning partly through its position within a classificatory field. The analogy must be used cautiously: social categories are not simply linguistic signs, and their material consequences cannot be reduced to semiotic difference. Saussure nevertheless supplies a conceptual resource for recognizing that meaning can depend on structured relations among terms rather than on isolated correspondence.

Cassirer's philosophy of symbolic forms broadens mediation beyond ordinary language. In the first volume of *The Philosophy of Symbolic Forms*, language belongs to a larger field of symbolic activity through which human experience is articulated and given objective form (Cassirer 1955). Myth, religion, art, language, and science represent different symbolic formations rather than imperfect versions of one universal representational scheme. Human access to a world is therefore symbolically organized. The world encountered through scientific concepts is not articulated in the same manner as the world encountered through mythic, artistic, or everyday linguistic forms.

Cassirer's position is particularly useful for distinguishing symbolic mediation from simple verbal mediation. Economic life is organized through currencies, numbers, accounting categories, legal forms, diagrams, models, rankings, narratives, contracts, and institutional classifications as well as through ordinary speech. Such symbolic formations can make objects comparable, action possible, and institutions intelligible. They can also exclude or obscure phenomena that do not fit their modes of articulation. Cassirer's project does not amount to a contemporary sociology of

classification, but it supplies an earlier philosophical foundation for treating symbolic form as constitutive of intelligibility rather than as a passive after-image of reality.

The later Wittgenstein reaches a different account of meaning through attention to use. *Philosophical Investigations* criticizes the temptation to search for one essence of language or one hidden object that every meaningful expression names. Language is instead approached through heterogeneous language-games embedded within forms of life (Wittgenstein 2009). Asking, ordering, reporting, joking, calculating, promising, thanking, describing, and hypothesizing are activities in which words acquire roles through use. Meaning is consequently inseparable from practices in which standards of correct and incorrect continuation are learned and sustained.

Wittgenstein's reflections on rule-following are important here because they complicate a picture in which syntax or meaning is determined once and for all by an abstract rule independent of practice. A rule does not contain all of its future applications in a manner that eliminates judgment. Rules are followed within practices in which examples, correction, training, agreement, and customary continuation make action intelligible (Wittgenstein 2009). This does not imply that meaning is arbitrary at each moment. It locates stability in publicly learnable practices rather than in a private mental association or an entirely self-applying formal object.

Austin's speech-act theory makes another dimension of linguistic mediation explicit. *How to Do Things with Words* shows that utterances can perform actions under conventional and situational conditions: promising, naming, warning, apologizing, declaring, and other acts are accomplished through language rather than merely described by it (Austin 1962). Linguistic meaning therefore has an institutional and practical dimension. The effect of saying something can depend on recognized procedures, speaker positions, uptake, context, and conventions. This is especially relevant to law and economics, where contracts, declarations, authorizations, prices, ratings, and classifications may alter relations partly because recognized linguistic or symbolic acts have institutional force.

Gadamer adds a further dimension by treating language as a medium of hermeneutical experience. Understanding does not first occur in a language-free interior and then receive linguistic clothing. Language participates in how a subject matter becomes articulable within dialogue and interpretation (Gadamer 2004). This position differs from Saussure's structural linguistics, Cassirer's transcendental philosophy of culture, Wittgenstein's ordinary-language investigations, and Austin's analysis of speech acts. Yet their juxtaposition establishes a common problem for later theory: symbolic systems do not simply transmit meanings whose form is entirely independent of mediation. The media of articulation participate in what can be distinguished, related, remembered, communicated, contested, and acted upon.

2.8.3 Historicity and Interpretive Horizons

Interpretation is historical in more than one sense. Texts, concepts, institutions, and languages have histories; interpreters also occupy historical positions from which some distinctions appear obvious while others remain difficult to formulate. Hermeneutic philosophy gives this double historicity a central place. The problem is therefore not only how an interpreter reconstructs a past meaning. It is also how the interpreter's own historically formed horizon enters the act of understanding.

Dilthey makes historical consciousness fundamental to the human sciences. Human expressions belong to historical nexuses whose meanings change as forms of life, institutions, and cultural possibilities develop (Dilthey 1996). An interpreter seeks to understand a historical expression through the relations in which it participated, while recognizing that the reconstruction occurs from another historical position. Dilthey's hermeneutics thereby links interpretation with a broader philosophy of historical life. Meaning is temporal because human projects, institutions, and self-understandings develop through time.

Heidegger radicalizes historicity by locating it within the temporal structure of existence. Dasein inherits possibilities that it did not originate and projects itself toward possibilities that remain open (Heidegger 1962). Understanding is therefore historically situated before explicit historiography begins. Concepts are inherited through traditions of interpretation, and practical possibilities are available through a world whose meanings have already been formed. This account provides one philosophical route toward the later hermeneutic claim that no interpretation begins from an empty standpoint.

Gadamer's language of horizon and historically effected consciousness develops this insight directly. A horizon is not a fixed boundary enclosing a subject in an incommensurable world. It is the range of possibilities available from a situated standpoint and is capable of movement through encounter and interpretation (Gadamer 2004). Understanding a text or another historical formation requires neither erasing the interpreter's present horizon nor assimilating the object entirely into it. Gadamer describes understanding through a fusion of horizons in which the subject matter can be articulated through a transformed relation between inherited and present questions.

This account also explains why tradition is not merely an external constraint. Traditions supply languages, problems, examples, standards, and expectations through which interpretation becomes possible. They can simultaneously carry exclusions, distortions, or inherited authority. Gadamer's emphasis on openness to questioning is meant to preserve the possibility that an encounter with a text or another interlocutor can challenge the interpreter's expectations. Hermeneutical understanding is therefore historical without becoming a doctrine that all interpretations are equally valid.

Ricoeur introduces distance more strongly into this picture. Once discourse is fixed as text, it can become partially detached from the original speaker's intention and situation, making new readings possible in contexts not foreseen at the moment of composition (Ricoeur 1991). This distanciation is not simply a loss of original meaning. It enables critique, comparison, structural analysis, and reappropriation. A text can project a world that later readers inhabit or contest differently. Ricoeur thus gives historical transmission a structure in which continuity and novelty coexist: inherited symbols and narratives constrain interpretation while remaining open to recontextualization.

The relation between interpretation and history is especially important for economic and social concepts. Terms such as labor, property, value, development, welfare, efficiency, risk, household, productivity, and capital do not carry identical meanings across periods and institutions. Their definitions can stabilize sufficiently for measurement, law, policy, and theory while remaining historically revisable. Hermeneutic approaches therefore caution against two symmetrical errors. One is

to assume that present categories transparently capture past realities. The other is to conclude that historical variation eliminates the possibility of comparison. Interpretation instead requires reconstruction of the horizons within which categories operated and explicit justification when concepts are translated across contexts.

This historical structure also matters for evaluation. A practice can acquire meanings that differ from those attributed to it by its original participants, and later interpreters may possess evidence, concepts, or normative resources unavailable at the time. Conversely, later frameworks can obscure dimensions that earlier actors understood more readily. Historical interpretation therefore involves a tension between reconstruction and re-description. The interpreter must ask both what a formation meant within its own horizon and what can be learned from examining it through later conceptual resources.

The importance of this lineage for the wider book is methodological rather than relativist. Earlier sections have already argued that evidence, salience, aesthetic judgment, and inquiry have histories. Hermeneutics adds that the categories through which these histories become intelligible are themselves historically positioned. This creates the possibility of later re-epistemization without implying that every reinterpretation is equally adequate. Interpretations remain answerable to texts, traces, actions, material conditions, alternative readings, and the explanatory consequences of the distinctions they introduce.

2.8.4 Interpretation Systems and Emerging Syntax

The phrase *emerging syntax* is used in this section as an organizing label rather than as a canonical term belonging to the traditions reconstructed here. It refers to the problem of how relatively stable rules of combination, distinction, continuation, and interpretation can arise and become operative within linguistic, symbolic, and institutional practices. Existing theories approach parts of this problem through different vocabularies: Saussure through linguistic structure and value, Wittgenstein through language-games and rule-following, Austin through conventional conditions of speech acts, Gadamer through dialogical interpretation, and Ricoeur through the relation between text, discourse, and recontextualization.

Saussure's distinction between *langue* and *parole* provides one early way to separate a socially available system from individual acts of speech (Saussure 1966). Particular utterances are possible because speakers participate in a language whose differentiations and combinatorial possibilities are not invented anew on each occasion. Yet language changes through historical use. Saussure's separation of synchronic and diachronic analysis therefore makes it possible to study both relative structural stability and transformation without assuming that one can be reduced to the other.

Wittgenstein relocates the problem of rule-governed language within practices. A language-game has recognizable regularities, but these regularities live in activity rather than functioning as a complete formal code standing outside use (Wittgenstein 2009). Learning a language includes learning how to continue, what counts as a mistake, what distinctions matter, and how correction works. These capacities depend on training, examples, shared practices, and forms of life. The stability of syntax in the broader sense used here can therefore be practical and normative: some continuations are treated as intelligible or appropriate while others are corrected, rejected, or interpreted as belonging to another practice.

Austin's analysis adds institutional felicity conditions. A performative utterance works only within circumstances in which relevant conventions, roles, and procedures obtain (Austin 1962). The sentence alone does not produce the act independently of context. A declaration made by an unauthorized person, a contract lacking relevant conditions, or a promise uttered in circumstances that defeat the act can fail in different ways. Meaningful linguistic action is therefore coupled to institutional syntax: positions, procedures, conventions, and recognized forms of uptake help determine what an utterance can do.

Gadamer approaches rule and syntax less formally. Hermeneutical dialogue depends on a language that interlocutors inherit, yet successful understanding can transform how a subject matter is articulated (Gadamer 2004). New distinctions may enter a discourse because a question exposes the inadequacy of existing formulations. Old words can acquire revised meanings in new contexts. The horizon of interpretation is therefore structured without being closed. This provides an important contrast with accounts that imagine a complete code from which every valid interpretation can be mechanically derived.

Ricoeur's theory of text gives another route to stability and innovation. Once discourse is fixed, textual organization constrains interpretation; not every reading is compatible with the text. At the same time, distance from the original speech situation permits new configurations of meaning and new applications (Ricoeur 1991). Interpretation is therefore neither unlimited invention nor simple recovery. It operates within structured possibilities whose boundaries can themselves become objects of argument.

These lineages help distinguish at least three questions that later work must keep separate. One concerns the existence of a relatively stable symbolic or linguistic system. A second concerns competent participation in practices governed by rules, conventions, or norms. A third concerns historical change in the very distinctions and continuations that constitute intelligibility. Treating all three as "syntax" would obscure their differences. The broader label is useful only if these levels remain analytically distinguishable.

The same caution applies when interpretive systems extend beyond language narrowly understood. Scientific disciplines, legal orders, accounting systems, bureaucratic classifications, markets, educational institutions, and computational systems each establish repertoires through which some combinations are meaningful, some transformations are authorized, and some observations count as relevant. These systems can be more formalized than ordinary language, but their operation still depends on practices of interpretation. A legal rule must be applied to cases, a statistical category must be operationalized, an accounting classification must be assigned to transactions, and a computational output must be interpreted within a task. Formal syntax can constrain these activities without eliminating the interpretive work through which symbols become consequential.

This point becomes increasingly important under computational mediation. Artificial systems can generate highly regular linguistic and symbolic sequences and can reproduce or recombine patterns learned from large corpora. The philosophical traditions reviewed here advise against identifying such syntactic productivity with the whole problem of meaning. They direct attention toward use, institutional conditions, historical horizons, discourse, and interpretation. At the same time, they also caution against defining meaning through an inaccessible private interior. The result-

ing question is therefore open rather than settled: how should meaning be analyzed when symbolic continuations are produced through heterogeneous combinations of human practice, institutional convention, computation, and subsequent interpretation?

For Chapter 2, the significance of this problem is foundational. Existing theories already show that systems of intelligibility can possess structure without being timeless, and that rules can guide action without eliminating interpretation. Later GR work may ask how such structures emerge, stabilize, couple to institutions, and change through repeated use. The present section does not supply that generative theory. It identifies the intellectual resources and distinctions that any such theory would need to inherit.

2.8.5 Meaning as Relational and Historical Formation

The traditions reconstructed in this section make it possible to state a limited synthesis without erasing their differences. Meaning can depend on relations among signs, on practical use, on symbolic forms, on speech acts, on historically inherited horizons, on textual organization, and on interpretive encounters. No single lineage establishes all of these claims in the same way. Saussurean difference is not Gadamerian dialogue; Wittgensteinian use is not Cassirer's symbolic form; Dilthey's historical understanding is not Austin's illocutionary analysis; and Ricoeur's hermeneutics of text cannot be reduced to Heidegger's existential analytic. Their convergence lies at a more modest level: meaning is difficult to understand as an intrinsic property that remains fully determinate independently of linguistic, symbolic, practical, and historical relations.

This convergence offers a foundation for analyzing social and economic reality. A price is a number, but its meaning depends on a currency, unit, market setting, temporal reference, contractual context, and expectations about what is being exchanged. A legal category is expressed through words, but its practical meaning depends on doctrine, institutional authority, procedures, precedent, and application. A statistical indicator is formally defined, yet its significance depends on classifications, measurement practices, comparison groups, policy contexts, and interpretive conventions. These examples do not imply that material reality is produced by language alone. They show that materially consequential action often proceeds through interpretive and symbolic infrastructures.

The historical character of these infrastructures matters equally. A category that becomes stable enough to organize conduct can later be revised, contested, subdivided, translated, or abandoned. The history of interpretation therefore concerns more than changing opinions about a fixed object. The categories through which actors recognize objects, positions, obligations, and possibilities can themselves change. When those categories are embedded in law, accounting, administration, technology, or markets, interpretive change can alter material trajectories by changing what actions are available, intelligible, or institutionally recognized.

This possibility also clarifies the relation between interpretation and normativity. Language-games and institutional speech acts involve standards of appropriate use; hermeneutical traditions concern better and worse interpretations; historical inquiry requires judgments about evidence and contextual adequacy. Interpretation is therefore not normatively empty. Yet semantic, epistemic, aesthetic, legal, and moral norms should not be collapsed. A linguistically well-formed statement can be

false, a historically plausible interpretation can be unjust in its consequences, and a legally valid classification can remain ethically contestable. The earlier argument that aesthetic and normative judgment may co-evolve without becoming identical has an analogue here: interpretive and normative orders can influence one another while remaining distinguishable objects of analysis.

The same recursive structure appears across the genealogy. Interpretation occurs under conditions that precede a particular act of understanding: languages, symbolic forms, concepts, traditions, institutions, and rules are already available. Those conditions are nevertheless historical products. Earlier acts of interpretation, classification, translation, institutionalization, and contestation participated in forming them. A later interpretation can in turn reinforce, modify, or destabilize the conditions inherited by subsequent interpreters. Existing hermeneutic and linguistic theories provide much of the conceptual material needed to recognize this recursion, even when they do not formulate it in generative-relational terminology.

This is the point at which a restrained GR bridge becomes possible. Later GR work may investigate interpretive relations as part of generative systems: how actors, signs, categories, institutions, technologies, and material conditions participate in producing relatively durable regimes of intelligibility; how those regimes shape subsequent perception and action; and how new encounters or conflicts alter the interpretive conditions inherited by later subjects. Such a project would extend rather than replace the traditions reconstructed here. It would also need to preserve their warnings against several reductions: meaning cannot be treated as merely private intention, merely formal syntax, merely arbitrary convention, or merely the passive reflection of an independently completed social structure.

The problem is especially consequential for a generative relational economics. Economic categories do not only describe economic activity. Once stabilized through contracts, standards, accounting, statistics, organizations, platforms, and policy, they can participate in coordinating and transforming that activity. At the same time, their effectiveness depends on material infrastructures, power relations, legal authority, and practical uptake. Interpretation therefore belongs neither wholly outside economic reality nor wholly above it. It can become one of the relations through which economic objects and possibilities acquire operational form.

This conclusion prepares the transition to the next sections of the chapter. Hermeneutics and philosophy of language show how understanding is mediated by historically inherited structures whose meanings remain open to interpretation and transformation. The genealogy can now move from interpretation toward the philosophy of relation itself. The next problem is therefore broader than linguistic mediation: what does it mean for relation to be analytically or ontologically significant, and how have different philosophical traditions conceptualized relations among entities, processes, structures, and becoming? The following section takes up that problem while retaining the interpretive cautions established here.

2.9 Philosophy of Relation

Earlier sections introduced relation as one possible ontological and analytical category and then examined specifically interpretive, linguistic, phenomenological, and dialogical forms of relationality. The present section reconstructs a broader philo-

sophical genealogy of relation itself. Its role is to clarify the intellectual resources through which relations can be treated as predicates of already constituted things, as irreducible facts connecting distinct terms, as conditions partly constitutive of identity or capacity, and as elements within structures whose own relations can become objects of analysis. The discussion proceeds through five problems: substance-first and relation-first traditions; the controversy over internal and external relations; relational constitution; higher-order relations; and relations among relations. The method remains comparative and genealogical. Aristotle, Bradley, Moore, Russell, Cassirer, Whitehead, Peirce, and contemporary structural realism do not form a single relational school, and their disagreements concern precisely the questions that later GR work must keep open: what the relata are, whether relations add anything to their terms, how strongly identity depends on relational position, and whether relational structures can themselves be related without an explanatory regress.

2.9.1 Substance-First and Relation-First Traditions

A long-standing philosophical route begins with substances or things and subsequently asks which properties and relations can be predicated of them. Aristotle provides an especially influential point of departure. In the *Categories*, relatives are treated as one category among several, while primary substance occupies a privileged position in the account of what is neither said of a subject nor present in a subject (Aristotle 1963). The Aristotelian corpus is too complex to reduce to a simple opposition between substances and relations, and Aristotle's discussions of form, causation, dependence, and actuality introduce structures that exceed a picture of isolated bearers of predicates. The categorical framework nevertheless provides a durable model in which relation is intelligible through terms that can be distinguished from the relation they bear.

The substance-first orientation remained attractive because it supplies a clear grammar for individuation and predication. One first determines what the relevant thing is and then asks what it is like, what it can do, and how it stands to other things. Much ordinary economic description retains this structure. A household, firm, worker, commodity, or state can be treated as a unit with properties, after which exchange, employment, ownership, competition, or obligation are represented as relations among those units. Such an approach can be analytically adequate whenever the identities and capacities of the units are sufficiently stable for the problem under investigation.

Modern philosophy and science also generated traditions in which this ordering became less secure. Cassirer's *Substance and Function* reconstructs an important transformation in scientific concepts from classification by fixed substantial features toward concepts whose contents are determined through systems of functional relations (Cassirer 1923). In such a framework, the position occupied within an ordered system can become more explanatory than resemblance to a paradigmatic thing. Cassirer's historical argument concerns the changing form of scientific concept formation: modern mathematics and physics increasingly employ concepts whose determinations arise through law-governed relations and series while retaining objects as positions within those systems.

Whitehead's process metaphysics offers another departure from substance-centered analysis. In *Process and Reality*, actual entities are treated through be-

coming, prehension, and inheritance from an already actual world; relational incorporation enters the account of actuality itself (Whitehead 1929). Whitehead's speculative metaphysics differs substantially from Cassirer's neo-Kantian account of concept formation. Their juxtaposition is useful because it reveals two distinct routes away from explanatory priority for self-sufficient substances: one concerns how scientific objects are conceptually determined; the other concerns a metaphysics in which becoming and relational incorporation enter the constitution of actuality itself.

Contemporary structural realism provides a further family of relation-sensitive positions. Ladyman distinguishes epistemic structural realism, which limits or redirects what can be known toward structure, from ontic structural realism, which gives structure and relations a stronger metaphysical role (Ladyman 1998). The resulting debate is internally diverse. Some structural realists retain objects while denying that they possess a fully independent intrinsic nature; stronger versions question whether fundamental individuals are required at all. Critics respond that relations appear to require relata and that purely structural description can underdetermine which worldly relations are intended. Structural realism therefore does not supply a settled relation-first ontology. It makes explicit a problem that had appeared in earlier forms: whether explanatory or ontological priority can shift toward structure without rendering the terms of relation unintelligible.

The historical contrast between substance-first and relation-first traditions should therefore be understood as a spectrum of explanatory priorities rather than a binary taxonomy. A theory may preserve entities while making some of their properties relationally dependent. It may treat relations as irreducible facts without claiming that relata are constituted by them. It may give structure epistemic priority while remaining agnostic about ultimate ontology. It may also treat the distinction between thing and relation as locally useful while denying that either side can be given unconditional priority. This range of positions provides the first foundation required by a generative relational programme: philosophical attention can shift toward relation without requiring an immediate metaphysical abolition of entities.

2.9.2 Internal and External Relations

The controversy over internal and external relations sharpened the question of how much a relation contributes to what its terms are. The terminology has changed across periods, and different authors use *internal* in different senses. One recurrent question asks whether a relation follows from, or belongs necessarily to, the natures of the terms related. Another asks whether a relational fact constitutes an addition to the intrinsic properties of its relata. A third asks whether terms can be adequately conceived independently of the larger whole in which they participate. These formulations overlap without being identical.

Bradley's *Appearance and Reality* became a major reference point for the British debate because it attacks attempts to understand qualities and relations as independently intelligible elements subsequently combined into a complex (Bradley 2011). His discussion of "Relation and Quality" argues that qualities considered apart from relations are abstractions, while relations considered as independently linking already constituted qualities generate further difficulties. The familiar Bradley regress emerges from this pressure: if a relation must itself be related to its terms in order to

unify them, an additional relation appears to be required, and the same question can recur. Bradley's broader metaphysics directs these difficulties toward a more holistic conception of reality.

Bradley's position requires historical care. Later summaries sometimes present him simply as a defender of the doctrine that every relation is internal. His critique is more radical than that formula suggests. He objects to external relations understood as independently subsisting connectors, while his later writings also resist an uncomplicated reduction of every relation to the intrinsic qualities of separate terms. The enduring philosophical contribution of the controversy lies less in a single doctrine than in the problem it exposes: a relation must connect distinguishable terms, yet an account of that connection cannot automatically assume that the terms are wholly intelligible prior to the relation.

Moore's "External and Internal Relations" responds to the idealist controversy by distinguishing relations whose possession belongs necessarily to a term from relations that can vary while the term remains numerically the same (Moore 1920). The paper thereby defends the intelligibility of purely external relations. A thing can stand in some relation at one time and fail to stand in it at another without every such difference constituting a change in the thing's intrinsic nature. Moore's analysis is significant for later relational inquiry because it blocks an inference from the importance of relations to the conclusion that every relation is constitutive of every relatum.

Russell's break with British idealism makes external relations central to the development of analytic philosophy and mathematical logic. *The Principles of Mathematics* treats relations as genuine logical constituents and emphasizes relations that cannot be reduced to monadic predicates of isolated terms (Russell 1903). Asymmetrical relations such as earlier than, greater than, or being to the left of resist a subject-predicate analysis that attempts to locate the whole relational fact inside one term. Serial order in particular requires attention to relational structure. Russell's logical programme therefore supplies a powerful reason for granting some relations irreducibility: mathematics itself depends on relational forms whose direction, order, and composition matter.

The internal-external controversy leaves a useful set of distinctions without resolving every metaphysical question. Some relations plausibly depend on intrinsic characteristics of their relata. Others can vary without changing what the relata are under the relevant description. Still others enter the very description by which the relatum is identified: creditor, parent, employee, citizen, and owner are examples in which a role is intelligible through a relation. The same concrete entity can therefore bear relations with different degrees of constitutive significance. This variation is important for later economic analysis. Treating all relations as external can miss how institutions form capacities and identities; treating all relations as internal can make every connection constitutive and thereby weaken analytical discrimination.

A further lesson concerns scale and description. Whether a relation is internal can depend on what is being individuated. A person may remain the same biological individual after leaving an organization, while the institutional subject-position of "director" ceases when the relevant organizational relations dissolve. A firm's physical assets may persist while its legal identity changes through merger, bankruptcy, or reorganization. Philosophical disputes about internality therefore anticipate a methodological question that becomes central in social inquiry: the unit of identity must be

specified before the constitutive force of relation can be assessed.

2.9.3 Relational Constitution

Relational constitution names a stronger possibility than the mere existence of relations. The relevant claim is that some feature of a thing – its identity, capacity, status, intelligibility, or mode of persistence – depends partly on the relations in which it stands. Philosophical traditions disagree about which features can be constituted in this way and about whether such constitution is conceptual, epistemic, social, causal, or metaphysical. The distinction matters because a relation can be causally influential without constituting its relata, and it can be constitutive under one description while remaining contingent under another.

Cassirer's functional conception illustrates relational determination at the level of scientific concepts. An object in a mathematical or scientific series can be identified through the law governing its position within a system rather than through possession of a self-contained qualitative essence (Cassirer 1923). The object remains distinguishable, yet the intelligibility of that distinction depends on the ordered relations in which it participates. This form of relational constitution concerns conceptual determination and should not be translated automatically into a universal claim about what exists independently of conceptual practice.

Whitehead offers a stronger metaphysical version. His actual entities arise through processes that take account of, or “prehend,” an already constituted world; an actuality's becoming therefore includes relations to antecedent actualities within its own constitution (Whitehead 1929). Whitehead's account is highly specific and carries theological, cosmological, and metaphysical commitments that GRE need not inherit. It nevertheless demonstrates a coherent philosophical possibility: relational dependence can belong to the formation of an entity rather than appearing only after the entity has been completely constituted.

Structural realism reopens the issue in the philosophy of science. Ontic structural realist positions ask whether the identity and individuality of physical objects can depend on the structures in which they occur, particularly where contemporary physics challenges classical assumptions about independently individuated particles (Ladyman 1998). Moderate versions preserve relata while denying that they need an intrinsic nature fully separable from their relations. Stronger versions give structure greater ontological priority. The continuing debate over “relations without relata” shows that relational constitution admits degrees. One may reject self-sufficient objects without eliminating objects altogether.

The distinction between *constitution* and *determination* is especially useful here. A relation may determine which value a property takes without constituting the bearer of that property. A relation may constitute a role while leaving the underlying person or organization intact under another description. A web of relations may constitute an institution in the sense that the institution ceases when the relevant practices, recognitions, and obligations disappear. Each of these claims has a different strength. Philosophical clarity requires the analyst to identify which level of dependence is being asserted.

This graded conception helps connect metaphysical debates with later social and economic traditions without collapsing them. A contract can generate obligations whose existence depends on legally recognized relations. A market position can de-

pend on relations of access, dependence, competition, and information. A capability can be affected by infrastructural and institutional relations. These examples establish neither that persons are reducible to relations nor that all economic objects are relational constructions. They show why the category of relational constitution is analytically necessary whenever an object's economically relevant identity or capacity changes with the relational configuration that sustains it.

Relational constitution also raises a temporal question that belongs primarily to the subsequent process-and-emergence discussion. If a relation helps constitute an entity at one time, the formation, persistence, and dissolution of that relation become part of the entity's history. Constitution can therefore be diachronic rather than instantaneous. The present section establishes only the philosophical possibility; the next step in the genealogy concerns theories of becoming through which constitutive relations themselves can arise and transform.

2.9.4 Higher-Order Relations

Philosophy and logic also expand the analysis of relation by distinguishing relations according to arity, order, and structural role. A relation need not be represented only as a simple tie between two independently characterized objects. Peirce's logic of relatives is an important nineteenth-century development because it treats relational form systematically and gives special attention to dyadic and triadic relations (Charles Sanders Peirce 1960). His writings on relatives develop an algebra and logic capable of analyzing how terms occupy distinct places within relational forms. Peirce's insistence on genuine triadic relations is especially significant because it challenges the assumption that every complex relation can be decomposed without remainder into a collection of dyadic ties.

Russell's logic of relations develops a different programme but reinforces the idea that relations possess formal characteristics worthy of analysis in their own right (Russell 1903). Relations can be symmetrical or asymmetrical, transitive or intransitive, serial or non-serial; they can have converses and enter products or compositions. Such properties concern the relation's form across possible or actual instances. Logical analysis therefore moves beyond asking whether a particular pair is related and begins to investigate what kind of relation structures a domain.

This development opens a route toward what may be called *higher-order relational analysis*. The phrase is used here as an organizing label rather than as a doctrine attributed uniformly to Peirce or Russell. A first-order inquiry asks which entities stand in a specified relation. A higher-order inquiry may ask how one relation depends on another relation, how relations compose, whether one relational pattern constrains another, or how a system of relations acquires properties that no single dyad possesses. The logical traditions make these questions intelligible even though their original aims were mathematical and logical rather than social-scientific.

Structural realism supplies another version of higher-order reasoning. Epistemic structural realist positions have sometimes characterized scientific knowledge in terms of structural properties, including relations among relations, rather than complete knowledge of the intrinsic natures of unobservable objects (Ladyman 1998). The philosophical controversy surrounding this move is instructive. Purely formal structure can become too weak if any sufficiently large domain can instantiate an isomorphic pattern. A useful relational account therefore requires constraints on which

relations matter, how they are identified, and what empirical or conceptual content fixes their interpretation. Higher-order structure cannot substitute automatically for substantive knowledge of the domain.

Higher-order relations are particularly important when direct ties derive their meaning from a wider relational architecture. The significance of an employment relation depends partly on legal relations, organizational authority, market alternatives, and social norms. The meaning of a credit relation depends partly on property rules, monetary institutions, accounting classifications, enforcement capacities, and relations of trust. These examples involve several kinds of relation whose interaction cannot be represented adequately by counting dyadic ties alone. The philosophical lineage does not yet provide a social theory of these configurations. It provides conceptual permission to treat relations themselves as analytically structured objects.

This permission should remain disciplined. Higher-order vocabulary can easily become a verbal substitute for specifying the mechanism under study. An analyst must identify what the relevant relations are, which relations take other relations or relational configurations as their objects, and how the higher-order structure changes explanation. The logical history of relations therefore supports greater complexity while also demanding greater precision.

2.9.5 Relations among Relations

The final problem concerns relations among relations themselves. Once relations are treated as analytically significant, it becomes possible to ask how they reinforce, inhibit, translate, authorize, represent, or transform one another. This question extends beyond higher arity. A triadic relation may still be a single relation among three terms, whereas a relation among relations concerns dependencies or structures in which relational configurations become *relata* for further analysis.

Bradley's regress provides an early warning about this move. If every relation requires another relation to connect it to its terms, explanatory work can be displaced into an indefinite sequence (Bradley 2011). A theory therefore needs some account of where relational articulation is primitive, where it is derivative, or how a complex unity is constituted without merely adding another connector. Russell responds in a different direction by allowing relating relations to be primitive components of facts rather than demanding that each act of relating receive a further relational explanation (Russell 1903). The disagreement remains philosophically valuable because it identifies a boundary condition for relational theorizing: more relations do not automatically produce deeper explanation.

The logical traditions also show that relations can stand in systematic connections to other relations. Converse, composition, implication among relational forms, and classification by formal properties create a level at which relational patterns can be compared and combined. Peirce's logic of relatives and Russell's relational logic make such operations explicit (Charles Sanders Peirce 1960; Russell 1903). These logical constructions should not be transferred directly into social ontology. They demonstrate that a domain can possess organization at the level of relations themselves and that this organization may have properties not visible from isolated relational instances.

Cassirer's functionalism adds a historical-epistemological dimension. Scientific concepts often belong to systems in which the determination of one function depends on its place among other functions and laws (Cassirer 1923). Structural realism sim-

ilarly asks what remains invariant or structurally continuous when theoretical descriptions of individual entities change (Ladyman 1998). Both lineages make relations among relations philosophically salient, although one concerns the formation of scientific concepts and the other the interpretation of scientific theories and reality. Their difference should be preserved.

For a later generative relational programme, this genealogy makes several questions available without settling them. A legal relation may authorize an ownership relation; an ownership relation may condition a labor relation; a labor relation may reproduce a status relation; a change in technological relations may alter bargaining relations and thereby modify the conditions under which future contracts are formed. The explanatory object in such cases is neither an isolated entity nor a single tie. It is a structured configuration in which relations condition the formation, persistence, and transformation of other relations.

The same point introduces an important distinction between *relational analysis* and the stronger *generative analysis* developed later in this book. Relational analysis identifies constitutive connections, positions, dependencies, and structures. Generative analysis additionally asks how those relations produce later subjects, capacities, institutions, constraints, and possibilities, including changes in the relations and rules through which subsequent generation occurs. Section 2.9 supplies philosophical precedents for the first task and a conceptual opening toward the second; it does not establish that any historical theory already contains the later GR framework.

The philosophical genealogy of relation therefore ends with a productive incompleteness. Substance-centered ontology preserves the importance of relatively persistent relata. External-relation theories preserve contingency and the possibility that connections change without every identity changing with them. Internal and constitutive accounts show that some identities and capacities are inseparable from relational conditions. Logic demonstrates that relations differ in arity and form and can enter higher-order structures. Structuralist traditions test how far explanatory priority can be assigned to structure while exposing the difficulties of relations without adequately specified relata. Taken together, these lineages make a relational research programme intellectually possible while leaving its strongest ontological claims open. The subsequent genealogy of process, becoming, and emergence adds the temporal problem that this section has largely held fixed: how entities and relations come to be, how novelty occurs, and how the conditions of transformation themselves can change.

2.10 Process, Becoming, and Emergence

The philosophy of relation reconstructed in the preceding section largely held temporal transformation in the background. Relations could be internal or external, constitutive or contingent, dyadic or higher-order, while the analytical question remained principally one of structure. The present section introduces a different family of problems: how events occur, how processes persist through change, how genuinely new configurations can arise, how historical sequences constrain later possibilities, and how the conditions under which transformation occurs may themselves be transformed. Its role is genealogical. Process philosophy, pragmatism, evolutionary thought, emergentism, path-dependence research, historical sociology,

structuration theory, and morphogenetic social theory address overlapping temporal problems without forming a single doctrine. The discussion therefore proceeds through five distinctions: process and event; becoming and transformation; emergence and novelty; historical and path-dependent becoming; and transformation of the conditions of transformation. These traditions make a later generative analysis intellectually possible, but they should not be read retrospectively as incomplete versions of GR.

2.10.1 Process and Event

One route toward a processual account of reality begins by shifting explanatory attention from enduring things to occurrences. The shift can be metaphysical, methodological, or both. A process philosophy may claim that processes or events are ontologically basic; a more modest approach may retain relatively persistent entities while insisting that their persistence, capacities, and interactions are intelligible only through temporally extended activity. The history of process philosophy contains both possibilities, and the distinction matters because treating change as analytically primary does not by itself require a complete process metaphysics.

Whitehead provides the most systematic twentieth-century metaphysical example. In *Process and Reality*, the basic units of actuality are event-like “actual occasions” rather than enduring substances understood as self-identical bearers of changing properties (Whitehead 1929). An actual occasion becomes through the integration of inherited data from an already actual world; once completed, it enters the world as datum for subsequent becoming. Persistence is therefore reconstructed through patterns of succession and inheritance rather than assigned to an independently enduring substance. Whitehead’s vocabulary of concrescence, prehension, and nexus belongs to a speculative metaphysical system and should not be imported directly into economic analysis. Its historical importance lies in demonstrating how a philosophy can make occurrence, dependence on a prior world, and temporal production constitutive of what counts as actuality.

John Dewey reaches processual conclusions through a different route. *Experience and Nature* treats experience as an interaction within nature and repeatedly emphasizes the conjunction of stability and precariousness, continuity and interruption, habit and novelty (Dewey 1925). Dewey’s naturalism does not begin from Whitehead’s categorical scheme. It begins from transactions in which organisms act within environments, encounter uncertain conditions, and reconstruct habits and situations through inquiry and practice. Events matter because situations develop, consequences unfold, and what is experienced as a stable object or institution can be understood through histories of interaction. Dewey therefore contributes a pragmatist process vocabulary in which temporal organization is inseparable from practical engagement.

George Herbert Mead’s *The Philosophy of the Present* adds a particularly important account of the event. Mead treats the present as the locus in which novelty occurs and argues that the occurrence of an emergent event can reorganize the meaning of the past from the standpoint of a changed present (Mead 1932). The past is not simply annihilated or freely invented. Evidence constrains historical reconstruction, while the significance assigned to earlier events can change when a later event creates new relations among them. Mead’s analysis is therefore important for any historical

theory in which temporal order is more than the accumulation of successive states. An event can be consequential because it changes what earlier events now mean for a developing process.

These process traditions also complicate the relation between event and continuity. If analysis isolates only discrete events, it can obscure the processes through which events become possible and acquire consequences. If analysis speaks only of continuous process, it can obscure thresholds, interruptions, and episodes that reorganize later development. Whitehead emphasizes event-like actualization within a wider process of becoming; Dewey analyzes problematic situations and their reconstruction; Mead focuses on emergent presents that alter the organization of temporal perspectives. Their conceptual vocabularies differ, but each resists reducing temporality to a sequence of externally dated snapshots.

For economic inquiry, this lineage offers a general methodological caution. A market transaction, institutional reform, technological adoption, strike, financial crisis, contract, or policy decision can be treated as an event, yet its intelligibility depends on processes that precede and follow it. Conversely, a long-run process such as industrialization or financialization is not adequately described if the events through which its direction changes disappear into a smooth trend. Process and event therefore designate complementary analytical resolutions. The historical traditions reconstructed here establish that temporal organization can itself be an object of theory before any specifically generative account is introduced.

2.10.2 Becoming and Transformation

The language of becoming adds a stronger problem to the analysis of process. Change may be represented as variation in the properties of something whose identity remains fixed. Becoming asks when the object, capacity, relation, or field of possibilities under analysis is itself being constituted through change. The distinction is not absolute: many theories combine relatively persistent carriers with transformational processes. It nevertheless identifies a recurring disagreement over whether temporal development should be modeled primarily as movement among pre-specified states or as a process capable of producing new determinations.

Bergson's *Creative Evolution* is a major philosophical statement of this problem. Bergson distinguishes lived duration from a spatialized representation of time in which succession is reconstructed as a series of discrete positions (Bergson 1911). Duration names a qualitative continuity in which earlier moments persist into later ones and in which change cannot always be decomposed without remainder into a sequence of already specified states. His broader evolutionary argument is tied to a vitalist metaphysics that later biology did not adopt. The enduring conceptual resource is narrower: becoming may involve qualitative differentiation for which a static state-space representation is analytically incomplete.

Dewey's naturalism develops transformation without Bergson's vitalism. Organisms and environments are not treated as fully independent terms whose interaction leaves each side conceptually unchanged. Habits develop in response to environmental conditions; action modifies environments; altered environments create new problems and opportunities for subsequent action (Dewey 1925). Transformation can therefore concern both the acting unit and the situation within which action takes place. Dewey's account remains grounded in inquiry, habit, and practical adaptation

rather than in a universal metaphysics of creative evolution.

Evolutionary economics later developed an explicitly economic account of temporally changing capabilities and routines. Nelson and Winter reject a picture in which firms can be adequately represented as timeless optimizers with fixed technologies and complete knowledge. Their evolutionary framework analyzes organizational routines, search, innovation, differential growth, and selection as processes through which industries change over time (Nelson and Winter 1982). The analogy with biological evolution is selective rather than literal. Firms possess routines that can persist and reproduce; search introduces variation; market competition affects survival and expansion; and the population of routines and firms changes through time. Economic transformation is thereby represented as an endogenous historical process rather than merely a comparative statics exercise.

This lineage clarifies several different meanings of transformation. A system may move while retaining its organizing relations. An entity may alter its properties while preserving its identity for the purposes of analysis. A population may change composition because heterogeneous units survive or reproduce at different rates. Routines and institutions may be revised. The categories through which actors perceive and act may also change. These processes need not share one mechanism. “Becoming” is therefore most useful as a prompt to specify what is becoming different, on what timescale, through which mechanism, and with what degree of continuity.

The distinction between movement and transformation is especially important for later economic analysis. A price change within an established market differs from a change in the rules that define what may be traded. A firm’s adjustment within an existing technological regime differs from the emergence of a new technological regime. A worker’s movement between jobs differs from a transformation in the legal and organizational constitution of employment. The earlier process traditions do not dictate one formalism for these cases. They establish a conceptual basis for asking whether the space of relevant states, identities, or relations should itself be treated as historically variable.

2.10.3 Emergence and Novelty

Emergence addresses a more specific question: when a new property, capacity, level of organization, or pattern appears, in what sense is it dependent on what preceded it, and in what sense does it possess explanatory autonomy? The modern concept developed through several traditions, including British emergentism, evolutionary philosophy, philosophy of mind, and later sciences of complex systems. The resulting literature contains substantial disagreement over whether emergence is epistemic, ontological, causal, explanatory, or merely relative to a chosen level of description.

C. Lloyd Morgan’s *Emergent Evolution* presents one of the canonical British emergentist accounts. Morgan distinguishes resultant combinations from cases in which a new kind of quality appears at a higher level of organization and cannot be treated simply as an additive continuation of lower-level properties (Morgan 1923). His theory is embedded in an evolutionary and metaphysical framework characteristic of its period. Its importance for later discussion lies in the attempt to combine continuity of evolutionary development with qualitative novelty.

C. D. Broad gave the emergentist problem a more precise formulation in *The Mind and Its Place in Nature*. Broad asks whether the characteristic behavior of a complex

whole could, even in principle, be deduced from complete knowledge of its components considered in isolation and in other combinations (Broad 1925). Emergence, in this formulation, concerns the appearance of properties associated with a particular organization of constituents whose behavior is not derivable through the laws already known for those constituents in other contexts. Broad's criterion mixes an epistemic test of deducibility with a metaphysical claim about genuinely distinctive laws, and later philosophers have repeatedly questioned whether failure of prediction or deduction is sufficient to establish ontological novelty.

Twentieth-century physics supplied a different motivation for anti-reductionist language. Anderson's essay "More Is Different" argues that knowledge of fundamental laws does not eliminate the need for autonomous concepts and explanations at higher levels of organization (P. W. Anderson 1972). Broken symmetry and collective organization provide examples in which new principles become necessary for understanding macroscopic behavior. Anderson's argument does not reproduce British emergentism, nor does it establish that higher-level properties are metaphysically independent of lower-level physics. It strengthens the methodological claim that derivational priority and explanatory sufficiency are different questions.

Contemporary philosophy of emergence often organizes the problem around some combination of dependence and autonomy. Emergent phenomena are expected to depend on lower-level constituents or conditions while displaying patterns, properties, or causal/explanatory roles that justify a partially autonomous description. The balance is difficult. If autonomy is made too strong, emergence approaches dualism or unexplained novelty. If dependence is made so strong that higher-level regularities add no explanatory content, emergence collapses into ordinary composition. The literature therefore warns against using the term merely because a system is complicated or because an outcome was unexpected.

Novelty is similarly ambiguous. Something may be novel to an observer because it was not predicted. It may be historically novel because a configuration has not previously occurred. It may be structurally novel because new relations or capacities become available. It may be ontologically novel under a stronger metaphysical interpretation. These senses should remain distinct. A new market institution, for example, may be historically unprecedented without requiring a philosophical claim about strong emergence. A collective property of a market network may require a higher-level description without implying that lower-level mechanisms are causally irrelevant.

For a later generative relational programme, the emergence literature supplies two important constraints. First, emergence requires an account of dependence: a new configuration must be related intelligibly to conditions from which it arises. Second, novelty cannot be inferred merely from the analyst's surprise. The specific respect in which something is new, irreducible, autonomous, or causally consequential must be stated. Chapter 2 therefore uses emergence as a historically developed problem-field, leaving the stronger GR question of generative production for later chapters.

2.10.4 Historical and Path-Dependent Becoming

Process and emergence become historically sharper when sequence matters. Path dependence identifies classes of processes in which the consequences of an event depend on the trajectory through which the system arrived at its present configuration.

The concept has been developed especially in economics, economic history, political science, and historical institutionalism. It should be distinguished from the weak observation that history matters. A path-dependent explanation specifies mechanisms through which earlier events alter the probabilities, payoffs, capabilities, or institutional conditions governing later developments.

Arthur's analysis of competing technologies provides a canonical economic formulation. Under increasing returns to adoption, an initially small advantage can be amplified because adoption itself raises the attractiveness of a technology through learning, coordination, network effects, or related mechanisms (Arthur 1989). Early contingencies can therefore influence which equilibrium or technological standard becomes dominant. The argument is mechanism-specific: historical sensitivity follows from positive feedback and increasing returns, rather than from history as such.

Paul David's account of QWERTY brought related historical reasoning into economic history. His analysis emphasizes how technical interrelatedness, scale economies, and quasi-irreversibility can make an early sequence consequential for later technological development (David 1985). The empirical interpretation of QWERTY subsequently became controversial, which is itself methodologically instructive. Path dependence is not established by identifying persistence after an early choice; one must show the mechanisms that make reversal costly or self-reinforcement consequential.

Nelson and Winter's evolutionary economics broadens historical dependence beyond lock-in. Firms inherit routines, capabilities, and organizational memories that shape their search behavior and feasible adaptations (Nelson and Winter 1982). Economic development is therefore cumulative: current action depends on competencies produced by earlier learning, while search and selection modify the population of routines available for future action. This tradition places path dependence within a wider evolutionary analysis of heterogeneous organizations.

Political science and historical institutionalism extend the logic to institutional development. Pierson argues that increasing-return processes can make timing and sequence consequential in politics because institutions, collective-action structures, authority relations, and adaptive expectations may create self-reinforcing effects (Pierson 2000). His analysis also emphasizes that political processes differ from market competition and therefore require their own mechanisms. The concept of path dependence is useful precisely when it specifies how a prior institutional arrangement alters subsequent costs, capacities, coalitions, or expectations.

Historical sociology adds an event-centered account of structural transformation. Sewell's analysis of the taking of the Bastille argues that historical events can become transformative when interconnected actions acquire new interpretations and reorganize the structures through which subsequent action becomes intelligible and possible (Sewell 1996). Events are consequential not simply because they occur at an earlier date. Their significance can be amplified through collective interpretation, resource mobilization, and changes in schemas. This brings path-sensitive history into contact with the process question introduced by Mead: later developments can reorganize the meaning and causal role attributed to earlier occurrences.

These literatures together distinguish several kinds of historical dependence. Positive feedback can stabilize a selected path. Accumulated capabilities can make some adaptations easier than others. Institutional arrangements can distribute resources and authority in ways that reproduce themselves. Interpretive events can transform

schemas and thereby change subsequent action. None of these mechanisms should be collapsed into a generic concept of “history.” A rigorous historical account identifies what is carried forward from one period to another and how that inheritance changes later possibilities.

This distinction is particularly important for economic transformation. History can matter through sunk investment, legal precedent, technical standards, organizational learning, social expectations, infrastructures, classifications, or distributions of power. Different forms of inheritance operate on different timescales and may reinforce or counteract one another. Path dependence therefore prepares a later generative analysis by establishing that present possibilities are partly produced by historical trajectories, while leaving open the question of how trajectories can also modify the mechanisms through which future trajectories are generated.

2.10.5 Transformation of the Conditions of Transformation

The strongest temporal problem in this genealogy arises when change modifies the conditions under which later change occurs. This differs from ordinary movement within a fixed rule system. It also differs from a single structural transition followed by a new stable regime. The problem is recursive: practices, institutions, schemas, capacities, and relations can be reproduced or altered through action, and their alteration can change what forms of action and transformation are subsequently possible. Several major social theories address this problem through different conceptual architectures.

Giddens’s theory of structuration formulates one influential response through the “duality of structure.” Structures are implicated in the production of social practices while being recursively reproduced through those practices (Giddens 1984). Rules and resources are therefore both medium and outcome of recurrent social action. This formulation rejects an image of structure as an external object that acts upon otherwise independent agents. At the same time, critics have argued that the close analytical identification of structure and practice can make it difficult to specify temporal sequences in which prior structural conditions and later transformations are empirically distinguished.

Sewell reformulates this problem by treating structures as composed of mutually sustaining schemas and resources while placing stronger emphasis on agency and the possibility of transformation (Sewell 1992). Schemas can be transposed to new contexts; resources are multiple and unevenly distributed; and actors possess capacities that allow them to reinterpret or mobilize structural elements in ways that generate change. His later analysis of historical events develops this temporal dimension further: an event can transform structures when chains of action and interpretation alter the schemas and resources that organize subsequent practice (Sewell 1996). The conditions of action are therefore historically inherited yet potentially reconstituted through consequential events.

Archer’s morphogenetic approach develops a contrasting solution by insisting on analytical separation across time. Structural and cultural conditions predate a given round of interaction; actors respond within those conditions; the resulting interaction can reproduce existing arrangements or generate structural and cultural elaboration that conditions a subsequent cycle (Archer 1995). Archer calls attention to “double morphogenesis”: agents can transform social structures while the same pro-

cess transforms the agents and collectivities capable of later action. Her analytical dualism differs sharply from Giddens's duality of structure. The disagreement is productive because both theories confront the recursive relation between inherited conditions and their reproduction or transformation while proposing different ways to preserve explanatory sequence.

These social theories can be placed beside evolutionary and path-dependent accounts without being assimilated to them. Nelson and Winter show how routines and search processes change organizational capabilities; Arthur shows how positive feedback changes the later attractiveness of alternatives; Sewell shows how events can transform schemas and resources; Giddens emphasizes recursive reproduction; Archer separates conditioning, interaction, and elaboration across time. Each provides a different answer to the question of how a process can alter what will count as a possible or probable transformation in the next period.

The phrase *transformation of the conditions of transformation* is used here as an organizing expression for this shared problem, not as a canonical term attributed to any of these authors. It identifies a level of inquiry at which the analyst asks more than what changed. One also asks whether the mechanisms, capacities, rules, relations, or interpretive resources governing later change have been altered. A constitutional reform may change policy while also changing the procedures through which later reforms can occur. A technological platform may create new products while altering the architecture through which future innovations reach users. A labor institution may change wages while also changing bargaining capacities and the organizational forms through which later claims are made. These examples remain illustrative; the section's purpose is to establish the lineage of the problem rather than to provide a completed GRE theory of recursive transformation.

This genealogy makes several resources available to later GR work. Process philosophy establishes that occurrence and becoming can be analytically primary. Bergson and pragmatist traditions show that temporal development need not be represented exhaustively as movement among pre-given states. Emergentism separates dependence from autonomy and forces greater precision about novelty. Evolutionary economics and path-dependence research demonstrate how histories produce differentiated later possibilities through specified mechanisms. Structuration, historical sociology, and morphogenesis make explicit the possibility that action can reproduce or modify the conditions of subsequent action.

These inheritances also impose limits. Process does not by itself establish emergence; emergence does not by itself establish generativity; path dependence does not imply irreversible lock-in; recursive reproduction does not imply that every structure is internally self-transforming; and transformation of conditions does not require a relation-only ontology. A later generative relational analysis must therefore specify which entities and relations persist, which processes reproduce them, where novelty enters, how historical inheritance constrains later possibilities, and whether a transformation changes only outcomes or also the conditions through which subsequent outcomes are generated. Section 2.10 provides the intellectual genealogy for those questions while leaving their GRE-specific formulation to later chapters.

2.11 Social Facts and Relational Reality

The preceding sections established intellectual resources for thinking about relation, process, emergence, and historically conditioned transformation. The present section turns to a further question that becomes unavoidable once these resources are brought into the social domain: how can facts, rules, classifications, offices, norms, and institutions be socially constituted while remaining sufficiently real to organize conduct, distribute powers, and generate durable consequences? Its role is genealogical and differentiating. The discussion reconstructs several traditions that approach this problem through distinct concepts: Durkheimian social facts; the sociology of knowledge and institutionalization; philosophical accounts of institutional facts; pragmatist and practice-theoretic accounts of habit; theories of social norms; legal positivist accounts of legal validity; institutional analyses of governance rules; and theories of symbolic power and reflexive social causation. The five subsections distinguish social facts; culture, habit, and norm; legal and governance facts; symbolic stabilization and causal effect; and the historical revisability of social reality. The purpose is to clarify the conceptual materials available to later GR analysis without treating every socially constituted phenomenon as the product of one mechanism.

2.11.1 Social Facts

The concept of a social fact provides one of the classical points of departure for a social ontology that refuses to reduce collective reality to the psychology of isolated individuals. In *The Rules of Sociological Method*, Durkheim defines social facts through their relative exteriority to the individual, their generality within a social group, and their capacity to exercise constraint (Durkheim 1982). Language, law, moral rules, monetary practices, occupational expectations, and other socially inherited forms confront a newly situated individual as already organized patterns. Their existence is expressed through individual conduct, yet they are not exhausted by any one individual's beliefs or actions. Durkheim's methodological injunction to treat social facts as things was designed to secure sociology an object of inquiry whose causes and functions could be investigated at the social level.

Durkheim's formulation makes persistence and constraint analytically central. A language remains available even when particular speakers enter or leave a population; a legal rule remains socially operative despite disagreement by particular subjects; a custom can exert pressure precisely because individuals encounter it as already established. The position should not be interpreted as claiming that social facts exist independently of all human practice. Durkheim's point concerns their relative independence from particular individual manifestations and the explanatory inadequacy of reducing them to individual intentions. The resulting lineage is therefore especially important for later theories that need to explain how social forms can be reproduced through persons while confronting those persons as conditions not of their own individual making.

Berger and Luckmann reconstruct this problem through the sociology of knowledge rather than through Durkheim's methodological vocabulary. *The Social Construction of Reality* analyzes everyday reality through processes of habitualization, institutionalization, objectivation, legitimation, and socialization (Berger and Luckmann 1966). Repeated conduct can become typified; reciprocal typifications can stabi-

lize into institutions; institutions can confront later participants as an objective social order; and socialization can make that order subjectively meaningful. Their account is therefore explicitly temporal. What appears to later participants as an already existing social reality can have been produced through earlier interaction and subsequently transmitted in forms that no single current participant designed.

The distinction between objective and subjective social reality in this tradition is consequential. “Objective” does not mean independent of human history in the sense of a mountain or a chemical element. It refers to the way institutionalized meanings, roles, and expectations acquire a socially objectivated existence that individuals must interpret and navigate. Conversely, social reality remains dependent on continuing processes of enactment, legitimation, transmission, and internalization. Berger and Luckmann thereby provide a vocabulary for explaining how socially produced reality can become experienced as given without assuming that its historical production makes it fictitious.

Searle approaches institutional reality through analytic philosophy. In *The Construction of Social Reality*, he distinguishes brute facts from forms of social and institutional fact that depend on collective intentionality or acceptance, representation, and constitutive rules (Searle 1995). Institutional facts concern such phenomena as money, property, offices, citizenship, promises, and games. Their relevant functions cannot be derived from physical structure alone. A material object can count as currency, a person can count as an officeholder, or an utterance can count as a promise within a system of collectively recognized statuses and rules. Searle’s later vocabulary of status functions and deontic powers emphasizes that institutional statuses can create rights, duties, permissions, obligations, and authorizations.

These three lineages should remain distinct. Durkheim emphasizes social exteriority, generality, and constraint. Berger and Luckmann emphasize the historical production, objectivation, legitimation, and internalization of everyday institutional reality. Searle focuses on the logical and representational constitution of institutional facts, especially status functions sustained by collective acceptance. Their objects overlap, but their explanatory questions differ. A rule can be Durkheimianly constraining, Berger–Luckmannianly institutionalized, and Searleanly constituted through status recognition without those descriptions being theoretically equivalent.

A first foundation for later relational analysis follows from this plurality. Social reality can possess forms of persistence and causal relevance that are neither reducible to a single individual’s current mental state nor independent of social relations altogether. The problem is therefore not resolved by choosing between “real” and “constructed.” Existing theory already provides several ways to explain how socially constituted facts can become stable objects of orientation, expectation, obligation, and action. The more difficult questions concern the mechanisms by which different kinds of social fact are produced, maintained, coupled, and transformed.

2.11.2 Culture, Habit, and Norm

The vocabulary of social facts becomes analytically sharper when culture, habit, and norm are distinguished. These concepts frequently interact in practice, yet they designate different objects. Culture can refer to historically transmitted repertoires of meaning, classification, symbolization, evaluation, and practice. Habit concerns acquired dispositions and recurrent modes of conduct. Norm refers more specifically to

standards or expectations through which conduct is evaluated, anticipated, encouraged, or sanctioned. Theoretical traditions differ over each term, and a lineage-first account should resist converting them into interchangeable layers of one model.

Dewey gives habit a strongly social and environmental interpretation. In *Human Nature and Conduct*, habits are acquired modes of conduct that depend on the cooperation of organism and environment; customs and social conditions participate in their formation and maintenance (Dewey 1922). A habit is therefore more than a private repetition stored inside an individual. Walking depends on a physical environment, speech on linguistic and social surroundings, and moral dispositions on patterns of interaction and expectation. Dewey's treatment is valuable because it makes habit both stabilizing and revisable. Habits enable coordinated conduct by carrying prior learning into present situations, while changed conditions, conflicting habits, and reflective inquiry can reorganize them.

Bourdieu's theory of practice develops a different account of socially formed disposition. In *Outline of a Theory of Practice*, the concept of habitus addresses durable and embodied dispositions generated under historically structured conditions and implicated in the production of practice (Bourdieu 1977). Habitus is not simply a list of consciously followed rules. It provides practical orientations, classifications, expectations, and embodied tendencies through which agents navigate fields without calculating every action from first principles. Because dispositions are formed through differentiated social trajectories, patterned conduct can be reproduced without requiring identical explicit beliefs across all participants.

This practice-theoretic lineage also complicates simple accounts of culture. Cultural competence is not exhausted by propositions that actors can state. Accent, gesture, taste, timing, bodily ease, classifications of what is appropriate, and expectations regarding institutions can be socially learned and practically operative without being fully explicit. Bourdieu's later work on symbolic power further emphasizes that linguistic and classificatory practices operate within unequal social conditions rather than within a neutral space of shared meaning (Bourdieu 1991). A cultural form can therefore be both meaningful and structured by differential authority to name, classify, certify, and have classifications recognized.

Norm theory identifies another mechanism. Bicchieri's *The Grammar of Society* analyzes social norms through the expectations that sustain compliance and through the conditions under which norms emerge, become salient, and change (Bicchieri 2006). This approach makes it possible to distinguish a norm from mere behavioral regularity. A population can behave similarly because members share material constraints, because they have acquired similar habits, because they expect others to behave in a certain way, because they believe others expect a particular conduct from them, or because formal sanctions attach to deviation. These mechanisms can coexist, but their coexistence should be demonstrated rather than assumed.

The distinction also clarifies the relation between custom and norm. A repeated practice may become habitual without acquiring a strongly articulated normative status. Conversely, a norm can remain normatively recognized while frequently violated. Culture can provide the symbolic vocabulary through which a norm becomes intelligible, while habit can make compliant conduct practically easy. Institutional sanctions can reinforce the same pattern from another direction. Social stability often results from such coupling, which explains why apparently simple regularities may be difficult to change: different mechanisms can support the same observable

conduct.

These lineages establish a useful caution for economic and institutional analysis. Observable regularity is an insufficient basis for inferring one underlying social mechanism. A queue, a dress convention, a professional credential, a pattern of household labor, a market convention, or a bureaucratic routine can involve habits, norms, classifications, sanctions, strategic expectations, and material constraints in different proportions. The concepts of culture, habit, and norm therefore provide distinct analytical resolutions for explaining why conduct becomes patterned and why some patterns persist even when individuals could physically act otherwise.

For later GR work, the important inheritance is methodological rather than doctrinal. Theories of habit and practice show how past social relations can become embodied dispositions; norm theory shows how expectations and social evaluation can stabilize conduct; theories of symbolic power show that meaning-making capacities are unequally distributed. A generative account may later ask how these mechanisms condition one another across time, but Chapter 2 should first preserve the conceptual differences through which existing theory has made those questions visible.

2.11.3 Legal Facts and Governance Facts

Law provides an especially clear case in which socially constituted facts can have precise practical consequences. Whether a statute is valid, a person holds an office, a contract exists, an agency possesses jurisdiction, or a procedure has been properly completed cannot usually be determined from physical description alone. Such facts depend on rule-governed practices, recognized sources, procedures, offices, and interpretive communities. Jurisprudence and institutional analysis therefore supply an important bridge between social ontology and the organized distribution of authority.

Hart's *The Concept of Law* analyzes a developed legal system through the union of primary and secondary rules (Hart 2012). Primary rules impose obligations, while secondary rules concern recognition, change, and adjudication. The rule of recognition occupies a distinctive position because it supplies criteria used by officials to identify legally valid rules. Its existence is itself a matter of social practice rather than legal validity established by a still higher legal rule. Hart's account therefore makes the existence of a legal order depend in part on shared official practices and an internal orientation toward rules as standards, while allowing the validity of particular legal rules to be determined through institutional criteria.

This analysis demonstrates a form of layered social fact. The fact that a legislature enacted a statute may depend on constitutional rules identifying the legislature, procedural rules governing enactment, evidentiary practices establishing that required acts occurred, and a rule of recognition identifying the relevant sources of law. Legal reality is consequently structured by relations among rules rather than by isolated commands. A legal fact can be highly determinate within an institutional system even though the system's foundational practices are historically contingent social facts.

Searle's theory of institutional facts offers a complementary vocabulary. A legal office, property title, authorization, or obligation can be analyzed as involving collectively recognized status functions and deontic powers (Searle 1995). The advantage of this framework is that it draws attention to the way institutional statuses alter what agents are entitled, required, or empowered to do. A physical person and an office-

holder can be materially the same individual while occupying different normative positions. The institutional status reorganizes relations of authorization and obligation among that person and others.

Institutional analysis broadens the inquiry beyond formal law. Ostrom's *Understanding Institutional Diversity* studies institutions through action arenas, rules used by participants, community attributes, and the conditions under which institutional arrangements operate and change (Ostrom 2005). This perspective directs attention toward rules-in-use and recurrent governance practices rather than assuming that formally promulgated law exhausts the institutional order. A community, firm, professional body, platform, or resource-management arrangement can possess meaningful governance structures whose operation depends on conventions, monitoring practices, procedures, and shared understandings alongside formal legal rules.

The phrase *governance fact* is used here as an organizing label for this broader class of socially constituted facts concerning authorized roles, jurisdiction, procedures, decision competence, rule applicability, and recognized outcomes. It is not presented as a canonical category shared by Hart, Searle, or Ostrom. The label helps distinguish, for example, the legal fact that a statute is valid from the governance fact that a particular committee is treated as the competent body for a decision under an organization's operative practices. The two may coincide, but informal institutions and organizational procedures can create governance facts that are not straightforwardly reducible to state law.

This distinction also prevents the category of social fact from becoming analytically flat. A greeting convention, a property title, a constitutional office, and an informal resource-allocation rule can all be socially constituted while differing in formalization, sanction, documentation, jurisdiction, and revision procedure. Legal systems characteristically develop specialized secondary rules and authoritative institutions for identifying and changing legal facts. Other governance arrangements may rely more heavily on custom, reputation, repeated interaction, or organizational procedure. The existence of a socially recognized rule therefore does not by itself establish its legal status.

For later relational economic analysis, jurisprudence and institutional theory provide two indispensable insights. First, authority and obligation are structured through relations among rules, offices, procedures, and recognized actors rather than through material capability alone. Second, changing a rule can change the relational positions from which later actions are possible: who may decide, who may challenge, what counts as evidence, which resources can be allocated, and which procedures confer validity. These insights will later matter for power and governance, but the present chapter uses them primarily to establish the intellectual foundations of socially constituted yet practically consequential institutional reality.

2.11.4 Symbolic Stabilization and Causal Effect

Social construction is sometimes misunderstood as implying causal weakness. The lineages reconstructed above support almost the opposite conclusion. A socially constituted classification or status can have durable effects precisely because actors, organizations, legal systems, and infrastructures orient their conduct around it. The relevant causal question is therefore how symbolic distinctions become stabilized, connected to resources and sanctions, reproduced in practice, and incorporated into

expectations.

Berger and Luckmann's account of objectivation and legitimation is one starting point. Institutional meanings become more durable when they are typified, transmitted, justified, and incorporated into broader symbolic orders (Berger and Luckmann 1966). A role is easier to reproduce when participants possess names and expectations for it; an institution becomes more resilient when its procedures are taught and justified; and a social classification can become part of everyday reality when it is embedded in routine interactions and socialization. Symbolization in this sense helps coordinate interpretation across persons and generations.

Bourdieu adds the problem of unequal symbolic authority. *Language and Symbolic Power* treats linguistic exchange as embedded in social relations in which speakers possess unequal capacities to have utterances recognized as legitimate, authoritative, official, or valuable (Bourdieu 1991). Symbolic efficacy therefore depends on social conditions of recognition. Naming, certification, classification, and public declaration can reorganize conduct when the speaker or institution possesses recognized authority and when the relevant audience inhabits a field in which the classification has practical meaning.

Legal and institutional facts illustrate this mechanism especially clearly. A judicial judgment, a property register, a professional license, a central-bank declaration, or an organizational appointment consists partly of symbolic acts and representations. Yet their consequences can include transfer of assets, restriction of liberty, access to markets, eligibility for benefits, or authority over organizational resources. Searle's account of status functions emphasizes this connection between collectively recognized representation and deontic power (Searle 1995). The symbolic and material dimensions are therefore analytically distinguishable but often causally coupled.

Merton's analysis of the self-fulfilling prophecy provides a different mechanism through which representation can become causally consequential. A definition or expectation can influence conduct in ways that contribute to producing the condition that participants anticipated (Merton 1948). The mechanism does not imply that every belief creates its own truth. It identifies a particular feedback structure in which socially consequential expectations alter behavior and thereby affect outcomes. Bank runs, reputational dynamics, and coordination processes offer familiar classes of cases in which expectations can participate in generating the conditions to which they refer, although each empirical case requires mechanism-specific investigation.

Institutional economics adds further precision by connecting rules to incentives and uncertainty. North defines institutions as humanly devised constraints that structure interaction and emphasizes their role in shaping incentives and long-run economic performance (North 1990). This account differs from Searle's social ontology and from Bourdieu's theory of symbolic power, yet it reinforces a common analytical point: institutionalized rules and classifications matter because they alter feasible actions, expected returns, transaction environments, and strategic relationships. The causal efficacy of an institution is mediated through behavior and organizational arrangements rather than through the mere semantic content of a rule.

These traditions therefore support a distinction among several routes from symbol to consequence. A representation can constitute an institutional status; a classification can coordinate expectations; a recognized authority can impose a binding designation; a norm can trigger approval or sanction; an expectation can change behavior in a self-reinforcing direction; and a formal rule can restructure incentives and

permissible actions. Symbolic stabilization is strongest when several of these routes reinforce one another, but the mechanisms should remain separately identifiable.

This is also where the term *relational reality* begins to acquire a disciplined social meaning. A socially constituted fact can be real for analysis when it is embedded in relations that reliably reorganize conduct, obligation, access, expectation, or resource distribution. Such a claim does not require treating every social representation as true, just, or equally efficacious. Nor does it require reducing the material world to discourse. It requires tracing the relations through which symbolic and institutional forms become causally consequential within a historically situated social order.

2.11.5 Historical Revisability of Social Reality

The stability of social facts creates a final theoretical problem: socially constituted reality can confront actors as durable and objective while remaining historically revisable. A satisfactory account must therefore explain both persistence and transformability. If social reality were freely revisable by individual belief, the concepts of institution, law, norm, and social fact would lose much of their explanatory force. If it were immutable, its social and historical constitution would become unintelligible.

Berger and Luckmann's institutional account already contains this temporal tension. Institutions are sedimented through habitualization, reciprocal typification, legitimation, and socialization, yet they remain products of ongoing social processes (Berger and Luckmann 1966). The same mechanism that makes an institution appear objective to later participants also explains why its continued existence requires transmission and reproduction. Historical durability therefore arises from successful reproduction across changing populations rather than from metaphysical permanence.

North's institutional analysis likewise treats institutions as both constraints and objects of change. Formal rules, informal constraints, and enforcement arrangements can persist because they organize incentives and expectations, while institutional change alters those same structures over time (North 1990). The path-dependent analysis developed in the preceding section adds that revision is rarely costless. Established organizations, sunk investments, legal precedents, learned routines, and distributions of bargaining power can make some institutional trajectories easier to continue than to reverse.

Historical sociology sharpens the possibility of discontinuous revision. Sewell's theory of structure and events shows how schemas and resources can be reproduced through ordinary practice yet transformed through consequential sequences that reorganize later action (Sewell 1992; Sewell 1996). Giddens similarly emphasizes the recursive relation between practices and the rules and resources reproduced through them (Giddens 1984). These traditions differ over how structure and agency should be analytically separated, but both reject an image of social structure as a timeless container external to practice.

Hacking's historical ontology adds an epistemic and classificatory dimension. His work examines how categories, concepts, and styles of reasoning can have histories that alter what can be described, investigated, and sometimes lived as a kind of person or social object (Hacking 2002). The relevance to social facts lies in the possibility that classificatory practices do more than describe an independently fixed social world. In some domains, changing classifications can alter institutions, self-understandings, administrative procedures, and patterns of action, thereby changing the very phe-

nomena subsequently classified.

Legal and governance facts make revisability especially visible because many institutions contain explicit procedures for their own alteration. Hart's secondary rules of change identify legal mechanisms through which valid rules can be introduced, amended, or removed (Hart 2012). Ostrom's institutional analysis likewise directs attention toward the rules through which participants organize and revise governance arrangements (Ostrom 2005). Social orders can therefore institutionalize transformation itself: the constitution of an authorized revision procedure becomes part of the reality whose future states that procedure can modify.

This recursive feature helps clarify why the concepts reconstructed in Section 2.11 matter for later GR. Existing theory already shows that social reality can be generated historically, objectivated, embodied as habit, stabilized through norms, constituted through legal and institutional rules, reinforced through symbolic authority, and revised through practice and explicit procedures. A later generative relational analysis can build on these lineages by asking how such mechanisms interact and how one socially constituted relation changes the conditions under which other relations can emerge, persist, or disappear. That later question should not erase the distinctions established here.

Several conceptual guardrails follow from the genealogy. Socially constituted does not mean arbitrary. Symbolically mediated does not mean causally inert. Habit does not mean norm. Norm does not mean law. Legal validity does not exhaust governance practice. Institutional stability does not imply historical irreversibility. Causal efficacy does not imply moral legitimacy. These distinctions allow social facts to be treated as historically generated and relationally sustained without reducing them either to private belief or to natural necessity. They also preserve the ontological suspension required by this book: the reality of a social fact can be investigated through its relations of recognition, reproduction, constraint, authorization, representation, and consequence without requiring a final metaphysical claim about what social reality ultimately is.

2.12 Primitive Structure of Social Dynamics

The preceding sections reconstructed theories of relation, process, emergence, and socially constituted reality. The present section asks a more elementary question: which conceptual distinctions have repeatedly been required when social theory attempts to describe how a configuration becomes different, how patterned organization persists, and how some possibilities are enabled while others are restricted? Its role is genealogical and preparatory. Rather than deriving a complete ontology of social dynamics, the section reconstructs established treatments of change, difference, structure, and constraint and then relates those concepts to a wider descriptive vocabulary of states, relations, entities, properties, processes, and events. These traditions do not converge on one metaphysics. Aristotle, process philosophy, structuralism, theories of practice, information-oriented approaches, institutional analysis, and analytic event ontology assign different status to the same terms. Their juxtaposition nevertheless clarifies why later GR can treat change, difference, structure, and constraint as a deliberately minimal analytical vocabulary while withholding the claim that any one of them is an ultimate constituent of reality.

2.12.1 Change

Change is among the oldest organizing problems of philosophy because any account of persistence, causation, action, or history must explain how something can become otherwise while remaining sufficiently identifiable for the change to be described. Aristotle's *Physics* provides a classical framework by analyzing motion and change through such distinctions as actuality and potentiality, form and matter, and different kinds of alteration (Aristotle 2018). Its relevance here is the durable analytical problem it establishes: description requires both some dimension along which a transformation occurs and some account of the continuity that permits one to say that a transformation has occurred to, in, or through a relevant subject.

Modern process philosophies alter the priority among these terms. Bergson's account of duration resists treating temporality as a succession of externally juxtaposed instants and instead emphasizes qualitative becoming (Bergson 1911). Whitehead goes further by developing a metaphysics in which process and event-like becoming are more fundamental than enduring substance (Whitehead 1929). Dewey's naturalism places change within organism–environment transactions and treats relatively stable forms as accomplishments within ongoing activity rather than as the opposite of process (Dewey 1925). Mead similarly makes the emergent present central to temporality and argues that a consequential novelty can reorganize the significance attributed to the past (Mead 1932). These positions differ markedly, but each makes it harder to regard change as a secondary disturbance imposed on an otherwise fully static world.

Social theory adds a further complication because the object that changes may partly consist in practices that reproduce it. Giddens's theory of structuration describes social systems as recursively produced through practices in which rules and resources are both conditions and outcomes of action (Giddens 1984). Sewell reformulates structure through schemas and resources and gives transformation a more explicit place in the theory, especially when events reorganize relations among them (Sewell 1992; Sewell 1996). Archer, by contrast, insists on analytical separation across time: structural and cultural conditioning precede interaction, interaction can produce elaboration or reproduction, and later agents confront conditions partly transformed by prior cycles (Archer 1995). The three traditions therefore share an interest in social transformation while disagreeing about how structure and agency should be separated analytically.

These lineages also show why change should not be identified with improvement, novelty, or eventfulness. Reproduction across time is itself a temporal achievement. A norm can remain similar because it is continuously reenacted; an institution can persist because actors repeatedly perform the work required for maintenance; a hierarchy can reproduce itself through changing personnel; and a relation can remain stable while its material supports are replaced. Conversely, a visible event may leave the generative conditions of a system largely intact. Social analysis therefore needs a concept of change broad enough to include variation in state, relation, organization, capacity, rule, and trajectory, while leaving the substantive significance of that variation open to investigation.

This point is important for the later GR vocabulary. A primitive concept of change need not presuppose what kind of thing is changing. It can refer provisionally to a detectable or inferable transformation between configurations, while the appropriate

ontology of the configuration remains unsettled. Such minimality prevents the analysis from assuming in advance that change must belong to an already constituted individual, institution, relation, or field. The stronger question—what kind of reality is transformed, by what mechanism, and with what consequences for subsequent transformation—can then be addressed at a later analytical stage.

2.12.2 Difference

A description of change requires some way of distinguishing what differs. Difference, however, has several theoretical meanings. It can indicate simple non-identity between observations, a contrast produced within a classificatory system, a difference that carries information for an observer or system, or a more fundamental principle of differentiation through which identities themselves become determinate. The intellectual history of the concept therefore spans logic, linguistics, anthropology, cybernetics, and metaphysics.

Saussure's linguistics provides one influential account of differential determination. In the linguistic system, the value of a sign depends on contrasts within a structured field rather than on an isolated intrinsic content possessed independently of other signs (Saussure 1966). This insight became foundational for structuralist approaches well beyond linguistics. The transferable lesson is narrower: some identities are intelligible only through systems of difference. A status, category, office, or classification may acquire determinate meaning partly because it occupies a position contrasted with other available positions.

Bateson's work offers a different route. His essays on communication, cybernetics, learning, and epistemology repeatedly treat pattern and difference as central to information and response (Bateson 2000). Here a physical difference becomes analytically consequential when it enters a circuit of discrimination, communication, or response. The emphasis therefore shifts from mere non-identity to consequential difference. This is especially useful for social inquiry because societies contain innumerable physical, symbolic, and behavioral variations, only some of which become recognized, encoded, institutionally relevant, or causally effective within a particular relation.

Deleuze radicalizes the philosophical status of difference in another direction. *Difference and Repetition* criticizes traditions in which difference is conceptually subordinated to prior identity and develops a metaphysics in which differential processes participate in the genesis of identities themselves (Deleuze 1994). GR does not need to inherit this metaphysical commitment in order to take the problem seriously. The lineage demonstrates that difference can be treated either as comparison among already constituted terms or as part of the process through which determinate terms arise. Those are different theoretical claims and should not be conflated.

In social analysis, difference can therefore be present at several levels. Two observed states may differ statistically. Two institutional positions may be differentiated by rule. Two actors may become socially distinguished through classification. A difference in access may generate a difference in later capability. An initially minor asymmetry may be amplified through cumulative advantage. Conversely, a physically measurable difference may remain socially inert because no relevant practice, institution, perception, or mechanism responds to it. Difference is thus neither automatically meaningful nor automatically causal.

This distinction also clarifies why difference should remain separate from inequality. Inequality is a normatively and substantively more specific relation concerning unequal quantities, positions, powers, opportunities, burdens, or valuations. Difference is analytically prior only in the weak sense that an inequality requires some relevant distinction or comparison. The presence of difference alone establishes neither hierarchy nor injustice. A later normative analysis must therefore identify which differences become socially organized, how they are evaluated, and through what mechanisms they affect life chances, recognition, value, or power.

For later GR, the concept can consequently remain minimal: difference marks a non-equivalence, distinction, gradient, contrast, or differentiation relevant to a specified analysis. The theory must then establish whether the difference is observed, represented, institutionally constituted, causally consequential, normatively salient, or generative of further differences. This keeps the primitive open enough to travel across empirical domains without converting every difference into the same kind of social fact.

2.12.3 Structure

The concept of structure addresses patterned organization. Its attraction lies in the possibility that the properties of a social configuration cannot be explained adequately by listing its elements independently. Yet “structure” has carried sharply different meanings across intellectual traditions. It can denote a system of relations among elements, a rule-governed transformation system, a relatively enduring distribution of positions and resources, or the recursively reproduced conditions of practice. A genealogical reconstruction is therefore necessary before the concept can function as a primitive.

Structural linguistics supplied one influential model. Saussure’s differential conception of language made the value of an element dependent on its position within a system (Saussure 1966). Lévi-Strauss extended structural analysis into anthropology, especially through kinship, myth, classification, and symbolic organization, seeking relations and transformations beneath the immediately observed diversity of cultural forms (Lévi-Strauss 1963). The structuralist move shifts explanatory attention from isolated units toward patterns among positions, oppositions, and transformations. Its limits are equally important: a structural description can illuminate organization while giving inadequate attention to historical genesis, agency, contingency, or the mechanisms by which a structure changes.

Piaget’s *Structuralism* provides a useful metatheoretical formulation because it characterizes structure through the linked ideas of wholeness, transformation, and self-regulation (Piaget 1970). Structure in this sense is more than an inventory of components. The elements belong to an organized whole whose transformations are governed by relations internal to the system. Although Piaget develops this formulation across mathematics, psychology, biology, and the human sciences, it does not follow that social structures literally possess the same formal properties as mathematical structures. The importance of the lineage lies in distinguishing structure from mere aggregation.

Practice theory and historical sociology rework the concept in ways more directly relevant to social dynamics. Giddens defines structure through rules and resources recursively implicated in the reproduction of social systems, making structure both

enabling and constraining rather than an external framework standing outside action (Giddens 1984). Sewell criticizes parts of this formulation while retaining the emphasis on duality; his account treats structures as mutually sustaining schemas and resources whose transposability and multiplicity create possibilities for both reproduction and transformation (Sewell 1992). Archer rejects the collapse of structure and agency into one recursive moment and insists that temporally prior structural conditions possess emergent properties capable of conditioning later interaction (Archer 1995). These disagreements reveal that “structure” is not one settled object.

A useful minimal concept must therefore avoid importing an entire structuralist or structuration-theoretic ontology. At the level required here, structure can designate patterned organization among distinguishable elements, positions, relations, or transformations such that the organization matters for what can occur next. This formulation leaves several questions open: whether the structure is material, symbolic, institutional, networked, legal, or mixed; whether it is represented explicitly by participants; whether it is stable or transient; whether it is reproduced through action; and whether its explanatory relevance lies in topology, rules, resources, meanings, or some other feature.

The minimality also helps distinguish structure from relation. A relation can connect two or more terms without by itself constituting a larger organized pattern. Structure concerns an arrangement of relations, positions, distinctions, or transformation rules whose organization is analytically consequential. Conversely, a structure need not be represented adequately by a static network of pairwise ties. Legal orders, classification systems, role systems, and temporal routines may possess structure whose relevant organization includes higher-order rules, sequences, or interpretive dependencies. Later GR can therefore ask how structures emerge from relations and how structures condition the generation of later relations without assuming that the two concepts are interchangeable.

2.12.4 Constraint

Constraint identifies a further feature of social dynamics: not every logically imaginable transition is equally available. Theories of constraint differ over whether restrictions arise from physical conditions, institutions, norms, distributions of resources, inherited structures, cognition, or strategic interdependence. They also differ over whether constraint should be understood negatively as limitation or more broadly as the patterned specification of a space of possible action.

Durkheim’s social facts offer a classical social-scientific starting point. Social facts are recognizable partly through the external constraint they can exercise over individuals (Durkheim 1982). Law, moral regulation, language, custom, and collective expectations confront persons as conditions they did not individually create. Durkheim’s formulation established constraint as a mark of social reality. Read too mechanically, however, it can encourage an image of structure acting externally upon an already constituted individual. Later theories consequently attempt to explain how constraint can be reproduced through practice or embodied in disposition.

Giddens explicitly treats structure as both constraining and enabling. Rules and resources do not merely block action; they make coordinated forms of action possible while organizing the conditions under which those actions occur (Giddens 1984). Bourdieu’s habitus provides another route because historically formed dispositions

shape practical expectations and perceived possibilities without requiring actors to consult an explicit rule at every moment (Bourdieu 1977). Archer again insists on temporal separation: structural and cultural properties can predate a particular action situation and condition the interests and opportunities of agents, even though later interaction may transform those conditions (Archer 1995). These accounts all reject a simple equation between constraint and direct coercion.

Institutional economics makes the concept more explicit in another register. North defines institutions through humanly devised constraints that structure interaction and thereby shape incentives and uncertainty (North 1990). Ostrom's institutional analysis gives greater attention to the specific rules-in-use through which participants organize action situations and to the diversity of institutional arrangements that can be constructed and revised (Ostrom 2005). Legal theory likewise shows that a rule can constrain by defining validity, authority, permission, obligation, and competence rather than by physically preventing alternatives (Hart 2012). Constraint can therefore operate through several mechanisms: exclusion, cost, sanction, authorization, expectation, classification, capability, procedural requirement, or the absence of a necessary resource.

The distinction between constraint and determination is crucial. A constraint narrows, shapes, redirects, or differentially prices possibilities without necessarily selecting one unique outcome. The same legal rule can generate different behavior across organizational contexts; the same resource shortage can produce adaptation, conflict, exit, substitution, or failure; the same norm can be obeyed, evaded, contested, or transformed. Social constraints are frequently conditional upon interpretation, enforcement, position, and the availability of alternatives. Their analysis therefore requires specification of mechanism and scope.

Constraint should also remain distinct from normativity. A constraint can be unjust, beneficial, neutral, or normatively ambiguous. Likewise, a normative commitment can guide conduct without operating as an effective social constraint when it lacks recognition, enforcement, embodiment, or institutional support. The analytical task is first to identify which possibilities are restricted or enabled for whom, through what relation, and over what timescale. Normative evaluation comes later.

For later GR, a minimal concept of constraint can thus refer to a condition that alters the feasible, probable, intelligible, permissible, or sustainable transitions available within a configuration. This definition is deliberately plural. Material scarcity, institutional rules, informational asymmetry, historical dependence, embodied disposition, and network position may all constrain, but they need not do so in the same way. Treating constraint as primitive therefore does not eliminate causal analysis; it creates a place in which heterogeneous limiting and enabling conditions can be investigated without prematurely reducing them to one ontology.

2.12.5 States, Relations, Entities, Properties, Processes, and Events

The four concepts reconstructed above do not exhaust the vocabularies through which social dynamics are described. Empirical and theoretical work routinely speaks of entities, properties, states, relations, processes, and events. Section 2.2 introduced these categories ontologically; the present subsection clarifies their role within a dynamic analytical vocabulary. The central point is that they can be treated

as different descriptive resolutions rather than as mutually exclusive claims about the final furniture of the social world.

Entity language identifies relatively bounded units. Persons, firms, organizations, states, households, platforms, contracts, or assets may be treated as entities when their continuity is sufficient for the research task. Property language attributes characteristics to such units or configurations. Armstrong's theory of states of affairs provides one metaphysical example in which particulars, properties, and relations combine in structured facts (Armstrong 1997). Social research usually requires a weaker commitment: an entity and its properties can be treated as analytically stable where doing so preserves the distinctions needed for explanation, even when the entity's internal constitution remains relational and historically variable.

State language provides a cross-sectional description of a configuration at a specified analytical time. A state may summarize properties, relations, resource distributions, legal statuses, expectations, or other variables judged relevant to subsequent change. The usefulness of a state description depends on resolution. Two situations can be represented as the same state under one model while differing substantially under another because the second representation retains distinctions suppressed by the first. State identity is therefore partly a representational achievement, not simply a transparent reading of reality.

Relation language describes connections, dependencies, obligations, contrasts, exchanges, recognitions, or other linkages among terms. The philosophy-of-relation lineage reconstructed in Section 2.9 showed why relation may be external, internal, constitutive, higher-order, or structurally embedded without those possibilities being equivalent. Within a dynamic vocabulary, relations can themselves be states of connection that form, persist, intensify, weaken, or dissolve. A relation can also modify the properties or capacities attributed to its terms, which is why an exclusively entity-centered representation may miss economically consequential constitution.

Process language shifts attention from snapshots toward temporally extended activity. Whitehead's process metaphysics represents an especially strong version of this shift, but process need not carry that metaphysical burden in social inquiry (Whitehead 1929). Institutionalization, learning, accumulation, bargaining, socialization, technological adoption, and organizational change can be analyzed as processes when their temporal organization matters to the explanation. A process can include many events and intermediate states while retaining enough continuity to be treated as one unfolding trajectory for a particular purpose.

Event language identifies occurrences sufficiently localized to matter as transformations within such trajectories. Davidson's event ontology is influential because it treats events as particulars capable of entering causal relations and of being described under different vocabularies (Davidson 2001). Social and historical inquiry need not inherit Davidson's full theory to use the distinction. A strike, election, merger, judicial decision, default, discovery, policy announcement, encounter, or organizational failure can function as an event when its occurrence marks a consequential transition. Sewell's historical sociology adds the important reminder that some events become historically significant because they transform the structures through which later action is organized, whereas many occurrences remain comparatively routine (Sewell 1996).

These categories are therefore cross-cutting. An entity can occupy a state; a state can include properties and relations; a process can transform states; an event can be

represented as a localized transition within a process; a relation can itself persist as an entity-like object for legal or administrative purposes; and an event can alter the properties through which an entity is subsequently identified. The categories are useful precisely because they permit different resolutions of the same historically changing configuration.

The genealogy developed in this section makes possible a restrained GR synthesis. The quartet of change, difference, structure, and constraint is a later GR compression of recurring analytical problems distributed across Aristotle, structuralism, process philosophy, institutional economics, theories of practice, and other lineages reviewed here. It should therefore be presented as an inherited and reorganized vocabulary rather than attributed retroactively to any single predecessor. Change registers transformation; difference registers non-equivalence and differentiation; structure registers patterned organization; constraint registers the conditioning of possible transitions. States, relations, entities, properties, processes, and events then provide richer descriptive forms that can be constructed when the empirical object requires them.

Calling the four terms *primitive* should therefore be understood methodologically rather than metaphysically. They are starting distinctions chosen to postpone stronger ontological assumptions. Their status remains analytical and provisional, leaving the composition of ultimate reality under ontological suspension. In later GR, stable entities, relations, subjects, institutions, values, and fields may be reconstructed through configurations in which change, difference, structure, and constraint become mutually organized and historically persistent. Chapter 2 establishes only why such a move is intellectually available. Whether the resulting vocabulary is adequate must be tested through later ontological, methodological, empirical, and economic analysis.

Several guardrails follow. Change does not imply progress. Difference does not imply inequality. Structure does not imply stasis. Constraint does not imply deterministic closure. A state is not the same object as the reality it represents. An entity need not be metaphysically self-sufficient. A relation need not eliminate relata. A process need not exclude relatively stable units. An event need not be historically transformative. Preserving these distinctions allows a minimal dynamic vocabulary to remain plural enough for social inquiry while preparing the more explicit GR account of ontological emergence developed in later chapters.

2.13 Subject Formation in Relational Systems

Theories of social reality require some account of the beings who perceive, act, interpret, occupy positions, receive recognition, and become objects of classification within that reality. The present section reconstructs established approaches to subject formation and asks how they have explained the emergence and persistence of socially situated subjecthood without assuming that all traditions mean the same thing by *subject*, *self*, *person*, *identity*, or *actor*. Its role in the chapter is preparatory. Symbolic interactionism, recognition theory, theories of ideology and subjectification, dramaturgical sociology, practice theory, narrative accounts of selfhood, critical realism, and relational sociology each isolate different mechanisms through which subjects become socially intelligible and consequential. The discussion proceeds from relational stabilization and recognition to subject positions, causal persistence, representation,

and competing ontological interpretations. The objective is to clarify the inherited conceptual resources from which a later GR account can be constructed while preserving the unresolved question of how much of subjecthood is constituted by social relations and how much must remain irreducible to them.

2.13.1 Subjecthood and Relational Stabilization

A major lineage in modern social theory treats selfhood as something that develops within social interaction rather than as a fully formed interior substance that merely enters into relations after its constitution. George Herbert Mead provides one of the clearest formulations. In *Mind, Self, and Society*, the self emerges through the social process in which an individual learns to take the attitudes of others and, at a more organized level, the standpoint of the generalized other (Mead 1934). The self is therefore socially mediated from the beginning of its specifically reflexive form. Mead's distinction between the "me" and the "I" also prevents this account from becoming a theory of simple social determination. The "me" incorporates organized social attitudes, whereas the "I" names the response that cannot be fully specified in advance by those attitudes. Social formation and novelty are consequently internal to the same account.

Berger and Luckmann develop a different but compatible problem-space through socialization, institutionalization, and the internalization of socially objectivated meanings (Berger and Luckmann 1966). Their analysis emphasizes how a social world that was historically produced by human activity can confront later participants as an objective reality and become internalized through primary and secondary socialization. Subject formation in this account cannot be separated from the acquisition of typifications, roles, vocabularies, legitimations, and taken-for-granted expectations through which a social world becomes intelligible. The socially formed subject is therefore situated within a reality that precedes the individual biography even though that reality itself has a historical origin.

Bourdieu's theory of practice relocates the problem from explicit internalization toward embodied disposition. *Habitus* designates durable and transposable dispositions formed under structured conditions and subsequently implicated in perception, judgment, and practice (Bourdieu 1977). Its importance for subject formation lies in the way past social conditions can become practically sedimented without requiring continuous conscious calculation. A person learns how to move, anticipate, distinguish, value, and respond within a field through historically formed dispositions. This does not imply that conduct is mechanically programmed. Bourdieu's account is precisely concerned with practical improvisation generated from dispositions whose history may remain partly opaque to the actor.

Giddens approaches subject formation through the recursive organization of practices. Agents draw upon rules and resources in the production of conduct, while the same practices participate in reproducing the social systems within which later conduct occurs (Giddens 1984). Routine is especially significant because continuity of self and continuity of social relations can be supported through recurrent practical organization. Subjecthood here is connected to knowledgeable agency and reflexive monitoring, yet it is exercised under conditions that the actor neither chooses in full nor comprehends exhaustively.

These approaches share a rejection of the image of an entirely pre-social subject,

but they should not be treated as equivalent. Mead develops a social account of reflexive selfhood through symbolic interaction. Berger and Luckmann emphasize socialization into objectivated institutional worlds. Bourdieu theorizes embodied dispositions and practical sense. Giddens analyzes knowledgeable agency within recursively reproduced systems. Each therefore identifies a different mechanism through which social relations can become stabilized within subjectivity and action.

Margaret Archer supplies an important counter-position to any inference that social mediation exhausts subjecthood. In *Being Human*, Archer distinguishes the emergence of self-consciousness and personal identity from the later acquisition of social identity, arguing that embodied practical engagement with the natural and practical orders is not reducible to linguistic or social constitution (Archer 2000). Social roles and relations matter greatly, but the person cannot be analytically dissolved into role occupancy or discursive position. This disagreement is foundational for the present chapter. A relational account of subject formation can range from the claim that some dimensions of selfhood are socially mediated to the much stronger claim that subjecthood is constituted through social relations all the way down. Existing theory does not settle that transition.

The literature therefore provides several senses of relational stabilization. A subject can become relatively stable because organized attitudes are internalized, because institutional meanings are learned, because dispositions become embodied, because routines are reproduced, or because roles and commitments acquire continuity across time. Stability in these traditions is an accomplishment of processes rather than evidence of an unchanging essence. At the same time, Archer's critique shows why stabilization within social relations need not establish that every property of the person has a social origin. This unresolved boundary becomes central once recognition and subject position are introduced.

2.13.2 Social Recognition and Subject Position

Theories of recognition ask how a person's relation to self and social standing depend on responses from others. Honneth reconstructs a recognition-theoretic lineage in which forms of socially mediated self-relation develop through relations of recognition, while experiences of disrespect or misrecognition can motivate social conflict (Honneth 1995). His later discussion of social invisibility sharpens the distinction between being physically perceived and being socially acknowledged as a person whose presence makes a normative claim on others (Honneth 2001). Recognition is therefore more than information about another individual. It concerns a relation through which socially consequential standing is affirmed, denied, or damaged.

The concept of a *subject position* develops through different theoretical traditions. Althusser's theory of ideology describes interpellation as a process through which ideology addresses individuals as subjects within already organized social meanings and practices (Althusser 2001). The importance of the argument lies in the reversal of a familiar picture. The individual is not first a fully constituted subject who subsequently adopts an ideology; ideological practices participate in producing the forms in which individuals recognize themselves and are recognized as subjects. Interpellation is consequently a theory of subject constitution through ideological structure rather than a general theory of interpersonal recognition.

Foucault develops another account in which the subject is formed within relations

of power and practices of subjectification. In “The Subject and Power,” he distinguishes modes through which human beings are made subjects and places individualization within historically specific power relations (Foucault 1982). The term *subject* carries a double implication in this lineage: a person may be subject to another through control and dependence while also being tied to an identity through knowledge of the self. Power is therefore productive as well as restrictive because it participates in forming capacities, classifications, conduct, and self-relations. Foucault’s account also preserves the possibility of resistance, since a power relation presupposes acting subjects whose responses are not completely predetermined.

Butler’s analysis of gender adds a further mechanism. *Gender Trouble* criticizes the idea that gendered identity simply expresses a prior stable substance and develops an account in which identity is sustained through reiterated social performances and norms (Butler 1990). The significance for subject formation is broader than any one identity category: repetition can produce the appearance of stability while simultaneously leaving room for variation, failure, displacement, and contestation. A socially recognizable subject position can therefore have real persistence without requiring an invariant essence underneath its repeated enactment.

These theories should remain analytically separated. Honneth focuses on normative relations of recognition and the formation of practical self-relation. Althusser theorizes ideological interpellation. Foucault investigates historically specific modes of subjectification through power and knowledge. Butler analyzes the performative reiteration of identity norms. Their vocabularies sometimes overlap around constitution, recognition, and social intelligibility, but they assign different mechanisms, normative implications, and degrees of agency to the process.

The distinction between subjecthood and subject position follows from this plurality. A subject position can refer to a socially available location from which a person becomes classified, addressed, authorized, constrained, or expected to act. Examples include legal person, citizen, debtor, patient, student, employee, parent, expert, refugee, or consumer. Theories of interpellation and subjectification make such positions central because socially organized categories can precede particular occupants. Recognition theory, by contrast, emphasizes relations through which persons acquire or lose socially consequential standing. The concepts intersect when recognition is mediated through positions, but neither reduces cleanly to the other.

This literature also explains why subject formation can be unequal. Access to valued positions, credibility, rights, authority, visibility, and recognition can be differentially distributed. A person can occupy a formally recognized role while being denied informal recognition; conversely, a socially meaningful identity can persist without formal legal codification. Institutional status, interpersonal recognition, ideological address, and embodied practice can therefore stabilize different dimensions of subjecthood at different rates. Later analysis requires mechanisms specific enough to identify which dimension is operating.

2.13.3 Causal Persistence and Relational Reality

A theory of socially formed subjects must explain why a subject position can remain consequential beyond a single moment of interaction. The issue is not persistence in a metaphysical sense alone. Social analysis also concerns the persistence of causal consequences: whether a role, classification, disposition, or recognized standing con-

tinues to shape later possibilities even when the immediate interaction that produced or activated it has ended.

Practice theory provides one route. Bourdieu's habitus explains how historically formed social conditions can persist through embodied dispositions that continue to orient action across situations (Bourdieu 1977). Giddens locates continuity in recurrent practices and the reproduction of rules and resources (Giddens 1984). Berger and Luckmann emphasize institutional objectivation and socialization, through which historically produced meanings become available as relatively durable social facts (Berger and Luckmann 1966). In each case, persistence is relationally supported, yet the carrier of persistence differs: disposition, recurrent practice, institutionalized meaning, or some combination of them.

Archer's treatment of roles adds a useful distinction between an occupant and a social position. Roles can pre-exist particular occupants, outlast them, and possess powers of constraint and enablement that are not reducible to the personal characteristics of whoever currently fills the role (Archer 2000). A professorship, judicial office, licensed profession, or organizational position can therefore remain causally consequential while its occupants change. The persistence of the role does not imply that occupants are interchangeable in every respect. It means that some causal properties belong to the organized position and its relations rather than to the biography of a particular person.

Institutional theories provide closely related resources. Searle's analysis of status functions shows how collectively recognized status can generate deontic powers, including rights, duties, permissions, and obligations, that change what an individual can socially do (Searle 1995). Hart's legal theory similarly shows that a rule-governed office or legal status can have consequences because it is embedded within a wider practice of recognition and secondary rules (Hart 2012). These accounts make it possible to say that a socially constituted subject position can be causally real without assuming that its reality is physically intrinsic to the person who occupies it.

Relational sociology generalizes the problem. Emirbayer argues for conceiving social entities through dynamic, unfolding relations rather than treating actors as self-sufficient substances whose properties are fully specifiable independently of relational processes (Emirbayer 1997). This approach does not require denying the existence of actors. It changes the explanatory question by asking how boundaries, capacities, preferences, identities, and causal powers are produced or transformed through transactions and relations. The resulting subject may have persistence, but that persistence must be explained through the organization and reproduction of relations rather than assumed as a primitive property.

Classification adds another form of causal persistence. Hacking's historical ontology emphasizes that categories used to classify people can be historically made and can interact with the people classified (Hacking 2002). Once institutionalized, a classification can organize records, eligibility, treatment, expectations, self-understanding, or research. Its effects may therefore persist through administrative and epistemic infrastructures even when particular acts of classification are no longer visible. The socially constituted category becomes consequential because practices, documents, institutions, and persons continue to respond to it.

These literatures allow a limited but important conclusion. Social constitution and causal reality are compatible. A status, role, identity category, or subject position can be historically contingent and relationally sustained while producing durable con-

sequences. This conclusion does not determine the ontology of the subject itself. It establishes only that causal persistence cannot be inferred solely from material intrinsicness, and social construction cannot be inferred to mean causal unreality. The specific mechanisms of persistence remain an empirical and theoretical question.

2.13.4 Symbolized and Represented Subjects

Subjects become socially consequential partly through representations. Names, records, credentials, profiles, diagnoses, classifications, narratives, reputations, legal documents, demographic categories, and institutional files make persons legible to others and to organizations. Existing theory has approached this symbolic dimension from several directions, each of which distinguishes the living subject from the representations through which social systems encounter that subject.

Mead's account already contains a representational moment because reflexive selfhood depends on significant symbols and the capacity to take the attitude of others toward oneself (Mead 1934). The self becomes an object to itself within symbolic interaction. Yet Mead does not reduce the self to a fixed representation: the "I" remains the response to organized attitudes, and the social process continues. Representation is therefore constitutive of reflexivity without exhausting the activity of the subject.

Goffman's dramaturgical sociology shifts attention to situated presentation. In *The Presentation of Self in Everyday Life*, participants manage impressions before audiences and employ expressive practices to sustain a socially intelligible definition of the situation (Goffman 1959). The presented self is neither simply fraudulent nor a transparent revelation of an inner essence. It is an interactional accomplishment governed by setting, audience, role, expectations, and the practical requirements of maintaining a performance. Different settings can consequently stabilize different presentations of the same person.

Ricoeur's hermeneutics of selfhood adds a temporal dimension. *Oneself as Another* treats personal and narrative identity as related problems and investigates how selfhood is articulated through action, narration, responsibility, and interpretation (Ricoeur 1992). Narrative can connect heterogeneous events within a biography and make continuity intelligible without requiring identity to mean complete sameness across time. This provides an important alternative to both a purely substantial self and a purely external social label: representation can participate in the temporal organization of self-understanding.

Sociological critique of the term *identity* further warns against allowing representation to become analytically total. Brubaker and Cooper argue that identity has been asked to perform too many explanatory tasks and propose more differentiated concepts such as identification, categorization, self-understanding, commonality, connectedness, and groupness (Brubaker and Cooper 2000). Their intervention is especially important for subject formation because a category assigned by a state, an identity claimed by a person, a sense of commonality, and an externally attributed group membership can diverge. Using one word for all of them can conceal the relations that require explanation.

Representations can also alter the subjects they represent. Hacking's work on classifications makes this feedback explicit: categories of people can enter practices and self-understandings, while responses by classified persons can in turn transform the category (Hacking 2002). Foucault's analyses similarly show how knowledge

practices and institutional classifications participate in modes of subjectification (Foucault 1982). Symbolic representation is therefore capable of becoming causally active when linked to institutions, expertise, sanctions, opportunities, recognition, or self-interpretation.

This literature supports several distinctions that later analysis should preserve. A subject is not identical to a record of the subject. Self-understanding is not identical to external categorization. A performed role is not identical to the entirety of the person performing it. Narrative continuity is not equivalent to institutional persistence. A representation can nevertheless participate in producing the conditions under which a subject acts and is acted upon. The analytical task is therefore to investigate the relation between subject, representation, audience, institution, and subsequent response rather than treating representation as either transparent description or mere illusion.

The contemporary expansion of machine-readable profiles gives these established problems new empirical scope without changing their basic philosophical structure. When access to credit, employment, education, insurance, welfare, communication, or visibility is mediated through data representations, institutions may act upon a represented subject whose operational profile differs from the person's own self-description or lived continuity. Chapter 2 need not supply a new theory of digital subjecthood to identify the lineage of the problem. Goffman, Hacking, Foucault, Ricoeur, and Brubaker and Cooper already provide distinct resources for separating presentation, classification, narration, subjectification, and identification.

2.13.5 Subjecthood under Ontological Suspension

The reconstructed traditions do not yield a single ontology of the subject. Mead treats reflexive selfhood as emerging within social process. Berger and Luckmann foreground socialization into institutional reality. Bourdieu emphasizes embodied dispositions. Honneth gives recognition a constitutive role in practical self-relation. Althusser and Foucault examine subject constitution through ideology and power. Butler emphasizes reiterated norm-governed performance. Ricoeur develops a hermeneutics of selfhood and narrative identity. Archer argues that embodied selfhood and personal identity possess properties that cannot be reduced to social identity. Emirbayer shifts explanation from substantial entities toward relational processes without simply eliminating actors. The disagreements concern more than vocabulary. They concern what a subject is, how it persists, which capacities are socially constituted, and what remains irreducible to social relations.

Ontological suspension provides a way to use these resources without prematurely adjudicating every metaphysical disagreement. A social inquiry may need to represent a person as an embodied organism in one analysis, a legal person in another, a role incumbent in another, a bearer of dispositions in another, a narrating self in another, a classified population member in another, or a participant in a changing network of relations. These descriptions can sometimes refer to the same human being while selecting different properties and causal mechanisms. Their coexistence does not establish that they are interchangeable descriptions of one already settled ontology.

This position also protects against two opposite reductions. The first treats subjecthood as entirely self-contained and regards social relations as external influences on a pre-formed person. The second treats the person as nothing more than the sum

of socially assigned positions, discourses, or representations. Existing theory supplies strong reasons to question both extremes. Mead, Honneth, Foucault, Butler, Bourdieu, and relational sociology show how deeply social relations can enter the formation of socially intelligible subjects. Archer and phenomenological traditions reviewed in Section 2.7 preserve dimensions of embodiment, practical engagement, finitude, and lived continuity that resist easy reduction to recognized social position.

The same restraint applies to persistence. A subject may persist biologically while losing a role, persist narratively through major institutional change, retain a legal identity despite transformed social recognition, or remain represented in administrative systems after the relations that originally generated the representation have changed. Conversely, the same institutional role can persist through many occupants. Subject persistence therefore cannot be treated as a single variable until the analytical object has been specified.

A later GR framework can inherit this plurality by treating subjecthood as a problem of formation, stabilization, transformation, and relational consequence while suspending stronger claims about ultimate ontology. The relevant questions then concern how particular forms of subjecthood become possible, what relations support them, which representations mediate them, what powers or constraints become attached to them, how they persist, and how they are transformed. Such questions are compatible with relational analysis without requiring the thesis that a subject is exhausted by relations.

The genealogical result of the section is therefore limited but consequential. Modern social theory has already established multiple mechanisms through which subjects can be socially formed: symbolic interaction, socialization, embodied disposition, recognition, ideological address, power, normative reiteration, role occupancy, institutional status, narrative interpretation, classification, and relational process. It has also generated strong objections to reducing humanity to any one of those mechanisms. This unresolved field supplies the theoretical foundation for GR to study generative relations of subject formation while retaining distinctions among person, subject, role, identity, representation, and position. The task for the later theory is to specify when these dimensions align, when they diverge, and how their relations participate in generating subsequent social and economic possibilities.

2.14 Value, Valuation, and Plural Forms of Value

Theories of social reality and subject formation become economically consequential when they address what persons, institutions, and communities treat as worth pursuing, preserving, exchanging, comparing, or refusing to compare. The present section reconstructs major intellectual lineages concerning value and valuation before the later chapters turn to ethics, political economy, allocation, exploitation, welfare, and generative value. Its objective is conceptual clarification rather than the construction of a unified theory of value. Philosophical axiology, pragmatism, economics, epistemology, aesthetics, environmental thought, and the sociology of valuation use the vocabulary of value for different analytical problems. The discussion therefore proceeds from the distinction between value and valuation to intrinsic, instrumental, and relational formulations; domain-specific forms of value; processes of value formation and transformation; and debates over pluralism, commensurability, and in-

comparability. The method is genealogical and comparative. Existing theories carry the explanatory burden, while the final synthesis identifies a limited set of questions that later GR and GRE can inherit without treating heterogeneous traditions as interchangeable.

2.14.1 Value and Valuation

The word *value* can designate a property attributed to an object, a relation between an object and a valuer, a reason for action, an evaluative standard, a socially recognized form of worth, or an outcome of practical appraisal. The word *valuation* directs attention toward the activity or process through which something comes to be appraised, ranked, cherished, priced, authorized, or rejected. The distinction is analytically useful because a theory can accept that some things are valuable without explaining how agents recognize or institute their value, while another theory can study practices of valuation without committing itself to the proposition that value is exhausted by those practices.

G. E. Moore's *Principia Ethica* provides a canonical analytic attempt to treat goodness as irreducible and to distinguish intrinsic value from the natural properties with which goodness may be associated (Moore 1903). Moore's project is important here because it exemplifies a value-theoretic orientation in which the principal problem concerns what is good and in virtue of what it is good. The evaluative property is not identified with an observable act of appraisal. This orientation differs markedly from pragmatist and sociological accounts in which valuation is approached as situated conduct.

John Dewey's *Theory of Valuation* shifts the emphasis toward the practical formation and appraisal of ends (Dewey 1939). Dewey analyzes desires, interests, ends-in-view, and judgments of value within situations in which conduct encounters difficulty and consequences become objects of reflection. Valuation is therefore connected to inquiry into the conditions and consequences of action. Ends do not function simply as fixed termini supplied independently of experience; they can be examined and revised in light of what their pursuit produces. This pragmatist formulation makes valuation temporally extended and experimentally revisable while avoiding the inference that every value judgment is merely an arbitrary report of preference.

The sociology of valuation introduces another level of analysis. Lamont surveys work in which valuation and evaluation involve social practices of categorization, legitimation, comparison, and the organization of multiple orders of worth (Lamont 2012). From this perspective, it matters who is authorized to evaluate, which criteria become legitimate, how evaluative devices are institutionalized, and how actors learn the repertoires through which persons and objects are judged. Valuation is consequently distributed across people, classifications, organizations, instruments, conventions, and fields. A prize committee, credit-rating system, peer-review process, market price, professional credential, and intimate attachment all perform evaluative work, but they do so through different procedures and with different consequences.

Economic reasoning supplies still another vocabulary. Classical political economy already distinguished different senses of economic value and their relations to exchange, labor, scarcity, and price. Smith's contrast between value in use and value in exchange, for example, identifies a problem that cannot be resolved merely by equating usefulness with market exchange ratios (Smith 1776). Marx later places the value

form of commodities within a historically specific system of social production and exchange, thereby treating economic value as connected to social relations rather than as a free-standing natural property of objects (Marx 1867). Later marginalist and neo-classical traditions will reformulate the problem through utility, preference, scarcity, and marginal choice; those developments are treated in their proper place later in this chapter. At this stage, the historical point is sufficient: economic thought has never possessed a single uncontested meaning of value.

These traditions therefore isolate different questions. Moore asks about the character of goodness. Dewey asks how valuation operates within practical inquiry. Sociology investigates the social organization of evaluative practices. Political economy asks how economically consequential forms of value arise within production, exchange, and social order. The distinctions matter because *value*, *valuation*, *price*, *preference*, *utility*, and *worth* cannot be treated as synonyms without losing the theoretical problems each vocabulary was designed to address.

2.14.2 Intrinsic, Instrumental, and Relational Value

A long-standing problem in value theory concerns whether something is valued for its own sake, for what it enables, or through the character of a relation in which it participates. The familiar distinction between intrinsic and instrumental value is useful, but its apparent simplicity can conceal several different philosophical distinctions. Korsgaard's analysis is especially important because it separates the intrinsic–extrinsic distinction from the final–instrumental distinction (Korsgaard 1983). Something may be valued as an end while its value still depends on relations, interests, or conditions outside the object considered in isolation. The claim that a good is non-instrumental therefore does not by itself establish that its value is intrinsic in the stronger sense of being independent of external relations.

Moore's account offers one influential version of intrinsic value, in which the value of a whole or state of affairs is examined independently of its usefulness as a means (Moore 1903). Instrumental value, by contrast, concerns contribution to another valued end. The distinction has obvious practical importance: a medicine may be valued because it restores health; money may be valued partly because it enables acquisition; and a scientific instrument may be valuable because it expands observational capacity. Yet instrumental analysis becomes inadequate where the mode of relation to a good partly constitutes what is valuable about it. Friendship, political membership, care, scientific understanding, or attachment to a landscape can be distorted if they are described only as interchangeable means to separately specified satisfactions.

Anderson develops a pluralist account in which different goods can call for different modes of valuation and can be realized through different social relations (E. Anderson 1993). Love, respect, use, admiration, and market exchange do not simply represent different quantities of one evaluative attitude. The mode in which something is valued can itself matter to the good. A relationship treated solely through market exchange may therefore be transformed even if the same material resources continue to circulate. Anderson's argument is especially important for later economic analysis because it makes the social form of valuation part of what must be evaluated rather than an ethically neutral container for a fixed underlying good.

The contemporary environmental literature on *relational values* provides a more specific use of relational vocabulary. Chan and colleagues argue that environmental

valuation is inadequately captured by an exclusive opposition between instrumental value to humans and intrinsic value in nature, because many commitments concern appropriate relationships, responsibilities, identities, and forms of living well with human and nonhuman others (Chan et al. 2016). Their concept should not be generalized automatically into a universal theory of relational value. It belongs to a particular interdisciplinary debate in environmental thought and policy. Its importance for the present genealogy lies in demonstrating that evaluative significance may attach to the quality and appropriateness of a relationship rather than solely to an isolated object or to the object's usefulness for another end.

The threefold vocabulary of intrinsic, instrumental, and relational value therefore does not form a single settled taxonomy across philosophy, economics, and environmental studies. Intrinsic value can mean value independent of consequences, value independent of external relations, or value possessed for its own sake, depending on the theory. Instrumental value may concern causal means, enabling conditions, or exchangeable resources. Relational value may refer to value constituted by a particular relation, value realized through a relation, or a normative commitment concerning how one ought to relate. Careful analysis requires specifying which claim is intended.

This distinction also guards against a premature relational reduction. The observation that some values depend upon relations does not establish that all value is relational in the same sense. A later GR framework may investigate how evaluative properties, subjects, and relations become co-constituted, but Chapter 2 need only establish that existing value theory already supplies multiple ways in which the location of value can be understood: in objects or states of affairs, in consequences, in modes of regard, in practical relations, or in historically organized forms of life.

2.14.3 Epistemic, Aesthetic, Ethical, and Economic Value

The plurality of value becomes clearer when different domains of evaluation are considered. Epistemic, aesthetic, ethical, and economic values can interact within the same practice, yet each domain has developed criteria and problems that resist immediate translation into the others. The distinction does not imply sealed spheres. Its purpose is to prevent a single evaluative vocabulary from silently absorbing standards that arose for different objects and purposes.

Epistemic value concerns goods associated with inquiry and cognition. The traditional problem of the value of knowledge asks why knowledge should be regarded as more valuable than true belief or other epistemically successful states. Kvanvig reconstructs this problem and gives particular importance to understanding as an epistemic achievement whose value may not be captured by simply counting true propositions (Kvanvig 2003). The problem is therefore evaluative as well as definitional: epistemology must specify what makes a cognitive state worth seeking. Longino adds a social dimension by showing that scientific inquiry is shaped by constitutive and contextual values and that objectivity depends upon organized critical interaction rather than the disappearance of every value from inquiry (Longino 1990). Epistemic evaluation can consequently concern truth, justification, reliability, explanatory understanding, critical scrutiny, openness to revision, and the organization of inquiry.

Aesthetic value has an equally complex genealogy. Kant's analysis of judgments of beauty treats aesthetic judgment as irreducible to mere agreeableness or straightforward conceptual determination, while still involving a claim that reaches beyond

purely private liking (Kant 1987). Dewey relocates aesthetic value within temporally organized experience in which doing and undergoing acquire a consummatory form (Dewey 1934). Bourdieu, in turn, demonstrates that aesthetic judgments and tastes are socially differentiated and implicated in classed histories of cultural competence and distinction (Bourdieu 1984). These accounts differ sharply concerning the philosophical standing and social formation of aesthetic judgment, but together they make clear that aesthetic value cannot safely be translated into market demand or individual pleasure without substantial theoretical loss.

Ethical value concerns goods, reasons, duties, virtues, forms of life, and relations that enter judgments about how persons ought to act or what is worth promoting and respecting. Moore's intrinsic-goodness project is one classical analytic approach; Anderson's pluralist account emphasizes different modes of valuing and the social relations through which goods are properly realized (Moore 1903; E. Anderson 1993). Sen's critique of the separation of economics from ethics further shows that economic assessment inevitably touches questions concerning well-being, agency, freedom, and the evaluative information regarded as relevant (Sen 1987). Ethical value therefore cannot be reduced in advance to the satisfaction of given preferences, even though preference satisfaction may remain one relevant consideration in some contexts.

Economic value has been theorized through several historically distinct frameworks: usefulness and exchange, labor and social production, marginal utility, preference, scarcity, willingness to pay, opportunity cost, and monetary price are among the major vocabularies. Smith and Marx already illustrate how different the objects called *value* can be within political economy (Smith 1776; Marx 1867). Later neoclassical theory narrows and formalizes particular evaluative relations for the analysis of choice and allocation, while welfare economics asks how individual evaluations can be related to social assessment. These traditions will receive dedicated treatment later. The present section requires only one guardrail: *economic value* should not be used as an unqualified synonym for *price*. Prices are socially consequential evaluative signals and coordination devices, but the existence of a price neither proves that all relevant value has been represented nor establishes that everything of value should be priced.

The domains also overlap. Scientific inquiry can be aesthetically admired, economically funded, ethically constrained, and epistemically evaluated at the same time. A forest can have market value, ecological significance, aesthetic importance, sacred meaning, and relational value within a community. A university can be valued for earnings effects, knowledge production, civic formation, status, beauty of intellectual achievement, and personal transformation. Such coexistence does not itself settle whether the values are commensurable. It establishes a prior point: social objects and practices can participate simultaneously in several evaluative orders whose criteria differ.

This multidimensionality is important for GRE because economic organization can alter non-economic values even where no explicit conversion was intended. A pricing device can change patterns of attention; an incentive can transform the meaning of an activity; a classification can affect dignity; an efficiency gain can alter epistemic diversity; a market can expand access while changing the social relation through which a good is provided. Chapter 2 does not yet judge such transformations. It establishes the intellectual basis for recognizing that economic valuation takes place within a wider field of heterogeneous value.

2.14.4 Value Formation and Transformation

If values were fixed properties transparently recognized by isolated subjects, the principal analytical task would be measurement. Several traditions instead make value formation itself an object of inquiry. Dewey's pragmatist account is foundational because ends and valuations can be reorganized through experience, inquiry, and reflection on consequences (Dewey 1939). What agents care about, how they formulate ends, and which consequences they treat as relevant can change through participation in problematic situations. Valuation therefore has a history within conduct.

Bourdieu supplies a different mechanism through habitus, field, and socially differentiated taste. Evaluative dispositions are formed through durable histories of position and practice, making judgments that appear immediate partly dependent upon embodied social trajectories (Bourdieu 1984). The sociology of valuation generalizes the analytical attention to social processes through categorization, legitimation, evaluative repertoires, institutional gatekeepers, and devices of comparison (Lamont 2012). Values and rankings can stabilize because organizations, professions, educational systems, markets, and cultural fields repeatedly enact criteria of worth.

Economic valuation illustrates how evaluative devices can participate in producing the object they claim merely to measure. Fourcade's comparison of environmental damage valuation analyzes the reasons for monetary valuation, the techniques through which monetary translations are produced, and the feedback from assigned monetary values into social practices and representations (Fourcade 2011). The lesson is broader than environmental economics. A valuation procedure can select relevant attributes, establish equivalences, create categories, authorize experts, and make a particular representation actionable. Once institutionalized, the resulting valuation may influence later behavior and thereby alter the environment in which subsequent valuations occur.

This feedback does not imply that evaluators can create arbitrary value without resistance from material conditions, other actors, legal rules, established meanings, or competing evaluative orders. Social valuation is constrained as well as productive. A market appraisal can fail to attract a buyer; a ranking can lose legitimacy; a scientific criterion can be rejected under new evidence; an aesthetic canon can be contested; a moral category can become politically unacceptable. Value transformation is therefore better understood as historically conditioned reorganization than as free symbolic invention.

The distinction between valuation and value also becomes important over time. A new valuation device can change what is visible and comparable before it changes deeper commitments. Conversely, a transformation in collective commitments may precede the development of institutions capable of representing those values. Monetary, legal, aesthetic, epistemic, and moral valuations can move at different speeds. Their interaction may produce reinforcement, conflict, conversion, or insulation. A community may refuse to monetize a sacred object while assigning it extensive legal protection; a research institution may value open inquiry while using bibliometric measures for allocation; a household may purchase care services without regarding care itself as exhausted by its price.

Existing literature therefore makes possible a dynamic conception of valuation without requiring a single theory of where value ultimately resides. Values can be learned, embodied, articulated, priced, classified, institutionalized, contested, and re-

vised. Evaluative criteria can also become objects of evaluation. Later GR can build on this inheritance by asking how relations among subjects, institutions, representations, and evaluative practices generate conditions for subsequent valuation. That later question should remain distinct from the historical claim established here: long before GR, pragmatist and sociological traditions had already made the formation and transformation of value a legitimate theoretical object.

2.14.5 Value Pluralism and Incommensurability

Value pluralism concerns the possibility that there are multiple genuine forms of value that cannot be reduced to a single master good without remainder. Incommensurability and incomparability concern more specific problems of comparison. These ideas are related but should not be identified. Several values may be plural yet commensurable under a contextually accepted metric; two options may be difficult to compare without belonging to fundamentally different value domains; and the absence of a common cardinal scale does not automatically imply that rational comparison is impossible.

Raz's account of value pluralism treats significant incommensurability as a feature of a social world containing multiple valuable forms of life and commitments (Raz 1986). Incommensurable options cannot always be represented as one being better, worse, or exactly equal to another on a single ordering. The philosophical literature collected by Chang develops the problem further by examining commensurability, comparability, indeterminacy, and practical reason as distinguishable issues (Chang 1997). The importance of this debate for economic inquiry is immediate. A decision problem may remain reason-governed even where values resist translation into one homogeneous quantity.

Anderson's pluralist theory approaches the issue through different modes of valuation and kinds of goods (E. Anderson 1993). The question becomes not only how much a good is valued, but how it is appropriately valued. Respect, affection, use, admiration, and market exchange may constitute different relations to goods and persons. A common monetary metric can therefore be practically useful while remaining normatively incomplete. Sen similarly criticizes informational narrowing in economic evaluation and reconnects economics with questions of agency, freedom, and ethical assessment (Sen 1987). These approaches differ, but both challenge the assumption that evaluative plurality can always be represented without loss through a single scalar measure.

Sociology adds an institutional dimension to commensurability. Espeland and Stevens define commensuration as the comparison of different entities according to a common metric and analyze it as a consequential social process (Espeland and Stevens 1998). Metrics do not merely reveal pre-existing comparability. They can change attention, suppress distinctions, create new equivalences, and redistribute authority. Commensuration is therefore simultaneously cognitive and political. The capacity to establish a metric, decide which attributes count, and determine acceptable trade-offs can become a form of power.

This point is essential for later GRE analysis because economic systems continuously perform conversions: labor into wages, environmental effects into damages, knowledge into intellectual property, reputation into creditworthiness, attention into advertising revenue, education into credentials, and heterogeneous projects

into ranked funding portfolios. Some conversions are indispensable for coordination. Others produce losses, exclusions, or changes in meaning. The existence of conversion does not prove full commensurability, and the practical necessity of decision does not establish that every relevant value has been captured by the chosen metric.

A careful vocabulary can therefore distinguish at least four situations. Values may be directly commensurable under a shared measure; they may be comparable through qualitative judgment without a common cardinal unit; they may be only partially comparable under context-specific conventions; or they may resist an accepted comparison for the decision at hand. Which situation obtains is itself an empirical, interpretive, and sometimes normative question. It should not be decided merely by the availability of a numerical representation.

The lineages reconstructed in this section leave a clear but limited foundation for later GR and GRE. Existing philosophy already distinguishes intrinsic, instrumental, final, relational, and plural forms of value. Pragmatism makes valuation situated and revisable. Epistemology, aesthetics, ethics, and economics disclose different evaluative objects and standards. Sociology shows how valuation, ranking, and commensuration are institutionally organized and historically consequential. Political and moral philosophy demonstrates that plurality need not collapse into a complete common ranking. Later GRE can therefore investigate heterogeneous value, conversion, circulation, return, capture, dissipation, and regeneration while treating the conditions and limits of commensuration as substantive objects of analysis. That programme remains downstream from the genealogy. The inherited literatures establish why the problem of plural value is intellectually available while leaving open which values exist, how they should be ordered, and which conversions are justified.

2.15 Ethics, Justice, and Nomos

Theories of value become normatively consequential when they address how agents ought to act, which social arrangements can be justified, how persons should stand in relation to one another, and how normative orders acquire authority while remaining open to criticism and change. The present section reconstructs several major lineages in ethics, theories of justice, procedural fairness, relational equality, social norms, jurisprudence, and the idea of *nomos*. Its objective is to clarify the conceptual resources that make later GR and GRE discussions of normative judgment, justice, institutional order, and normative transformation possible. The discussion proceeds from normativity and ethical judgment to justice and social order, procedural and relational justice, norm formation and *nomos*, and the revisability of normative orders. The method is genealogical and comparative. Existing theories carry the explanatory burden, while the final synthesis identifies a limited set of unresolved questions that later GR can inherit without treating distinct moral, legal, and political traditions as interchangeable.

2.15.1 Normativity and Ethical Judgment

Normativity concerns standards under which actions, reasons, institutions, characters, or states of affairs can be assessed as required, permitted, justified, admirable,

wrong, unfair, or otherwise evaluatively answerable. Ethical judgment is one mode through which such standards are applied, interpreted, contested, or revised. Neither term names a single philosophical doctrine. Major ethical traditions differ over the object of judgment, the source of normative authority, the role of character and consequences, and the relation between practical reasoning and social life.

Aristotle's *Nicomachean Ethics* provides a classical account in which ethical inquiry is inseparable from the cultivation of character, practical wisdom, habituation, and a conception of human flourishing (Aristotle 2014). Ethical judgment is therefore not reducible to the mechanical application of universal rules. The practically wise person must discern what a situation requires under conditions in which action is particular, context-sensitive, and shaped by cultivated dispositions. Justice enters Aristotle's account both as a virtue and as a problem of proportion, distribution, and rectification. The importance of this lineage for the present chapter lies in its treatment of ethical competence as historically and socially cultivated practical judgment rather than as a detached calculation performed by an otherwise unchanged chooser.

Kant's moral philosophy provides a markedly different foundation. In the *Groundwork of the Metaphysics of Morals*, moral obligation is connected to autonomy, the categorical imperative, and the requirement to treat humanity as an end rather than merely as a means (Kant 2012). The authority of morality is not grounded in the contingencies of desire, social convention, or expected consequences. Kant therefore supplies a powerful deontological lineage in which ethical judgment concerns whether a maxim can satisfy a principle of universal practical reason and whether action respects persons as bearers of moral status. This differs sharply from Aristotelian virtue ethics, even though both traditions reject the reduction of ethics to the aggregation of immediate preferences.

Scanlon's contractualism relocates a central part of morality within the relation of mutual justification. On his account, judgments of right and wrong concern principles for the general regulation of behavior that others could not reasonably reject (Scanlon 1998). The significance of this approach is relational in a specific normative sense: moral requirements are connected to what persons owe one another and to the possibility of justifying conduct to those affected by it. This should not be generalized into a complete theory of all value or all social relations. It supplies a distinctive account of interpersonal moral wrongness, reasons, responsibility, and justification.

Pragmatist approaches introduce another orientation. Dewey's theory of valuation treats evaluative judgment as situated within practical inquiry, where ends, means, and consequences can become objects of reflection and revision (Dewey 1939). Ethical judgment in this lineage is neither the passive recognition of timeless value-properties nor arbitrary preference expression. It develops within problematic situations and can be reconstructed when consequences disclose inadequacies in established ends or habits. The resulting normativity is experimental and fallibilist without being normatively empty.

These traditions make different elements of ethical judgment visible. Aristotle emphasizes cultivated practical discernment and character; Kant emphasizes autonomy and universal moral obligation; Scanlon emphasizes mutual justifiability; Dewey emphasizes situated appraisal and revisability. They should not be compressed into a single model of normative judgment. Their coexistence establishes a more limited point for Chapter 2: ethical judgment has long been theorized through different combinations of practical reasoning, character, universal principle, interpersonal justifi-

cation, and reflective revision. Later GR can inherit the problem of how these forms of judgment become socially and historically possible without claiming that their normative validity is exhausted by the conditions of their emergence.

2.15.2 Justice and Social Order

Theories of justice extend normative inquiry from individual conduct toward institutions, distributions, rights, capabilities, forms of cooperation, and durable structures of social power. The relation between justice and social order is especially important because an order can be stable without being just, while a conception of justice must eventually address the institutions and relations through which persons actually live together. Political philosophy therefore distinguishes questions of social coordination from questions of normative justification even when the two are empirically intertwined.

Rawls's *A Theory of Justice* reoriented twentieth-century political philosophy by treating the basic structure of society as a primary subject of justice and by developing justice as fairness through the device of the original position (Rawls 1999). Principles are to be selected under conditions that abstract from morally arbitrary social position and natural advantage. The resulting theory gives priority to basic liberties and regulates social and economic inequalities through principles intended for free and equal citizens. Rawls therefore supplies a contractual and institutional theory in which justice concerns the organization of major social institutions rather than the moral quality of isolated transactions alone.

Sen's work shifts emphasis from a fully specified ideal arrangement toward comparative evaluation of freedoms, capabilities, agency, and actual injustice. His critique of informationally narrow economic reasoning and his capability-oriented approach emphasize what persons are effectively able to do and be, rather than treating resource holdings or utility as sufficient measures of advantage (Sen 1987; Sen 1999). This changes the informational basis of justice. Identical resources can generate different substantive opportunities because persons occupy different bodily, social, institutional, and environmental conditions. Justice assessment must therefore attend to conversion conditions as well as nominal allocations.

Young develops a different critique of distributive reductionism. *Justice and the Politics of Difference* argues that domination and oppression, the organization of decision making, the division of labor, cultural representation, and institutional exclusion can be justice-relevant even where the distribution of material goods is not the sole or most revealing object of analysis (Young 1990). This line of argument broadens justice from the allocation of divisible goods toward the structures and relations through which social positions, voices, capacities, and vulnerabilities are produced and maintained.

Recognition theory adds another dimension. Honneth analyzes social recognition as important to the development of practical self-relations and interprets forms of disrespect as normatively significant injuries (Honneth 1995). Recognition should not be treated as a substitute for distribution, legal rights, or institutional design. Its contribution is to make the quality of social relations themselves visible as a domain of normative assessment. A social order can allocate material resources while still organizing relations of humiliation, exclusion, subordination, or denial of standing.

These approaches therefore differ in their primary objects of justice. Rawls focuses

on the basic structure and fair terms of cooperation; Sen emphasizes substantive freedoms and comparative justice; Young foregrounds domination and oppression; recognition theory investigates relations through which persons acquire or are denied social standing. Their differences prevent a single definition of justice from being assumed at the foundation of GRE. What they jointly establish is a richer field of possible justice-objects: distributions, capabilities, rights, institutional structures, decision procedures, social positions, relations of recognition, and the production of domination can all become normatively relevant under different theories.

For economic inquiry, this plurality matters because the same economic arrangement can appear differently under different informational and normative perspectives. A policy may improve aggregate income while diminishing substantive freedom for a particular group; a distribution may satisfy an allocative criterion while being sustained through relations of domination; a formally universal rule may reproduce unequal effective access; and a relationship can be materially advantageous while remaining humiliating or coercive. Chapter 2 does not adjudicate among these theories. It establishes why later GRE cannot treat justice as synonymous with either efficiency or distribution alone.

2.15.3 Procedural and Relational Justice

Justice can concern outcomes, procedures, and the relations among participants. These dimensions frequently interact but are analytically distinct. A favorable outcome can be produced by an objectionable procedure, while a fair procedure can yield an outcome that remains contestable under another theory of justice. Likewise, formally correct procedures can operate inside social relations structured by domination or unequal standing. The distinction between procedural and relational justice therefore adds resolution to the broader problem of social justice.

Rawls provides an influential philosophical vocabulary by distinguishing forms of procedural justice and by embedding procedures within a wider conception of justice as fairness (Rawls 1999). A procedure cannot be assessed in isolation from the background conditions that make its operation meaningful. The same formal rule can have different normative implications under different distributions of rights, opportunities, and institutional power. Procedure is therefore not simply the sequence of steps through which an outcome is reached; its fairness depends partly on the justice of the framework within which participants act.

Empirical procedural-justice research adds a different kind of evidence. Tyler's studies of legal authority show that perceptions of fair treatment, respectful interaction, neutrality, and opportunities for voice can affect legitimacy and voluntary deference independently of whether a person receives a preferred outcome (Tyler 2006). This literature does not by itself settle the philosophical question of what makes a procedure normatively just. It demonstrates that procedural experience has causal and legitimacy effects that an outcome-only model would miss. Institutions therefore govern not only by allocating results but also through the manner in which persons are heard, classified, addressed, and treated.

Relational theories of equality shift the object again. Anderson criticizes views of equality centered primarily on compensating persons for bad brute luck and instead develops democratic equality around the social relations appropriate among citizens who stand as equals (E. S. Anderson 1999). Young's analysis of domination and oppres-

sion similarly makes relations of power and participation constitutive objects of justice rather than secondary effects of an independently assessed distribution (Young 1990). Honneth's recognition theory, although grounded in a different philosophical project, further indicates that institutionalized relations of disrespect can be normatively significant even where an allocative measure alone does not register the injury (Honneth 1995).

Procedural and relational justice should nevertheless remain distinct. A procedure can be participatory while the surrounding social relation remains coercive; a relationship can exhibit mutual respect while the governing procedure lacks transparency or review; and a formally neutral procedure can reproduce inequalities generated outside the immediate decision setting. Theories of justice therefore differ over which background conditions count, which inequalities undermine standing, and which forms of justification are required.

This distinction will later matter for GR because relational systems can be evaluated at more than one level. One may ask whether an outcome is just, whether the procedure that generated it is just, whether the relations among participants are just, and whether the background process through which those relations and procedures became available was itself just. Chapter 2 should not yet turn that observation into a new GR taxonomy of justice. Existing procedural, relational, recognition-based, and structural theories already establish the intellectual possibility of evaluating more than final distributions. The later task is to determine how those dimensions interact when relations and rules themselves evolve over time.

2.15.4 Norm Formation and Nomos

Normative orders persist through more than philosophical principles. They are reproduced through expectations, habits, sanctions, legal rules, institutional practices, interpretations, narratives, and shared understandings of what counts as valid, appropriate, obligatory, or deviant. The formation of norms therefore belongs simultaneously to moral psychology, sociology, institutional analysis, jurisprudence, and political theory. The concept of *nomos* adds a further dimension by directing attention toward the broader normative world within which prescriptions acquire meaning.

Bicchieri's theory of social norms analyzes compliance through empirical and normative expectations rather than treating every regularity as a norm (Bicchieri 2006). Individuals may follow a norm because they expect relevant others to conform and because they believe others expect conformity from them. This makes norm formation dependent upon beliefs, reference networks, conditional preferences, and changing information. The theory is particularly useful because it separates norm-governed conduct from generic habit, convention, or private moral commitment.

Legal theory supplies a different account of normative order. Hart's analysis of primary and secondary rules explains legal systems through practices that distinguish obligations from rules for recognizing, changing, and adjudicating other rules (Hart 2012). The rule of recognition is especially important because legal validity depends upon a social practice among officials rather than upon each legal proposition being derived from a separate moral judgment. Hart thereby distinguishes legal normativity from morality without denying that law operates through social practices of acceptance.

Ostrom's institutional analysis shows that operational rules can also emerge and

persist through self-organized arrangements rather than only through centralized legislation (Ostrom 1990; Ostrom 2005). Rules-in-use structure positions, choices, information, payoffs, and collective action in specific action arenas. This broadens the study of normative order beyond formal statutes and courts. Communities can generate durable institutional arrangements through repeated interaction, monitoring, graduated sanctions, boundary rules, and procedures for changing rules themselves.

Cover's concept of *nomos* addresses another layer of the problem. In *Nomos and Narrative*, law is located within a normative universe composed not only of formal prescriptions and institutions but also of narratives through which communities understand what is lawful, unlawful, valid, obligatory, and possible (Cover 1983). Normative meaning is therefore connected to histories, commitments, interpretive communities, and imagined futures. Legal texts do not exhaust the normative worlds in which they operate, and multiple communities can generate competing normative meanings around the same formal legal material.

The term *nomos* should not therefore be treated as a synonym for either a single norm or positive law. A norm can be one rule or expectation within a wider order; a legal rule can acquire institutional validity through recognized procedures; a social norm can be sustained through reciprocal expectations; a *nomos*, in Cover's sense, names a broader normative universe in which rules and practices are situated within narratives of origin, authority, identity, and aspiration. These levels can align, but they can also diverge. Formal law may prohibit a practice that remains socially normalized; a community may generate a normative commitment not yet recognized by state law; institutional practice may reinterpret a legal rule; and competing narratives can make the same prescription intelligible in incompatible ways.

This plurality gives norm formation a temporal character. Norms can stabilize through repetition, social expectation, enforcement, institutionalization, narrative legitimation, and embodied habit. They can also weaken when expectations change, authorities lose legitimacy, interpretive communities split, or new experiences render established prescriptions untenable. Later GR can draw upon these traditions when analyzing how normative relations are generated and maintained. The genealogical point remains prior: sociology, jurisprudence, institutional analysis, and legal theory already provide multiple mechanisms through which normative orders become socially real.

2.15.5 Revisability of Normative Orders

A normative order that can guide conduct must possess some stability, yet a normative order that cannot be criticized or revised risks converting historical arrangements into unquestionable authority. Modern moral, legal, and political theory therefore repeatedly confronts a tension between continuity and revisability. Theories differ over who may challenge a norm, what reasons count as valid criticism, which procedures authorize change, and whether revision concerns the application of an existing norm or the norm itself.

Dewey's pragmatism supplies one model of revisability. Valuations, ends, and institutional arrangements can become objects of inquiry when their consequences generate conflict or frustration (Dewey 1939). Revision does not require abandoning normative judgment; it requires treating established standards as fallible and responsive to experience. The process is reconstructive because inquiry can alter both the pro-

posed solution and the criteria through which the problem is understood.

Habermas develops a different model in which the legitimacy of law and democratic institutions is connected to processes of public justification and deliberation (Habermas 1996). The relation between facticity and validity means that legal norms operate as socially effective institutions while also making claims to legitimacy that can be criticized. Democratic procedures are therefore important not only because they aggregate preferences but because they organize conditions under which norms can be publicly contested, justified, and revised. Habermas's account remains much more procedurally and discourse-theoretically specified than Dewey's pragmatist reconstruction.

Sen and Young provide additional reasons why normative revision may be required even without agreement on a complete ideal theory. Sen's capability-oriented approach emphasizes comparative assessment of actual freedoms and remediable injustice (Sen 1999). Young's work demonstrates that norms and institutions presented as impartial can reproduce exclusion when the standpoint embodied in them is socially particular (Young 1990). Revision can therefore concern the informational basis of judgment, the composition of decision-making publics, the institutional distribution of voice, and the categories through which injustice becomes perceptible.

Cover's nomos adds a further complication. Normative change need not originate only within centralized lawmaking institutions. Interpretive communities can generate alternative normative meanings and narratives that challenge official legality or reorient its future development (Cover 1983). Such plurality can be generative, but it can also produce conflict among normative worlds. The existence of competing nomoi does not itself determine which claim is just. It shows that normative order is historically inhabited and that legal meaning can develop through struggles over interpretation, memory, authority, and imagined futures.

The possibility of normative revision also creates a second-order problem. If norms guide the evaluation of conduct, what guides the evaluation of the norms themselves? Different traditions provide different answers: practical wisdom, universalizability, mutual justification, democratic deliberation, public reason, capability expansion, opposition to domination, or responsiveness to consequences. No single criterion can be imported into GRE as an uncontested foundation. A theory of normative change must therefore distinguish the historical explanation of how a norm changes from the normative justification of whether that change is desirable. Genealogy alone cannot establish validity, just as abstract validity alone does not explain how normative orders become socially effective.

The lineages reconstructed in this section provide a limited foundation for later GR and GRE. Existing ethical theory distinguishes character, duty, reasons, mutual justification, and practical inquiry. Theories of justice broaden evaluation from allocation to capabilities, rights, institutions, domination, recognition, procedure, and relations among persons. Sociology and jurisprudence explain how norms become socially and legally stabilized. Cover's nomos places legal prescription within wider normative worlds of narrative and communal meaning. Pragmatist and discourse-theoretic traditions make normative orders criticizable and revisable rather than historically frozen.

Later GR can build upon this inheritance by examining how normative judgments, procedures, relations, institutions, and interpretive worlds become coupled across time; how the conditions under which a norm is formed differ from the conditions

under which it is later justified; and how changing relations can alter the very criteria through which subsequent relations are judged. That later programme should preserve a decisive distinction established by the prior literature: the *emergence* of a norm, its *social effectiveness*, its *legal validity*, and its *normative justification* are different questions. Keeping them distinct allows GR to study the generation and transformation of normative orders without reducing justice to historical success, institutional stability, or mere social acceptance.

2.16 Classical Political Economy and Social Wealth

The preceding sections established philosophical and social-theoretical foundations for value, normativity, subject formation, institutional reality, and historically structured social change. Classical political economy provides the first sustained economic lineage in this chapter in which these concerns are assembled around the production, circulation, distribution, and reproduction of social wealth. The objective of the present section is to reconstruct how major classical writers conceptualized wealth and production, labor and specialization, exchange and markets, distribution among social classes, and the relation between economic order and wider social structure. The discussion proceeds from early political economy and physiocratic reproduction through Smith, Ricardo, Malthus, and Mill, with Marx appearing only as a later critical continuation that will receive separate treatment. The method is genealogical and comparative. Classical political economy is treated as a heterogeneous field rather than a unified doctrine, and later GRE questions are introduced only at the level of intellectual inheritance.

2.16.1 Wealth and Production

Classical political economy emerged before economics was organized primarily around the allocation of scarce means among alternative ends. Its central objects included the sources of national wealth, the organization of productive activity, the reproduction of material conditions across time, the relation among agriculture, manufacture, and commerce, and the institutional arrangements under which an economic order could persist or expand. The category of *wealth* therefore had a social and historical breadth that should not be identified automatically with later concepts of utility, welfare, gross domestic product, or monetized asset value.

James Steuart's *Inquiry into the Principles of Political Oeconomy* illustrates the breadth of this earlier problem-space. Political economy appears there as a science of domestic policy encompassing population, agriculture, industry, trade, money, circulation, public credit, taxation, and the distribution of inhabitants among different classes of employment (Steuart 1767). The economic order is consequently inseparable from questions of population, government, occupational differentiation, and monetary circulation. Steuart's framework does not provide the later Smithian system, but it shows that political economy originally addressed the organization of a society rather than an autonomous market sphere abstracted from political and social relations.

Physiocracy supplied a different early architecture. Quesnay's *Tableau économique*, developed in 1758–1759 and preserved in later critical editions, represented the an-

nual circulation of expenditures and revenues among a productive agricultural class, proprietors, and what physiocratic terminology called the “sterile” class (Quesnay 1972). Its substantive privilege accorded to agriculture is historically specific and was rejected by later political economy. Its analytical importance lies elsewhere: wealth appears as a reproduced social flow requiring advances, expenditure, circulation, class relations, and the renewal of conditions that permit another annual cycle. Production is therefore already connected to reproduction and distribution rather than treated as an isolated technical act.

Smith’s *Wealth of Nations* reorganized the problem. The wealth of a society is connected to the annual produce of its land and labor, while the productive powers of labor depend importantly on division of labor, accumulation of stock, and the organization of exchange (Smith 1776). Smith’s analysis moves repeatedly between individual activities and aggregate social consequences. Productive capacity is affected by specialization; specialization is limited by the extent of the market; accumulation supports the employment of labor; and the annual produce is distributed through wages, profit, and rent. Wealth is thus neither a mere stock of precious metal nor an attribute of isolated persons. It is a property of a socially organized process of production and circulation.

The classical category of productive labor also reveals historically specific judgments about what counts as wealth creation. Smith connected productive labor to labor that adds value to a vendible commodity and contributes to accumulation, while later writers disputed the boundary between productive and unproductive activity (Smith 1776; Malthus 1820; Mill 1848). Malthus defended a conception of wealth that emphasized accumulation and material objects capable of entering national stock, whereas Mill retained a productive/unproductive distinction while modifying its formulation and embedding it in a wider treatment of utilities, capital, and productive consumption (Malthus 1820; Mill 1848). These classifications should be read historically. They encode assumptions about durable wealth, services, accumulation, and the economic significance of different forms of labor rather than supplying a timeless ontology of productive contribution.

Malthus also complicated any simple identification between saving, accumulation, and increasing wealth. His *Principles of Political Economy* examines accumulation as one possible stimulus to growth while insisting that continued expansion depends on conditions of demand, distribution, consumption, and profitable employment as well as on the capacity to save (Malthus 1820). This disagreement with Ricardian tendencies is important because it shows that classical political economy already contained competing accounts of how production is sustained. The supply of productive capacity and the realization of output through effective demand could not simply be assumed to coincide.

Mill’s *Principles of Political Economy* provides a late-classical synthesis in which production, distribution, exchange, and social philosophy are explicitly joined (Mill 1848). Mill distinguishes conditions of production that follow from material and technological constraints from rules of distribution that depend substantially on social institutions, laws, and customs. Whatever one makes of the sharpness of this distinction, it makes a foundational point visible: the quantity and form of social wealth cannot be understood solely through physical production. Property, institutional arrangements, and distribution shape who controls wealth, how it is used, and which forms of economic order are reproduced.

The classical lineage therefore leaves several different meanings of production in view. Production can refer to transformation of material conditions, mobilization of labor and capital, reproduction of annual advances, generation of a surplus, or expansion of a society's capacity to sustain future activity. These meanings overlap without being equivalent. Later GRE can inherit this breadth while remaining free to reconsider classical exclusions concerning care, services, knowledge, ecology, and other forms of contribution. Chapter 2 requires only the narrower historical conclusion: classical political economy made social wealth and its reproduction central economic objects long before economics was reorganized around marginal allocation.

2.16.2 Labor and Division of Labor

Labor occupies a distinctive place in classical political economy because it connects material production to social organization. The classical writers did not treat labor only as a quantity of effort. They investigated the organization of work, specialization, skill, cooperation, wages, productive capacity, and the relation between workers and owners of property. The division of labor therefore belongs simultaneously to theories of production and to theories of social differentiation.

Smith gives the canonical account. Division of labor increases productive powers through specialization, improved dexterity, saving of time, and the possibility of machinery adapted to specialized tasks (Smith 1776). Yet the mechanism is social rather than purely technical. Specialization presupposes exchange and is limited by the extent of the market. A more extensive network of exchange can support finer differentiation of occupations; greater differentiation can in turn increase output and deepen interdependence among producers. The famous manufacture examples therefore sit within a broader account of social coordination.

This account contains a tension that becomes important for later political economy. The same specialization that raises productivity can narrow the range of activities performed by individual workers and alter the distribution of knowledge, skill, and dependence within society. Smith's broader work recognizes educational and civic problems associated with extreme occupational specialization even though the productivity analysis in Book I emphasizes its material advantages (Smith 1776). Division of labor is therefore already more than a production technique. It reorganizes capacities and relations among persons.

Ricardo treats labor within a more abstract analytical system concerned with value, wages, profit, rent, and accumulation (Ricardo 1817). His labor-centered analysis of value applies under specified conditions and is complicated by capital durability, time, machinery, and differing production structures. The importance for the present genealogy lies less in identifying a single classical labor theory of value than in recognizing how labor became a common term connecting production conditions to distributive conflict. Changes in wages could affect profits; technical change could alter demand for labor; and class income depended on the structure through which the social product was divided.

Mill retains labor as an agent of production while emphasizing the joint importance of capital, natural conditions, knowledge, cooperation, and combined labor (Mill 1848). His treatment helps separate two questions that later economic theory often distinguishes more sharply: what makes coordinated production technically effective, and what institutional relations determine claims over the resulting product.

Combined labor can increase productive capacity, while ownership and distributive rules determine how the advantages of cooperation are apportioned.

The classical treatment of division of labor consequently provides an important intellectual foundation for relational economic analysis without already constituting such an analysis. Specialization creates dependence among differentiated activities; market extension changes the feasible degree of specialization; the organization of work alters productive capacities; and ownership structures mediate claims upon the product. These are relational observations in an ordinary analytical sense. They do not establish the stronger GR proposition that subjects and relations are recursively generated through changing relational systems. They instead make that later question historically intelligible.

A further distinction is necessary. Productive contribution, productive necessity, and distributive entitlement are separate problems. Classical political economy frequently connected them through prevailing property and class arrangements, but the connection was contested even within the tradition. Labor may be necessary to a production process without the laborer controlling the product; ownership may create a legally recognized claim without directly corresponding to labor performed; organizational or technological change may alter the necessity of a particular task while leaving social status or income relations partly intact. Later GRE will return to these separations under conditions of automation and capability asymmetry. Section 45 records their classical prehistory rather than supplying a contemporary resolution.

2.16.3 Exchange and Markets

Exchange is central to classical political economy, but the market in this literature should not be treated as a single self-contained mechanism. Smith, Ricardo, Malthus, and Mill analyze exchange through different combinations of specialization, money, price, demand, production cost, trade, and institutional arrangement. Markets coordinate activities, transmit claims on output, and affect the scale of specialization, while remaining embedded in wider structures of property and production.

Smith links exchange to the division of labor and to the emergence of money as a practical medium that facilitates increasingly differentiated production (Smith 1776). His distinction between natural and market prices provides a way of analyzing temporary deviations as well as longer-run conditions associated with wages, profit, and rent. Competition matters within this account, but exchange is not analytically prior to production and distribution. The organization of price presupposes property, production, differentiated income claims, and an existing social division of labor.

Ricardo further systematizes the relations among value, natural and market prices, rent, wages, profit, taxation, trade, and accumulation (Ricardo 1817). Foreign trade becomes an important part of the analysis because differences in relative production conditions can make exchange mutually advantageous even when one country possesses absolute productivity advantages across activities. At the same time, Ricardo's framework remains strongly concerned with how the gains and burdens associated with economic change are distributed among classes. Market exchange does not dissolve the distributive problem; it operates within it.

Malthus introduces a significant disagreement over demand and the conditions under which production is actually sustained. His treatment of demand and supply distinguishes the existence of productive capacity from an effectual demand suf-

ficient to maintain continued supply, while his analysis of accumulation questions whether increased saving and productive employment automatically guarantee a continued increase of wealth (Malthus 1820). The disagreement is theoretically important even where later economics reformulates its terms. Classical political economy therefore contained a live dispute over whether production generates adequate demand through its own operation or whether the composition of expenditure and distribution can obstruct realization and continued accumulation.

Mill offers another useful distinction. In his treatment of production and distribution, exchange functions as machinery through which the social product is apportioned under a commercial system rather than as the fundamental source of all distributive relations (Mill 1848). Property institutions and class positions are analytically prior to some of the claims that are subsequently expressed through market prices and monetary exchange. This prevents a direct identification of observed market outcomes with an institution-free distribution generated by exchange alone.

Classical market analysis therefore leaves at least four separable objects: the social differentiation that creates reasons for exchange; the monetary and price mechanisms through which exchange occurs; the production and demand conditions that sustain transactions; and the property and class structures that determine participants' positions before and after exchange. Later theories may reorganize these objects, and marginalist economics will place different analytical weight on utility, scarcity, substitution, and equilibrium. The classical lineage is important precisely because it preserves a broader conception of markets as parts of a social process of production and distribution.

For later GRE, this creates a useful foundation for distinguishing exchange from conversion. Exchange normally concerns transfers under some recognized equivalence, price, contract, or reciprocal arrangement. A broader theory of value conversion may also need to examine transformations among heterogeneous forms of value for which no complete common metric exists. That stronger claim belongs later in the book. The classical tradition supplies the narrower precedent that economic circulation changes the form, location, and social command of wealth without being reducible to the physical act of production.

2.16.4 Distribution and Social Classes

Distribution is one of the defining objects of classical political economy. The question concerns more than inequality among individuals. Classical writers commonly analyze how the social product is divided among structurally differentiated groups whose claims arise from labor, ownership of stock or capital, and ownership of land. Wages, profits, and rent are therefore simultaneously income categories and expressions of a particular organization of production and property.

Smith's analysis of the component parts of price and the rates of wages, profit, and rent establishes an influential class structure within political economy (Smith 1776). Workers, owners of stock, and landlords occupy different positions in relation to production and receive different forms of income. Smith also attends to differences in bargaining position and to the ways in which legal and institutional circumstances affect labor and property. The distribution of the annual product is therefore connected to social relations among groups rather than appearing as a purely technical decomposition of output.

Ricardo places distribution even more explicitly at the center of political economy. His preface organizes the problem around three classes—landowners, owners of capital, and laborers—and the changing proportions of the social product received as rent, profit, and wages (Ricardo 1817). Accumulation, population, agricultural conditions, technology, and the cultivation of land affect these shares. Ricardo's theory of rent and his analysis of wages and profits consequently treat class distribution as a dynamic problem linked to economic development rather than as a fixed accounting identity.

Malthus shares many of these categories while disputing important Ricardian conclusions. His treatment of rent, profits, wages, accumulation, and effective demand gives landlords, capitalists, laborers, consumers, and unproductive expenditure different roles in the maintenance of demand and wealth (Malthus 1820). The disagreement matters because it shows that a common class vocabulary did not yield a common theory of the relation between distribution and growth. A distributive arrangement could affect demand, accumulation, and the realized expansion of wealth differently under competing classical accounts.

Mill makes the institutional status of distribution unusually explicit. He argues that the rules through which wealth is distributed depend on laws and customs and can vary across societies even though any chosen arrangement has consequences that must be understood empirically (Mill 1848). Property is therefore not a neutral background fact. It helps constitute the classes and claims through which distribution occurs. Mill's discussion of landowners, capitalists, and laborers preserves classical categories while opening the possibility that their relations can be reorganized through institutional change.

The classical distribution problem should therefore be distinguished from a purely statistical distribution of income. It concerns positions within the organization of production, legally and socially recognized claims, class-specific income forms, and the consequences of accumulation for those positions. A society can display a particular distribution of monetary income for many reasons; classical political economy asks how some of those reasons are rooted in land, capital, labor, property, and the organization of the productive process.

Marx's later critique transforms this inherited problem by reconstructing capital, wage labor, surplus value, accumulation, and class relation within a theory of capitalist production (Marx 1867). The conceptual transition is important, but its detailed treatment belongs to the later sections devoted to Marxism, historical materialism, circulation, and reproduction. For the present genealogy, Marx demonstrates that classical categories of labor, property, surplus, and class could become objects of immanent critique rather than merely elements of an accepted economic order.

This classical focus gives later GRE a valuable inheritance: distribution can be analyzed as a relational problem concerning how claims to socially produced value are constituted and maintained. Yet classical class categories should not be universalized. Modern economies include corporate forms, financial claims, public institutions, platforms, intellectual property, care work, ecological dependencies, data infrastructures, and heterogeneous forms of capital that require additional analysis. The classical framework supplies a historical foundation for asking who participates in production, who controls productive conditions, and through what relations the resulting value is appropriated and distributed.

2.16.5 Economic Order and Social Structure

Classical political economy ultimately treated economic life as part of a wider social order. Production depended on legal property arrangements, accumulated stock, population, knowledge, infrastructure, division of labor, and political conditions. Exchange presupposed monetary and institutional arrangements. Distribution reflected durable social positions. Accumulation altered the relative importance and interests of classes across time. Political economy therefore remained connected to history, governance, and social structure even when individual authors disagreed sharply about the appropriate role of public authority or the mechanisms of economic coordination.

Steuart's formulation of political economy as domestic policy makes this connection especially visible (Steuart 1767). Population, employment, agriculture, commerce, money, credit, and taxation belong to one problem of governing and sustaining an economic society. Quesnay's physiocratic system similarly links the reproduction of wealth to an ordered circulation among classes and to conditions affecting agricultural advances and annual reproduction (Quesnay 1972). Their substantive conclusions differ, but both precede a clean separation between "the economy" and the institutional order in which economic reproduction occurs.

Smith's account likewise extends well beyond exchange. Different historical arrangements of land, towns, commerce, public revenue, defense, education, and colonial policy affect the development of opulence and the organization of productive activity (Smith 1776). The famous defense of market exchange therefore forms part of a broader political economy concerned with institutional history and public functions. Treating Smith only as a theorist of decentralized exchange would obscure the range of social and governmental conditions examined in the work.

Ricardo narrows some dimensions of the inquiry while making distributional structure analytically sharper. Economic development changes rents, profits, wages, and the interests attached to land, capital, and labor; taxation and trade policy redistribute burdens across these positions; technical change can alter the demand for labor (Ricardo 1817). The social order is consequently dynamic even where Ricardo's formal abstractions are more pronounced than Smith's historical narrative.

Mill makes the connection to social structure explicit through the subtitle of his work and through his treatment of property, institutions, progress, and distribution (Mill 1848). Production operates under material conditions, while institutional arrangements shape property and the distribution of wealth. Economic analysis therefore interacts with questions of social philosophy without collapsing into them. This distinction is useful for GRE because it permits economic inquiry to remain a domain-specific project while recognizing that the conditions under which economies operate are partly legal, political, cultural, and historical.

Several inheritances from classical political economy are therefore important for the later development of GRE. First, wealth can be treated as a socially organized and temporally reproduced phenomenon rather than only as an individual possession. Second, production depends on differentiated activities whose coordination changes productive capacity. Third, exchange takes place within prior structures of production, property, and distribution. Fourth, class and distributive positions can alter the trajectory of accumulation and the reproduction of the economic order. Fifth, economic institutions are historically variable even when their consequences are subject

to material constraints.

These inheritances do not establish a generative-relational economics. Classical political economy generally works with categories—labor, capital or stock, land, rent, profit, wages, productive and unproductive activity, social classes—whose boundaries and ontological status vary across authors and historical contexts. GRE will eventually ask how such categories, relations, capacities, and forms of value are themselves generated, stabilized, converted, contested, and transformed. That later move requires additional foundations from marginalism, Marxism, institutional economics, economic sociology, relational theory, evolutionary thought, ecology, complexity, and formal sciences. Section 45 supplies one indispensable lineage: economic order as the historically structured production, circulation, distribution, and reproduction of social wealth.

2.17 Marginalism, Neoclassical Economics, and Allocation

Classical political economy organized economic inquiry around social wealth, production, accumulation, exchange, and distribution among structurally differentiated classes. Marginalism and the later neoclassical tradition did not simply discard these objects, but they changed the analytical center of gravity. Value was increasingly reconstructed through marginal evaluation, economic action through constrained choice, coordination through prices and equilibrium, and welfare through properties of alternative allocations. The objective of this section is to reconstruct that transformation without treating “marginalism” or “neoclassical economics” as a single internally homogeneous doctrine. The discussion proceeds from marginal theories of value and utility through scarcity and choice, equilibrium and coordination, welfare and allocation, and finally information, incentives, and allocation mechanisms. Its method remains genealogical. The analytical gains of abstraction are identified together with the assumptions under which they operate, while stronger GR and GRE claims about the generation of preferences, agents, relations, values, and feasible sets are reserved for later chapters.

The terminology itself requires restraint. Jevons, Menger, and Walras are commonly grouped within the marginal revolution, yet their accounts of utility, value, exchange, and economic method differ substantially. Marshall’s partial-equilibrium synthesis is not identical with Walrasian general equilibrium; Pareto’s ordinal reformulation changes the status of utility; Robbins’s scarcity definition changes the disciplinary object of economics; Hicks and Samuelson further reorganize consumer theory and formal method; Arrow and Debreu provide a rigorous existence framework under explicit assumptions. “Neoclassical economics” is therefore used here as a broad historical family of approaches in which marginal reasoning, constrained optimization, price-mediated coordination, and equilibrium analysis became especially influential. It is not treated as a timeless or perfectly unified theoretical system.

2.17.1 Marginal Value and Utility

The marginalist reorganization of value shifted attention from the labor, cost, or class-distribution problems that dominated much classical political economy toward the

relation between available quantities, wants, and incremental evaluation. This shift did not yield a single theory. Jevons, Menger, and Walras developed different conceptual and methodological architectures, but each made the value of an additional unit relative to circumstances of use and availability analytically central.

Jevons's *Theory of Political Economy* explicitly reconstructs value through utility and the “final degree of utility,” connecting exchange ratios to marginal evaluations rather than to embodied labor alone (Jevons 1871). Utility in this framework varies with quantity: an additional increment of a good generally contributes differently depending on how much of the good is already available. This makes the margin analytically decisive. The object of explanation becomes less the historical origin of an entire social product and more the conditions under which incremental units are valued and exchanged by choosing agents.

Menger's *Grundsätze der Volkswirtschaftslehre*, also published in 1871, arrives at marginal valuation through a different route (Menger 1871). Goods acquire economic character in relation to human needs and the quantities available for satisfying them. Value is connected to the importance of satisfactions that depend on command over particular quantities of goods. The conceptual emphasis is therefore subjective without being reducible to a numerical psychology. Menger's account of goods of different orders, exchange, price, and money also develops causal sequences that differ from Jevons's more explicitly mathematical treatment.

Walras's *Éléments d'économie politique pure* connects marginal evaluation to a much more systematic theory of mutually interdependent markets (Walras 1874). His concept of *rareté* links utility and limited quantity, while exchange under free competition is represented through systems of demand, offer, prices, and equilibrium conditions. The marginal problem thus becomes inseparable from simultaneous market interdependence. Whereas Menger emphasizes causal formation from individual economizing and Jevons focuses on utility and exchange at the margin, Walras develops a mathematical architecture in which many markets must be solved together.

Marshall's *Principles of Economics* later integrates marginal demand analysis with supply, cost, production, time, and industrial organization (Marshall 1890). Marshall's famous use of the two blades of scissors resists a one-sided theory of value: market value is shaped jointly by conditions of demand and supply, with the relative analytical importance of each varying across time horizons. His partial-equilibrium method isolates a market or problem under simplifying conditions rather than solving an economy-wide system simultaneously. This methodological difference from Walras is as important as their common use of marginal reasoning.

Pareto further changes the status of utility. In the *Manual of Political Economy*, preference orderings and indifference analysis permit economic choice to be represented without requiring a measurable cardinal quantity of pleasure (Pareto 1971). Hicks develops this ordinal reformulation more systematically in *Value and Capital*, replacing much older marginal-utility language with indifference curves, marginal rates of substitution, income and substitution effects, and a theory of consumer demand based on preference orderings rather than interpersonal or cardinal measurements of satisfaction (Hicks 1939b).

The resulting lineage should therefore be described carefully. Marginalism does not merely replace “objective” value with “subjective” value. It relocates a major part of economic analysis toward incremental trade-offs, ordering of alternatives, and

the behavior of agents facing limited quantities and competing uses. The gain is substantial: local choice, substitution, demand response, and relative valuation become tractable in a way that supports precise comparative reasoning. The abstraction also postpones other questions. Preferences, wants, and the identity of goods are often treated as sufficiently given for the purpose of the model, even though other traditions ask how they are socially formed, historically transformed, or institutionally mediated. Chapter 2 need not resolve that tension. It is enough to identify it as one boundary between marginal analysis and the later generative questions of GRE.

2.17.2 Scarcity and Choice

Marginal analysis becomes especially influential when joined to a conception of economics centered on scarcity and choice. Scarcity in this lineage does not mean absolute material shortage alone. It concerns the relation between limited means, multiple possible uses, and ends that cannot all be simultaneously realized. This formulation permits the economic problem to be represented across a wide range of domains, but it also changes what counts as the characteristic object of economics.

Robbins's *Essay on the Nature and Significance of Economic Science* gives the canonical formulation: economics studies human behavior as a relation between ends and scarce means that have alternative uses (Robbins 1932). The importance of the formulation lies partly in its abstraction from the substantive content of ends. Economics can analyze choice among alternatives without determining whether the ends themselves are morally good, culturally specific, or historically generated. Scarcity is therefore formal and relational: a means is scarce because it is insufficient relative to competing uses, not simply because its physical quantity is small.

This formulation consolidates tendencies already present in marginalism. If agents rank alternatives, if resources can be directed toward different uses, and if opportunity cost accompanies selection, then economic analysis can focus on feasible sets and choices within them. The resulting framework is powerful because it permits common analytical tools to be applied to consumption, production, labor supply, intertemporal choice, portfolio allocation, and many other problems. Samuelson's *Foundations of Economic Analysis* further formalizes maximizing behavior and equilibrium systems within a common mathematical vocabulary (Samuelson 1947). The diversity of substantive settings can then be represented through structurally similar constrained problems.

The abstraction does not imply that every neoclassical model assumes literal psychological calculation by fully informed individuals. Optimization can function as a representation of choice consistency, a characterization of equilibrium behavior, or an analytical device under specified conditions. Likewise, the feasible set need not be interpreted as technologically fixed in every application. Yet much of the analytical convenience arises from treating ends, constraints, available alternatives, and agent boundaries as sufficiently specified at the point of analysis.

This is a decisive shift from much classical political economy. The central question is no longer only how a social surplus is produced and distributed among classes, but how limited resources are allocated among alternative uses given preferences, technologies, and endowments. Distribution remains present, but it can enter as an initial endowment, a budget constraint, a property-right structure, or an outcome of market exchange rather than always as the primary organizing problem. The eco-

conomic subject correspondingly appears more often as a chooser, consumer, producer, or owner of resources whose relevant characteristics are represented through preferences, technologies, and constraints.

The distinction between scarcity and deprivation is important. A society can face scarcity in the formal Robbinsian sense even when material abundance is high, because resources such as time, attention, land, computational capacity, skilled labor, or ecological absorption remain limited relative to possible uses. Conversely, severe deprivation cannot be understood solely by noting that scarce resources must be allocated. Sen's later entitlement and capability approaches, treated elsewhere in this chapter, show why command over resources and substantive possibilities may differ even where aggregate availability is unchanged. The scarcity-choice framework identifies a real structural problem, but it does not by itself determine which ends matter, how entitlements arise, or whether the initial distribution is just.

For later GRE, this lineage establishes a foundation that should be retained rather than rejected. Trade-offs, opportunity costs, constraints, and alternative uses remain economically indispensable. The later generative question is different: how are the ends, resources, constraints, capabilities, and recognized alternatives themselves produced and transformed? That question supplements rather than invalidates the scarcity-choice problem.

2.17.3 Equilibrium and Coordination

If marginalism gives a theory of incremental choice, equilibrium analysis provides a theory of mutual consistency among choices and constraints. Equilibrium has several meanings across economics, and it should not be identified automatically with historical stasis or social harmony. At minimum, an equilibrium representation specifies a configuration in which a set of modeled conditions are simultaneously satisfied. The interpretation of those conditions differs across partial equilibrium, general equilibrium, temporary equilibrium, and later strategic or dynamic models.

Walras provides the foundational general-equilibrium architecture. Prices connect demand and supply across multiple markets, and equilibrium requires simultaneous compatibility among the decisions represented in the system (Walras 1874). The analytical achievement is not simply a claim that markets “balance themselves.” It is the representation of interdependence: a change in one price, endowment, technology, or demand condition can propagate through other markets because the equations are jointly connected. The economy becomes representable as a coordinated system of exchange and production rather than a collection of isolated bilateral trades.

Marshall develops a different strategy. Partial equilibrium deliberately holds many surrounding conditions comparatively fixed in order to study one market or adjustment problem with greater local clarity (Marshall 1890). The method sacrifices economy-wide simultaneity in exchange for analytical tractability and attention to time, industry-specific conditions, and supply responses. The contrast with Walras therefore concerns method as much as doctrine: one approach emphasizes system-wide consistency, while the other isolates a tractable domain under controlled abstraction.

Pareto and Hicks further transform equilibrium analysis. Pareto links general equilibrium to ordinal preferences and the analysis of efficient allocations; Hicks develops an integrated theory of value, substitution, expectations, and temporary equilibrium

that makes explicit how current decisions can depend on anticipated future conditions (Pareto 1971; Hicks 1939b). Samuelson then systematizes equilibrium conditions and comparative statics within a general mathematical program (Samuelson 1947). Comparative statics asks how an equilibrium configuration changes when parameters change. It is therefore a theory of differences between modeled equilibria rather than, by itself, a theory of the historical path through which one configuration becomes another.

Arrow and Debreu provide a major formal consolidation. Their 1954 paper proves existence results for competitive equilibrium in an integrated model of production, exchange, and consumption under explicit assumptions (Arrow and Debreu 1954). Debreu's *Theory of Value* later presents an axiomatic framework organized around commodities and prices, producers, consumers, equilibrium, optimum, and uncertainty (Debreu 1959). These works clarify what must be assumed for a competitive-equilibrium solution to exist. Existence is a mathematical property of a formal system; it should not be confused with a claim that every actual economy rapidly converges to such an equilibrium, that the equilibrium is unique, or that the institutional process of reaching it is costless.

Coordination is therefore analytically separable from equilibrium. A price system can be studied as one institution through which dispersed plans are made mutually compatible, but institutional coordination can also occur through firms, contracts, associations, public administration, customary rules, or other mechanisms. Coase's theory of the firm makes this explicit by asking why transactions are sometimes coordinated within organizations rather than through repeated market exchange (Coase 1937). Hayek adds another dimension: the relevant knowledge for coordination is dispersed, incomplete, and often local, so an economic order must be assessed partly by how it communicates and uses information distributed among many actors (Hayek 1945).

The equilibrium tradition therefore contributes several distinct analytical resources: mutual consistency, system-wide interdependence, local comparative analysis, price-mediated coordination, and formal conditions for existence and optimality. None requires the stronger claim that an economy is fundamentally an equilibrium object. For later GRE, equilibrium can remain one useful representation of a stabilized configuration, while trajectories, institutional change, changing preferences, transformed capacities, and endogenous modification of the feasible set require additional tools.

2.17.4 Welfare and Resource Allocation

Once economic analysis is organized around choice and equilibrium, a normative question follows: how should alternative allocations be evaluated? Welfare economics develops several answers, and their differences are important. Efficiency, aggregate welfare, compensation tests, distribution, and social evaluation should not be treated as interchangeable concepts.

Pareto supplies the best-known efficiency criterion. An allocation is Pareto-improvable if at least one person can be made better off without making anyone worse off; a Pareto-efficient allocation admits no such improvement. The importance of the criterion is its limited informational demand: it can identify some unambiguous improvements without requiring a complete cardinal comparison of welfare

across persons. Its limitation follows from the same restraint. Many radically different distributions can be Pareto efficient, and the criterion alone does not determine which among them is just or socially preferable. Pareto efficiency is therefore a property of an allocation relative to preferences and feasibility, not a complete theory of welfare or justice (Pareto 1971).

Pigou's *Economics of Welfare* develops a broader welfare-economic project centered on economic welfare and the national dividend, while giving special analytical importance to divergences between private and social net product (Pigou 1920). External effects create a reason why individually advantageous decisions may fail to produce socially desirable outcomes. This line of analysis makes the institutional environment of allocation relevant: taxes, subsidies, public provision, regulation, or other arrangements may alter the relation between private incentives and social consequences.

The "new welfare economics" of the late 1930s sought to formulate welfare propositions while reducing reliance on interpersonal cardinal utility comparisons. Hicks and Kaldor developed compensation-based criteria under which a change could count as a potential improvement when beneficiaries could in principle compensate those who lose (Hicks 1939a; Kaldor 1939). These criteria expanded the domain of welfare comparison beyond strict Pareto improvements, but they also generated controversies concerning actual compensation, distribution, reversals, and the normative significance of willingness and ability to pay. They therefore illustrate a recurring problem: a more operational comparison rule can gain analytical reach while embedding assumptions about what information and claims are allowed to count.

General-equilibrium welfare theory later establishes deep connections between competitive allocation and Pareto efficiency under specified conditions. The significance of these results lies in identifying the assumptions under which decentralized price-mediated choice has strong efficiency properties. Those assumptions concern preferences, technologies, market completeness, information, and other structural conditions; when they fail, the conclusions cannot simply be carried over unchanged. Debreu's axiomatic organization of equilibrium and optimum makes the conditional character of the analysis especially clear (Debreu 1959).

Resource allocation in this tradition is therefore a precisely structured problem. There are agents or units, resources or commodities, feasible transformations and exchanges, preferences or objectives, and institutional rules through which an allocation is selected. The framework can answer important questions about efficiency, substitution, scarcity, shadow values, and the consequences of constraints. It can also make distribution visible through endowments and budget sets. Yet an allocation model need not explain how the relevant resource categories were historically produced, how the recipients became recognized as the relevant units, how preferences and capabilities developed, or what happens to resources after allocation as they circulate through relations and generate later capacities.

This boundary is especially important for GRE. A later relation-indexed or generative account of allocation should not be presented as a rejection of welfare economics. It inherits the requirement to specify scarce resources, feasible alternatives, opportunity costs, incentive effects, and efficiency losses. Its extension concerns the object over which evaluation is performed. The eventual question is not only who receives a resource at one moment, but what relations, capabilities, dependencies, institutional

feedbacks, and future possibilities that allocation helps generate. That stronger claim belongs to the substantive GRE chapters rather than to the present genealogy.

2.17.5 Information, Incentives, and Allocation Mechanisms

The allocation problem becomes more demanding once information and incentives are treated as endogenous constraints on institutional performance. A planner, market participant, firm, or regulator rarely possesses complete knowledge of preferences, technologies, costs, risks, or future states. Agents may also have reasons to misrepresent private information or alter behavior in response to the rules under which resources are allocated. Twentieth-century economic theory therefore increasingly asks not only whether an allocation is feasible or efficient, but what institutional mechanism can generate desirable outcomes given informational and incentive limitations.

Hayek's account of dispersed knowledge is one major foundation. The economic problem, on this view, is not merely the calculation of an allocation from data already gathered in one mind. Relevant knowledge is divided among individuals and often concerns particular circumstances of time and place (Hayek 1945). Prices can function as signals that permit adjustment without requiring every participant to know the complete structure of the economy. Whether one accepts Hayek's wider institutional conclusions or not, the epistemic point is important: allocation mechanisms differ in the information they require, transmit, aggregate, and leave decentralized.

Coase's theory of the firm establishes a related institutional plurality (Coase 1937). If using the price mechanism is costly, some transactions may be coordinated within organizations through authority and administrative direction. Market and hierarchy are therefore alternative coordination arrangements with different costs and informational structures rather than mutually exclusive descriptions of economic life. Later institutional economics and organizational theory will develop this point further, but its relevance to allocation is already clear: the mechanism through which decisions are made is itself an economic variable.

Hurwicz's work on informationally decentralized systems provides a direct bridge to mechanism design. An allocation mechanism can be analyzed as a rule-governed communication and decision system through which messages, information, and institutional rules produce outcomes (Hurwicz 1972). The later mechanism-design tradition extends this framework by asking which rules can implement desired social objectives when participants possess private information and respond strategically to incentives. The 2007 Nobel scientific background describes this development explicitly as a theory for comparing markets and other institutions under informational and incentive constraints. The conceptual move is substantial: instead of taking an existing market institution as given and predicting its outcome, the institutional rule itself becomes an object of analysis.

This lineage changes the meaning of allocation. Allocation is no longer only a vector of final quantities. It can also be studied as the result of an informational and incentive architecture. Different mechanisms may produce different outcomes from the same underlying resources because they elicit different messages, assign different rights, create different strategic opportunities, and distribute decision authority differently. Markets, firms, auctions, public rules, and other institutions can therefore be compared as allocation mechanisms rather than classified simply as more or

less “market.”

The neoclassical and mechanism-design traditions consequently supply several resources that later GRE should retain. First, scarcity and opportunity cost discipline claims about what can be jointly realized. Second, marginal reasoning permits analysis of local trade-offs and substitution. Third, equilibrium theory represents mutual consistency and systemic interdependence under explicit assumptions. Fourth, welfare economics distinguishes efficiency from wider normative evaluation. Fifth, information economics and mechanism design show that the rules through which agents communicate and act can determine whether desirable allocations are implementable.

Their characteristic abstractions also identify later questions. Preferences may change through social interaction; technologies and feasible sets can be transformed by investment and institutional change; agents can acquire or lose capabilities; classifications of resources can change; mechanisms can reshape the subjects who participate in them; and an allocation can modify the relations that determine future allocations. These possibilities do not render marginal or neoclassical analysis false. They mark dimensions that often require complementary historical, institutional, relational, and dynamic theories.

The intellectual inheritance for GRE can therefore be stated narrowly. Allocation theory provides rigorous ways to represent scarcity, trade-offs, coordination, efficiency, information, and incentives. GRE’s later contribution is not to abandon these questions, but to ask when the units, preferences, constraints, relations, and mechanisms entering an allocation problem are themselves generated and transformed through the economic process. Section 46 thus establishes the allocation-centered lineage that later sections must place alongside historical materialism, institutional economics, capability theory, social reproduction, evolutionary and ecological economics, and the formal sciences of dynamic relational change.

2.18 Marxism and Historical Materialism

Classical political economy made production, accumulation, exchange, and distribution central objects of economic inquiry. Marxism transforms that inheritance by asking how those economic processes are constituted through historically specific social relations and how changes in material production become connected to class formation, consciousness, institutions, political conflict, and social transformation. The role of this section is to reconstruct the principal conceptual lineages of historical materialism that later make generative-relational questions possible. Its objective is neither to present Marxism as a unified doctrine nor to translate Marxist concepts directly into GR vocabulary. The discussion proceeds through material conditions and historical formation, productive forces and relations of production, labor and capital as social relations, the formation of human subjects, and contradiction and historical transformation. The method is genealogical and comparative: Marx’s writings are read alongside influential later reconstructions that differ over technological priority, structural causation, historical agency, class, ideology, and contingency.

The term *historical materialism* itself can conceal important internal differences. A minimal shared orientation gives explanatory priority to historically organized material production and reproduction over explanations that derive social order primarily

from autonomous ideas. Stronger versions attribute developmental primacy to the growth of productive forces; structural Marxist versions emphasize the articulation of relatively autonomous structures and practices; humanist and historical traditions stress experience, agency, class formation, and struggle; Western Marxist traditions extend the analysis toward reification, hegemony, and consciousness. These positions cannot be treated as simple variants of one causal formula. The conceptual value of the lineage lies partly in the disputes through which its central categories have been repeatedly reinterpreted.

2.18.1 Material Conditions and Historical Formation

The materialist orientation developed by Marx and Engels begins from historically situated human activity rather than from an abstract opposition between matter and ideas. In *The German Ideology*, social life is approached through real individuals, their activity, the material conditions under which they live, the division of labor, forms of property, and the changing organization of production (Marx and Engels 1970). Consciousness is therefore embedded in historically specific practical life. Ideas, religion, law, and political forms remain consequential, but their explanation is connected to the social relations through which human beings produce and reproduce their conditions of existence.

This orientation is developed with particular compression in Marx's 1859 Preface to *A Contribution to the Critique of Political Economy*. Marx distinguishes the material productive forces of society from the relations of production within which those forces operate, and he describes the totality of relations of production as an economic structure connected to legal, political, and ideological forms (Marx 1859). The well-known distinction between economic "base" and legal-political "superstructure" became one of the most influential formulations in later Marxism. Yet the Preface should not be read as if it alone provided a complete theory of causal determination. It is a schematic statement written at a particular point in Marx's intellectual development, and later Marxist traditions have disagreed substantially about how strongly to interpret the priority it gives to material production.

The early materialist writings also complicate any interpretation in which human beings merely receive determination from an external economic structure. The *Theses on Feuerbach* criticize contemplative materialism for treating reality only as an object rather than as sensuous human activity and practice; the same text characterizes the human essence as an ensemble of social relations and emphasizes that social life is practical (Marx 1994). Material conditions therefore enter Marx's developing framework through practice. Human beings inherit conditions they did not individually choose, but they also reproduce and transform those conditions through socially organized activity.

Later Marxism has drawn different consequences from these formulations. Cohen's analytical reconstruction gives a particularly systematic role to the development of productive forces and functional explanation in historical materialism (Cohen 2001). In this reading, relations of production can be explained partly through the way they facilitate or impede the development of productive capacities. Other Marxists resist making technological development the principal motor of history. Wood, for example, argues for a historical materialism attentive to the specificity of social-property relations, class processes, political forms, and the historical constitution of

capitalism, while criticizing technological determinism and teleological narratives (Wood 1995). The disagreement is foundational. Historical materialism can be reconstructed as a relatively strong developmental theory, as a method for analyzing socially organized material reproduction, or as a historical research programme centered on the changing relations through which production and appropriation occur.

The concept of material conditions should therefore remain wider than physical technology and narrower than an all-purpose explanation of social life. It can include productive capacities, access to land and resources, labor organization, property relations, infrastructural arrangements, and the institutional conditions through which populations reproduce themselves. The historical-materialist contribution is to insist that these conditions matter for the formation of political and intellectual life while leaving open the precise causal architecture connecting them. That openness becomes important for later GR, but Chapter 2 should preserve it as an inherited theoretical problem rather than close it prematurely.

2.18.2 Productive Forces and Relations of Production

The distinction between productive forces and relations of production is one of historical materialism's most influential analytical constructions. Productive forces commonly include labor power, tools, machinery, technical knowledge, organization, and other capacities through which production becomes possible. Relations of production concern socially organized relations among persons in production, including ownership, control, access, command, cooperation, dependence, and appropriation. The distinction enables historical change to be studied through both changing capacities and changing social organization.

Marx's 1859 formulation describes productive forces as developing within definite relations of production and presents historical transformation as becoming possible when existing relations become fetters on further development (Marx 1859). This language strongly influenced stage-theoretic interpretations of history. Yet Marx's mature economic analysis also shows that productive forces and production relations are difficult to isolate empirically. Cooperation, manufacture, machinery, factory organization, and the collective labor process are productive capacities whose operation depends on particular relations of command, property, and wage labor (Marx 1867). Technical capacity is therefore already socially organized. Conversely, property and class relations operate through material infrastructures and productive techniques rather than floating above them.

This interdependence generates an interpretive problem. A productive-force-centered account can treat social relations as selected or transformed because they become more or less compatible with expanding productive capacities. Cohen's reconstruction offers the most philosophically explicit modern defense of this direction (Cohen 2001). A relation-centered interpretation places greater weight on the historically specific relations through which producers gain access to conditions of production and through which surplus labor is appropriated. Wood's renewal of historical materialism belongs to this second tendency, emphasizing class as a social relation and treating capitalism's distinctive economic dynamics as consequences of historically specific social-property relations rather than as the automatic result of technical advance (Wood 1995).

Structural Marxism introduces another reconstruction. Althusser rejects a model

in which every political, ideological, and cultural form simply expresses one economic essence. His concepts of structural causality, social formation, and overdetermination make social contradictions dependent on the articulation of multiple structures and historically specific conjunctures (Althusser 2006). The economic remains important, but causal determination is mediated through political institutions, ideology, national histories, and other relatively autonomous conditions. This approach distances historical materialism from a simple sequence in which productive forces cause production relations, which then mechanically cause the rest of society.

The resulting genealogy makes several separations necessary. Productive forces are not equivalent to technology. Relations of production are not equivalent to formal legal ownership. A mode of production is not merely a list of technologies plus property rules. Historical materialism instead opens a problem concerning the coupling of capacities, ownership, labor organization, control, appropriation, institutional form, and reproduction. Different Marxist schools assign different explanatory priorities within that field.

For later GRE, this is an especially important inheritance because it directs attention toward the conditions under which capacities become socially usable. A machine, body of knowledge, infrastructure, or computational system becomes economically consequential within relations that organize access, authority, labor, ownership, and distribution. The stronger generative question of how those relations and capacities recursively transform one another belongs to later chapters. Here the foundation is the historical-materialist recognition that productive capacity and social organization cannot be analyzed as wholly independent layers.

2.18.3 Labor, Capital, and Social Relations

Marxism also changes the analytical status of labor and capital. Within much political economy, labor can appear as a productive input and capital as an accumulated stock or factor of production. Marx retains their material dimensions while reconstructing both through social relations. Wage labor presupposes historically specific conditions under which workers sell labor power and lack independent command over sufficient means of production. Capital similarly refers to more than produced means or accumulated wealth; it operates through social relations that permit value to command labor, appropriate surplus, and reproduce the conditions of capitalist production.

This relational interpretation is already visible in Marx's early economic writings and becomes more systematic in *Capital*. The 1844 manuscripts analyze estranged labor through the worker's relations to the product, productive activity, other persons, and human capacities (Marx 1994). The later theory abandons several formulations of the early manuscripts while retaining the problem of how social relations confront persons in objectified forms. In *Capital*, the analysis of labor power, surplus value, cooperation, machinery, accumulation, and commodity fetishism places relations among producers, owners, and commodities at the center of the capitalist mode of production (Marx 1867).

Commodity fetishism is particularly important for a relational genealogy. Marx argues that the social character of labor can appear in commodity exchange as a relation among things. This does not mean that material objects are unreal or that prices are merely illusions. The analytical point concerns a historically specific form of so-

cial mediation in which relations among producers acquire objective economic forms that confront participants as properties of commodities and market relations (Marx 1867). Social relations can therefore become causally effective through objectified forms while their relational origin becomes difficult to perceive.

Class receives a related interpretation. A Marxian class is not exhausted by a descriptive income bracket. Class concerns positions within relations of production and appropriation: who controls conditions of production, who must sell labor power, how surplus labor is extracted, and how those relations are reproduced. Wood makes this point especially strongly by treating class as a process and relation rather than a geological layer of persons possessing similar quantities of assets or income (Wood 1995). Class conflict consequently concerns relations connecting producers and appropriators, even though empirical class formation also depends on political organization, culture, law, gender, race, locality, and historical circumstance.

Lukács extends the relational analysis of commodity society into the problem of reification. In *History and Class Consciousness*, commodity relations and rationalized social forms are connected to modes of consciousness in which historically produced relations acquire the appearance of fixed, thing-like structures (Lukács 1972). Lukács's theory differs from Marx's analysis of commodity fetishism and introduces its own philosophical commitments concerning totality and class consciousness. Its importance for the lineage lies in extending the question from economic relation to the forms through which a social order becomes experienced and understood.

These traditions provide later GRE with a conceptual warning against treating economic entities as analytically self-sufficient. "Labor," "capital," "commodity," and "class" can name stabilized economic categories while simultaneously referring to relations among persons, institutions, rights, productive capacities, and material objects. The relational interpretation does not eliminate entities; it changes the explanatory question from what an entity possesses in isolation to the historically organized relations through which its economic powers and meanings become effective.

2.18.4 Social Relations and the Formation of the Human Subject

Historical materialism also contributes to the problem of subject formation. Marx's early writings reject the image of a timeless individual whose essential characteristics exist prior to social history. The *Theses on Feuerbach* describes the human essence as the ensemble of social relations and criticizes theories that abstract the individual from historical process (Marx 1994). The *German Ideology* similarly situates consciousness, needs, division of labor, forms of intercourse, and practical life within historically specific modes of social organization (Marx and Engels 1970). Human beings remain active participants in history, yet the capacities, categories, dependencies, and conflicts through which they act are socially and materially formed.

The 1844 manuscripts develop this problem through alienation. Estranged labor concerns the worker's relation to the product, the activity of labor, other persons, and human powers, showing how a form of production can shape the subject's relation to self and world (Marx 1994). The later Marx gives less theoretical centrality to the language of species-being, but the general problem survives: economic relations are also formative relations. Wage dependence, factory discipline, commodity exchange, property, and class position organize practical possibilities and forms of consciousness as well as distributions of material resources.

Later Marxism develops this issue in divergent directions. Lukács links capitalist social forms to reification and class consciousness, treating the standpoint of social actors as historically connected to their position within a total social process (Lukács 1972). Gramsci broadens the problem through hegemony, civil society, common sense, intellectual organization, and the state. His *Prison Notebooks* make political and cultural leadership central to the reproduction and transformation of social order, thereby complicating any model in which economic position automatically produces political consciousness (Gramsci 2007). Althusser moves further from humanist formulations by emphasizing ideological practices and structural conditions through which subjects are constituted, a line developed explicitly in his later theory of interpellation and already prepared by his anti-humanist reading of Marx (Althusser 2006; Althusser 2001).

These approaches disagree about the status of the human subject. Humanist Marxist readings preserve alienation, practice, experience, and emancipatory human capacities as central categories. Structural Marxism resists explaining social formations through an already constituted human subject and treats subjectivity itself as an effect of ideological and structural processes. Gramscian approaches give greater weight to political organization, education, culture, and hegemony. Lukács places class consciousness within a dialectical account of totality. The differences are theoretically substantive, particularly for any later framework concerned with whether subjects are constituted through relations while retaining capacities for reflexive transformation.

Thompson's critique of Althusserian Marxism is important in this context. Thompson argues that historical materialism must remain answerable to historical experience, agency, and empirical process rather than replacing history with a self-contained theoretical structure (Thompson 1978). The dispute is useful for Chapter 2 because it exposes a problem that later GR must also confront: a theory of relational constitution can become excessively structural if it cannot explain how historically situated actors interpret, resist, reproduce, and modify the relations through which they were formed.

The historical-materialist inheritance therefore supports a relational account of subject formation without determining a final ontology of the person. Social relations can shape needs, capacities, identities, consciousness, practical horizons, and forms of dependence. This does not by itself establish that persons are reducible to those relations. The tension between social constitution and practical agency remains one of the central open problems passed forward to GR.

2.18.5 Contradiction and Historical Transformation

The final foundational problem concerns historical transformation. Marxist theories frequently explain change through contradiction, but the meaning of contradiction varies across texts and traditions. It can refer to tension between productive forces and relations of production, conflict between classes, contradictory requirements of accumulation, incompatibilities among institutional forms, or dialectical relations in which a social order reproduces conditions that also destabilize it. These meanings should not be collapsed into a single mechanism.

The 1859 Preface gives the canonical developmental formulation: productive forces can come into conflict with existing relations of production, after which the

relations that once enabled development become fetters and a period of social transformation becomes possible (Marx 1859). In *Capital*, contradiction appears through more concrete analyses of commodity production, labor and capital, competition, accumulation, machinery, and the reproduction of class relations (Marx 1867). The mature critique therefore does not depend on one abstract contradiction alone; capitalist development involves several interacting mechanisms operating at different institutional and temporal scales.

Later Marxism intensifies the disagreement over how such contradictions produce historical outcomes. Cohen's reconstruction gives a relatively systematic developmental role to productive capacities and the functional adaptation of production relations (Cohen 2001). Althusser argues that historically consequential contradictions are overdetermined by political, ideological, national, and international conditions and are never encountered in a pure form (Althusser 2006). Gramsci's analysis of hegemony and civil society further explains why structural tensions need not generate immediate political transformation: consent, organization, institutions, intellectual leadership, and political strategy shape whether and how conflict becomes transformative (Gramsci 2007). Thompson's historical critique insists in another register that actual historical processes cannot be deduced from theory independently of experience and agency (Thompson 1978).

Wood's reconstruction of historical materialism offers a useful synthesis of some of these concerns without dissolving their differences. Her emphasis on the historical specificity of capitalism, class as a social relation, and the separation of economic and political forms resists both technological determinism and theories in which social transformation follows automatically from structural contradiction (Wood 1995). The historical-materialist question becomes how particular relations of production organize compulsion, appropriation, political power, and possibilities of collective action under determinate historical conditions.

For the later development of GR and GRE, Marxism contributes several indispensable foundations. It makes relations of production historically specific; connects productive capacities to social organization; treats labor and capital as social relations rather than merely physical inputs; shows that social forms can become objectified and causally efficacious; connects subject formation to historically organized practices; and makes the transformation of social relations an explicit object of theory. At the same time, the Marxist lineage leaves unresolved how much explanatory priority belongs to productive forces, class relations, political organization, ideology, culture, technology, and contingent agency. GR should inherit that unresolved plurality rather than erase it.

The restrained generative-relational extension begins from this inheritance. Historical materialism already asks how one configuration of productive and social relations develops, reproduces itself, encounters limits, and becomes transformable. Later GR can add a more general question concerning how relations generate capacities, subjects, constraints, representations, and further relations, and how those generated elements subsequently alter the conditions of later transformation. That extension should remain distinguishable from Marxism itself. The conceptual continuity lies in treating history, production, social relation, and transformation as constitutive analytical problems; the difference lies in the broader domain and formal vocabulary through which GR will later attempt to study them.

2.19 Marxian and Post-Marxian Theories of Circulation and Reproduction

Section 47 reconstructed historical materialism as a family of approaches to material production, social relations, subject formation, and historical transformation. The present section narrows the genealogy to a different but closely connected problem: how capitalist relations persist through circulation and reproduction rather than through production alone. Its role is to recover the conceptual traditions that make value form, the movement of capital, turnover, realization, accumulation, reproduction of total social capital, reproduction of labor-power, and contemporary transformations of capital available as distinct objects of analysis. Its objective is not to present one unified Marxian theory of reproduction. Marx's analysis of capital circulation differs from later value-form reconstruction; debates over accumulation differ from theories of social reproduction; and contemporary accounts of financialization, spatial reorganization, or platform capitalism extend the object in different directions. The discussion therefore proceeds genealogically through value and social form, capital circulation, accumulation and reproduction, social reproduction, and contemporary transformations of capital before identifying a limited inheritance for later GR and GRE.

The term *reproduction* requires particular care. In Marx's economic analysis it can refer to the renewal of the conditions and components of capitalist production, including the reproduction of total social capital across interconnected departments. In later Marxist theory it can also refer to the reproduction of labor-power, class relations, institutions, ideology, households, care arrangements, and other background conditions through which a capitalist social order persists. These usages overlap but are not interchangeable. Likewise, *circulation* is wider than a sequence of market exchanges: it concerns transformations of capital among monetary, productive, and commodity forms, the time required for those transformations, and the conditions under which value is realized and recommitted to a new circuit. Keeping these meanings distinct is necessary if circulation and reproduction are to remain analytical concepts rather than general synonyms for continuity.

2.19.1 Value and Social Form

Marx's mature critique of political economy makes value inseparable from historically specific social forms. In the opening chapters of *Capital*, commodities possess use-values but confront one another in exchange through a value relation whose social substance is abstract labor and whose necessary form of appearance develops through exchange-value and money (Marx 1867). This analysis does not treat value simply as an intrinsic physical property of commodities. It asks how privately performed labors become socially related within a commodity-producing society and how those relations acquire objective forms that confront participants through commodities, money, prices, and the requirements of exchange.

Commodity fetishism sharpens the problem of social form. Relations among producers are mediated through things, so the social character of labor becomes expressed through apparently objective relations among commodities (Marx 1867). The theoretical problem is therefore double. Economic forms are socially constituted, yet they are not merely subjective interpretations that disappear once their history is

recognized. They organize conduct, constrain reproduction, and mediate access to resources. Social form in this sense refers to a historically specific mode through which relations become objective and practically efficacious.

Rubin's reconstruction makes this dimension of Marx's value theory especially explicit. His *Essays on Marx's Theory of Value* argues that Marx's political economy studies the social form of production relations rather than only their material-technical content. Rubin places commodity fetishism, reification, social labor, and the relation between material categories and production relations at the center of the theory of value (Rubin 1972). On this reading, a category such as value cannot be understood by identifying a physical quantity that commodities possess independently of the social organization through which labor is equated and distributed. Value theory becomes a theory of a specific organization of social labor and of the forms through which that organization becomes expressed.

Later value-form and critical-theory interpretations extend this line in different ways. Postone reconstructs Marx's mature critique around historically specific forms of social mediation, especially commodity, abstract labor, value, and capital. His account gives particular importance to temporality: socially necessary labor time becomes part of an impersonal form of domination in which productivity gains repeatedly transform the temporal standards against which labor is socially validated (Postone 1993). This interpretation differs from approaches that treat labor primarily as an emancipatory standpoint opposed to capital. For Postone, labor under capitalism is itself part of the historically specific social mediation that must be critically explained.

These approaches should not be collapsed. Marx's own presentation, Rubin's value-form reconstruction, and Postone's critical theory assign different explanatory weight to labor, form, class, and historical temporality. They nevertheless establish a common foundational problem for this chapter: economically consequential objects can possess a material dimension and a social-form dimension simultaneously. Money is a material or symbolic medium, but its economic powers depend on social relations and institutional recognition. A commodity is a useful object or service, but commodity form places it within relations of exchange and valuation. Capital can appear as money, machinery, inventories, claims, or organizational capacities, yet Marxian theory asks under what social relations those heterogeneous elements function as capital.

This distinction becomes important for later GRE because it discourages the treatment of economic categories as context-free entities. The point inherited from value-form theory is not that every economic object is merely linguistic or representational. It is that the causal powers attributed to economic objects may depend on historically organized relations, socially recognized forms, and recurrent practices of valuation. Later GR can generalize the question of how such forms emerge and transform, but the intellectual foundation remains Marxian: social relations can become objectified through forms that are both historically produced and practically real.

2.19.2 Capital Circulation

The second volume of *Capital* shifts the analytical center from the immediate production process to the process of circulation. Marx distinguishes the circuits of money-capital, productive capital, and commodity-capital and examines how industrial cap-

ital must pass repeatedly through these forms if accumulation is to continue (Marx 1993). Production and circulation are therefore analytically distinguishable but mutually necessary moments of a larger process. Surplus value may be produced through exploitation in production, yet commodities must be sold, monetary value must return, productive inputs must be renewed, and the circuit must be recommenced.

This analysis makes capital less intelligible as a static stock than as a movement through differentiated forms. Money does not function as capital merely because it is held; machinery does not function as capital merely because it is technically productive. Their place in a circuit matters. Money is advanced to acquire labor-power and means of production, productive activity transforms these inputs, commodity-capital must enter circulation, and realized value can then be consumed, hoarded, or advanced again. The unity of the process depends on successful transitions among forms whose temporal and institutional requirements differ.

Turnover introduces time directly into the analysis. Marx distinguishes production time from circulation time and shows that the duration and frequency of turnover affect the quantity of capital that must be advanced and the pace at which surplus value can be realized and recommitted (Marx 1993). Fixed capital creates additional temporal problems because machinery and infrastructure transfer value over extended periods while remaining materially committed to particular productive arrangements. Circulating components are renewed differently. Capital circulation therefore has a temporal architecture: delays, bottlenecks, inventories, credit arrangements, transport, payment practices, and the durability of fixed assets can affect reproduction even when the immediate production process is unchanged.

The distinction between circulation and exchange is consequently important. Exchange names a transaction between parties. Circulation concerns the connected movement through which capital changes form and returns to conditions from which another circuit can begin. A particular exchange may be successful while the wider circuit is interrupted. Conversely, institutions such as credit can temporarily bridge discontinuities by allowing production or purchase to proceed before previous values have been fully realized. Marx's circulation analysis therefore opens questions about synchronization, liquidity, turnover, temporal mismatch, and the dependence of productive activity on infrastructures that connect geographically separated moments of the circuit.

Harvey's Marxian reconstruction develops the spatial and temporal implications of this problem. *The Limits to Capital* treats capital accumulation as repeatedly encountering barriers connected to turnover, fixed capital, credit, spatial organization, and the geographical movement of investment (Harvey 1982). Built environments can facilitate accumulation while simultaneously fixing capital in long-lived spatial forms. Credit and finance can coordinate activity across time while also redistributing and intensifying risk. These arguments extend rather than replace Marx's circulation analysis: they ask how capital attempts to overcome spatial and temporal barriers by producing infrastructures and financial arrangements that themselves become conditions of later accumulation.

For Chapter 2, the principal inheritance is conceptual. Capital circulation makes economic continuity a problem of connected transformations rather than of repeated isolated exchange. It also makes time analytically endogenous to economic organization. The capacity to reproduce a process depends not only on quantities of inputs and outputs but on whether heterogeneous moments can be coordinated across

time, space, legal form, payment systems, and institutional infrastructures. Later GRE can ask more generally how relations enable or obstruct such transformations, but it should preserve the specific Marxian insight that circulation is a structured process with its own temporal conditions and points of interruption.

2.19.3 Accumulation and Reproduction

Accumulation adds a further dimension because capitalist reproduction ordinarily involves more than restoring an unchanged process. In simple reproduction, surplus is consumed while productive activity is renewed on approximately the same scale. Expanded reproduction requires part of the surplus to be converted into additional means of production and labor-power so that production can continue on an enlarged scale. Marx's reproduction schemes in Volume II examine this problem at the level of total social capital, dividing production into departments producing means of production and means of consumption and asking what proportional relations permit their outputs to be mutually renewed (Marx 1993).

These schemes alter the analytical unit. The reproduction of one individual capital does not guarantee the reproduction of the social process as a whole. One firm's output may be another firm's input; workers' consumption participates in the realization of consumer goods; replacement of machinery requires corresponding production elsewhere; and accumulation in one department changes demand for outputs produced in another. Reproduction thus concerns interdependence among capitals and sectors, not merely the successful continuation of each enterprise considered separately.

Marx's schemes also generated long-standing debates about realization, proportionality, and the sources of demand required for expanded accumulation. Luxemburg's *The Accumulation of Capital* famously argued that Marx's schemes did not adequately explain the realization of surplus value under expanded reproduction within a society composed only of capitalists and workers. She therefore gave non-capitalist environments an essential role in the historical expansion of capitalism and connected accumulation to imperial expansion and the incorporation of external social formations (Luxemburg 2003). Her solution has remained controversial, but the controversy itself is theoretically important because it shows that accumulation raises questions that cannot be reduced to production of surplus value alone.

Accumulation can therefore be approached through several non-equivalent problems. One concerns the production and reinvestment of surplus. Another concerns the realization of commodity values. A third concerns proportional relations among sectors. A fourth concerns the renewal and transformation of fixed capital. A fifth concerns access to labor-power, raw materials, land, credit, and markets. Marxian crisis theories have assigned different explanatory priority to profitability, realization, disproportionality, finance, overaccumulation, and class conflict. Chapter 2 should preserve that plurality rather than present reproduction theory as if it generated one universal crisis mechanism.

Reproduction is also transformative. Expanded accumulation can alter technical composition, firm scale, spatial organization, labor demand, class structure, and the infrastructures on which future production depends. The conditions renewed at the end of a circuit may therefore differ from those at its beginning. This point links reproduction to the process vocabulary reconstructed in Section 39: persistence is com-

patible with transformation because reproducing a system can involve changing the components and relations through which continuity is maintained. In Marxian theory, capitalist reproduction is especially dynamic because competitive accumulation continually pressures firms to reorganize production, reduce costs, alter technologies, and search for new fields of investment.

The foundational contribution is consequently wider than a model of steady-state renewal. Accumulation and reproduction direct attention to how economic processes regenerate their own conditions while changing scale, composition, and interdependence. Later GRE will require a more general vocabulary for generative relations, value conversion, and the transformation of the conditions of subsequent transformation. Section 48 does not introduce that vocabulary as if it were already contained in Marx. It identifies a prior theoretical achievement: Marxian political economy made the reproduction of the conditions of economic activity an explicit object of analysis.

2.19.4 Social Reproduction

The concept of social reproduction extends the problem beyond the renewal of industrial capital. Even Marx's economic analysis requires the recurrent availability of labor-power, means of subsistence, legal and monetary institutions, and social relations through which workers and owners re-enter the circuit. Later Marxist and feminist traditions ask more explicitly how these conditions are reproduced and how their costs are distributed. The extension is substantial because it moves attention from the continuity of capital to the reproduction of persons, capacities, institutions, and social relations that capitalist production presupposes.

Althusser formulates one influential version by arguing that every mode of production must reproduce the conditions of production, including productive forces and existing relations of production. His essay on ideological state apparatuses therefore links schools, families, legal institutions, political organizations, media, and other institutions to the reproduction of labor-power, skills, submission to rules, and social relations (Althusser 1971). This is not the same problem as Marx's reproduction schemes. Althusser is concerned with how a social formation reproduces the capacities and relations needed for its continued functioning, including ideological conditions that cannot be represented simply as flows between economic departments.

Feminist social-reproduction theory shifts the problem again. Vogel reconstructs Marxist theory around the production and reproduction of labor-power, asking how generational replacement, daily maintenance, domestic labor, households, and gender relations connect to capitalist production (Vogel 1983). Her unitary approach resists treating capitalism and patriarchy as entirely separate systems whose interaction must be explained only after each has been independently theorized. Instead, it examines how the reproduction of labor-power creates a necessary but historically variable relation between capitalist production and forms of socially organized reproductive labor.

This extension also reveals limits in analyses that treat the wage relation as if it contained all conditions needed for its own renewal. Labor-power must be maintained biologically and socially; new generations must be raised; people require care during childhood, illness, disability, and old age; capacities must be learned; and households and public institutions distribute these activities in historically variable ways. Some of this labor is commodified and waged, some organized through states, some

performed within households, and some sustained through communities or informal relations. The category of social reproduction therefore directs attention to activities whose economic importance may exceed their representation in market price or conventional production accounts.

Fraser broadens the argument still further by treating capitalist economy as dependent on background conditions that include social reproduction, ecological reproduction, and public power. Her proposal understands capitalism as an institutionalized social order whose officially economic mechanisms depend on domains that are institutionally differentiated from commodity production yet repeatedly drawn upon by accumulation (Fraser 2014). This perspective turns the boundary between production and its background conditions into a historical and political object. It also introduces the possibility that accumulation can destabilize the very reproductive capacities on which it depends.

These traditions should remain differentiated. Marx's reproduction of total social capital, Althusser's reproduction of productive and ideological conditions, Vogel's theory of the reproduction of labor-power, and Fraser's expanded account of capitalism's background conditions address overlapping but distinct problems. Section 51 will later examine care, feminist economics, and social-reproduction economics in greater depth. The present section needs only to establish why reproduction cannot be confined to the circulation of commodity values if the continued availability of persons, institutions, ecological conditions, and social capacities is part of the explanandum.

For later GRE, this literature provides an especially important warning. An economic process can appear self-reproducing when analytical boundaries externalize part of the work that renews its conditions. The relevant question is therefore not simply whether a circuit closes within a chosen model, but which conditions have been assumed, displaced, subsidized, depleted, or reproduced elsewhere. GR can later formulate this as a boundary-sensitive problem of generative dependence, but its foundation lies in long-standing Marxian and feminist disputes over what capitalist reproduction requires.

2.19.5 Contemporary Transformations of Capital

Post-Marxian theories have also asked how the forms through which capital circulates and reproduces itself change historically. The problem is not merely that capitalism expands quantitatively. Financial institutions, corporate organization, state capacities, global production networks, infrastructures, technologies, and forms of ownership can alter the routes through which value is advanced, realized, appropriated, and reinvested. The category of capital therefore remains historically specific even within capitalism: recurrent accumulation can transform the organizational forms through which later accumulation occurs.

Harvey's account emphasizes geographical and temporal reorganization. Capital seeks ways of overcoming barriers to accumulation through investment in infrastructures, urbanization, credit, geographical expansion, and other spatial-temporal arrangements (Harvey 1982). These arrangements can open new fields of accumulation while immobilizing resources in fixed capital and producing new dependencies. Spatial reorganization is therefore neither external to circulation nor a simple movement of already constituted economic entities across a neutral map. Capitalist development produces built environments, transport systems, property relations, and

credit structures that alter the conditions of later movement.

Arrighi places financial expansion within a much longer historical sequence. *The Long Twentieth Century* analyzes successive systemic cycles of accumulation in which material expansion and financial expansion are connected to changing centers of state and economic power (Arrighi 1994). His argument differs from Marx's reproduction schemes and from Harvey's geographical political economy, but it extends the circulation problem toward world-historical transformations in the organization of money, state power, and accumulation. Financial expansion becomes one recurrent phase within a historical pattern rather than simply a sectoral increase in banking activity.

The modern financialization literature further specifies changes in the sources and organization of profit. Krippner's historical sociology of the United States defines financialization through the growing importance of financial activities relative to production and traces this transformation through deregulation, international capital flows, and monetary-policy changes from the 1970s onward (Krippner 2011). Her explanation is especially useful because it resists treating financialization as an automatic technological stage. Policy responses to political and distributive dilemmas helped produce institutional changes whose cumulative consequences transformed the economy. Financialization can therefore be studied as historically generated rather than assumed as the inevitable maturation of capital.

Digital platforms introduce another organizational form. Srnicek describes platforms as businesses that provide infrastructures on which other actors interact and identifies data extraction, network effects, cross-subsidization, and platform control as characteristic features of several contemporary business models (Srnicek 2016). Platform capitalism does not abolish earlier problems of labor, ownership, circulation, competition, or finance. It changes some of the infrastructures through which transactions, attention, information, logistics, and market access are coordinated. A platform can therefore become both an intermediary within circulation and an object of accumulation whose control reorganizes relations among users, workers, advertisers, producers, and complementary firms.

These contemporary approaches do not form a single post-Marxian theory. Harvey emphasizes spatial and temporal barriers, Arrighi long systemic cycles and financial expansion, Krippner historically specific institutional financialization, and Srnicek platform-centered business models. Their scales, mechanisms, and explanatory commitments differ. Taken together, however, they sustain the older Marxian question in a transformed context: capital is reproduced through historically variable organizational and institutional forms, and those forms can change the conditions under which subsequent accumulation occurs.

Several distinctions can therefore be carried forward. Capital circulation is not identical to commodity exchange. Accumulation is not identical to a larger stock of physical assets. Reproduction is not equivalent to equilibrium or stasis. Social reproduction is not reducible to the reproduction of total social capital. Financialization and platformization are historically specific transformations rather than universal stages through which every economy must pass. Each concept identifies a different mechanism through which continuity and transformation can become connected.

The restrained GR/GRE inheritance lies in this connection between circulation, reproduction, and transformation. Marxian and post-Marxian theories make it possible to ask how value forms, temporal circuits, sectoral interdependencies, labor-power,

institutions, infrastructures, and background conditions are renewed through economic activity and how that renewal alters the conditions of the next cycle. Later GRE can extend the problem toward heterogeneous value conversion, generative return, capture, dissipation, regeneration, and relations that transform the mechanisms of subsequent relation formation. That extension should remain analytically distinguishable from the traditions reconstructed here. The achievement of the Marxian lineage is prior and foundational: it makes the reproduction of economic and social conditions, rather than production of outputs alone, a central object of political-economic inquiry.

2.20 Institutional Economics and Economic Sociology

Sections 45–48 reconstructed several major economic lineages through wealth, allocation, historical materialism, circulation, and reproduction. The present section turns to traditions that made the institutional and social organization of economic action itself a primary object of inquiry. Its role is to recover the conceptual resources through which economists and sociologists came to analyze firms, rules, conventions, networks, trust, collective action, organizational fields, and historically persistent institutional arrangements as constitutive conditions of economic coordination rather than as residual background. Its objective is genealogical rather than synthetic. Old institutional economics, new institutional economics, economic sociology, and sociological institutionalism differ in their units of analysis, explanatory mechanisms, and assumptions about action. The discussion therefore proceeds through institutions and coordination, rules and conventions, embeddedness, trust and social capital, and institutional change before identifying a limited inheritance for later GR and GRE.

The term *institution* is unusually heterogeneous across these traditions. For Commons, institutions are forms of collective action that control, liberate, and expand individual action; for North, they are humanly devised constraints structuring interaction; for Williamson, the institutional environment must be distinguished from governance arrangements; for Ostrom, rules-in-use configure action situations and collective governance; and in sociological institutionalism, institutional environments can shape organizational forms through legitimacy, professionalization, imitation, and normative expectation. Economic sociology introduces a further shift by asking how ostensibly economic action remains embedded in social relations and networks. These approaches overlap in rejecting an economy composed only of isolated choices under fixed rules, yet they should not be treated as equivalent theories of institutions.

2.20.1 Institutions and Economic Coordination

American institutional economics developed partly through dissatisfaction with economic theory that treated preferences, technologies, and institutional settings as fixed givens. Veblen's 1898 critique of economics as insufficiently evolutionary called for an account of economic life as a cumulative process in which habits of thought, institutions, technologies, and conduct develop historically rather than appearing as timeless elements of a static taxonomy (Veblen 1898). His institutionalism therefore differs from later approaches that introduce institutions chiefly as constraints surrounding otherwise stable optimizing agents. Institutions, habits, and technological practices participate in the formation of economic conduct itself.

Commons developed a different institutionalist architecture. In his account, the relevant unit is not merely an isolated individual or commodity but the *transaction*, situated within working rules and collective action. Institutions organize bargaining, managerial, and rationing transactions; collective action can constrain individual conduct while also enabling capacities that isolated actors would not possess (Commons 1931). This perspective places law, custom, organizations, bargaining power, and authorized forms of collective control inside economic analysis. Coordination is therefore neither reducible to prices nor external to legal and organizational arrangements.

The later new institutional economics begins from a different analytical starting point. Coase's theory of the firm asks why economic coordination occurs through firms when market exchange is available and identifies costs associated with using the price mechanism as part of the answer (Coase 1937). The firm can thereby be studied as an alternative coordination arrangement rather than simply as a production function. Williamson extends this line by treating firms and contracts as governance structures and distinguishing the broader institutional environment from more immediate institutions of governance (Williamson 2000). Transaction characteristics, contractual incompleteness, adaptation, and governance become central to explaining why different forms of coordination arise.

North similarly makes institutions central to economic performance, defining them as humanly devised constraints that structure interaction and shape incentives under uncertainty (North 1990). His framework differs from Commons's transaction-centered institutionalism and from Veblen's evolutionary emphasis on habituation. It is nevertheless important for the transition from allocation under fixed rules to analysis of the rules themselves. Property rights, political arrangements, enforcement, informal constraints, and organizations can influence the costs and possibilities of exchange, investment, and coordination over long periods.

Ostrom's institutional analysis further expands the range of coordination arrangements. Her studies of common-pool resources show that durable governance need not be represented through a simple opposition between private markets and centralized state command. Communities can construct monitoring arrangements, rules, sanctions, conflict-resolution procedures, and nested forms of governance adapted to particular resource conditions (Ostrom 1990). Her later Institutional Analysis and Development framework treats rules, community attributes, material conditions, and action situations as analytically separable components whose configurations shape interaction (Ostrom 2005). The foundational lesson is not that one institutional form is universally superior. It is that coordination problems can be organized through heterogeneous institutional architectures whose performance depends on context, rule configuration, information, enforcement, and participant capacities.

These traditions thus enlarge the concept of economic coordination beyond price-mediated allocation. Markets, firms, associations, households, public agencies, commons, contracts, and hybrid arrangements can all coordinate economic activity, while the rules under which they operate remain part of the explanation. For later GRE, this inheritance is important because it permits economic architecture to be treated as an object of inquiry. The present section does not yet ask how such architectures are generatively produced; it establishes first that economic outcomes cannot always be explained adequately while institutional forms are held constant.

2.20.2 Rules, Conventions, and Economic Action

Institutional analysis also changes the status of rules. In a purely parametric representation, rules can appear as fixed external restrictions on action. Institutional theories instead ask how rules are recognized, interpreted, enforced, contested, and reproduced in practice. Commons's *working rules* are especially important in this respect: they emerge from collective action and define practical permissions, duties, powers, exposures, and expectations within transactions (Commons 1931). Economic conduct therefore depends on an organized normative and legal environment rather than on material incentives alone.

North distinguishes formal rules from informal constraints and emphasizes that both can structure incentives and expectations (North 1990). Formal constitutional or legal change can occur rapidly, while informal conventions, norms, and enforcement practices may change slowly. This difference helps explain why formally similar rules can produce different outcomes across societies and why institutional reform cannot be inferred from legislative text alone. The effective institution includes the relation between written rules, informal expectations, enforcement, and organizations capable of acting upon them.

Ostrom provides a still more fine-grained account by distinguishing rules-in-form from rules-in-use and by analyzing how different rule types configure positions, boundaries, choices, information, payoffs, and aggregation within action situations (Ostrom 2005). Rules are consequently neither mere descriptions of repeated behavior nor simply commands backed by centralized sanction. Their operation depends on shared understanding, monitoring, enforcement, and the practical setting in which participants interpret them. Institutional diversity arises partly because different communities combine these elements differently.

Economic sociology and organizational theory add a further dimension: action can be oriented toward legitimacy and convention as well as calculable efficiency. DiMaggio and Powell's analysis of organizational fields identifies coercive, mimetic, and normative processes through which organizations become more similar even when similarity cannot be explained solely by competitive efficiency (DiMaggio and Powell 1983). Dependence on states or powerful organizations, uncertainty that encourages imitation, and professional norms can all stabilize organizational forms. Institutional regularity may therefore be reproduced because an arrangement is taken as legitimate, normal, or professionally appropriate rather than because each participant has independently calculated it to be technically optimal.

This literature requires a distinction among *rule*, *convention*, *norm*, and *institution*. A rule specifies or structures conduct; a convention may stabilize mutual expectations around one among several possible practices; a norm adds social expectations and evaluative force; an institution can incorporate rules, conventions, roles, enforcement, symbolic classifications, and organizational capacities. The categories overlap in particular cases but are not synonyms. An institution may contain explicit rules while depending on informal conventions for interpretation, and a convention can remain operative without becoming a legally codified rule.

For later GR and GRE, the important inheritance concerns the practical generation of regularity. Economic action occurs within fields of permissions, expectations, classifications, and institutionalized meanings that can shape which actions are intelligible, feasible, legitimate, or sanctionable. Chapter 2 should not yet convert this obser-

vation into a general generative theory. Its foundational task is to establish that rule-governed economic action cannot be understood fully by observing choices while ignoring the historically formed rule systems and interpretive practices through which those choices become possible.

2.20.3 Embeddedness

The concept of embeddedness connects institutional economics to economic sociology, but it carries more than one historical meaning. Polanyi's account of the *great transformation* argues that the self-regulating market represents a historically specific institutional project in which land, labor, and money are increasingly organized through market mechanisms. Earlier economies, in his reconstruction, were more visibly instituted through reciprocity, redistribution, householding, political authority, and social obligation; the nineteenth-century market order attempted an exceptional degree of institutional separation of economic processes from other social relations (Polanyi 1944). Embeddedness here concerns the institutional place of the economy within society and the historical transformation of that relation.

Granovetter's influential 1985 formulation addresses a different problem. His target is both an undersocialized image of atomized actors and an oversocialized image in which behavior follows internalized norms independently of concrete relational structure. Economic action, he argues, is embedded in ongoing networks of social relations (Granovetter 1985). Trust, information, reputation, opportunism, and access to opportunities can depend on actual patterns of interpersonal and interorganizational connection. The concept therefore moves from a macrohistorical question about the institution of the economy toward a relational account of action within social networks.

These two meanings should not be collapsed. Polanyi's embeddedness concerns the historical-institutional organization of economy and society; Granovetter's concerns the relational location of action within concrete social ties. They can complement one another, but they answer different questions. A market can be institutionally central within a society while individual transactions remain deeply network-embedded. Conversely, identifying dense networks does not by itself explain the legal, political, and institutional order through which markets are constituted.

Network organization also complicates the classical market-hierarchy dichotomy. Powell identifies network forms characterized by recurrent exchange, reciprocal communication, reputation, and interdependence that are not well described as either discrete market transactions or hierarchical command (Powell 1990). Networks can support learning, joint problem solving, and coordination where knowledge is distributed and relationships are persistent. Their operation depends on social structure, however, and does not imply harmony: network position can create exclusion, dependency, brokerage advantages, and unequal access.

Embeddedness therefore changes the object of economic explanation. Prices and contracts remain important, but their effects may depend on who is connected to whom, which relations carry information, how reputation travels, what institutional environments authorize exchange, and which actors can enter relevant networks. The concept also limits methodological individualism without requiring the disappearance of individual agency. Actors choose and strategize, yet they do so from positions in relational structures that shape information, expectations, opportunities, and

exposure to sanctions.

The later GR/GRE significance is again prospective. Embeddedness provides a foundation for treating economic action as relationally situated, but it does not yet establish a theory of how actors and networks co-generate one another, how relations among networks form, or how economic fields transform over time. Those stronger questions belong to later sections. Here the lineage establishes that the economic actor cannot always be modeled adequately as if social relations entered only after preferences and opportunities were already formed.

2.20.4 Trust, Reciprocity, and Social Capital

Institutional coordination often depends on expectations that cannot be reduced to complete contracts or continuous external enforcement. Trust, reciprocity, reputation, and social capital became important concepts for explaining how cooperation can be sustained when monitoring is costly, information is incomplete, or future inter-action matters. These concepts are related but analytically distinct. Trust concerns an expectation that vulnerability will not be exploited under specified conditions; reciprocity concerns patterns of response to prior action; reputation concerns socially transmitted information about past conduct; social capital refers to resources made available through social relations and structures.

Coleman's formulation of social capital is deliberately positioned between rational action and social structure. He treats social capital as a resource for action located in relations among persons rather than as a property contained within an isolated individual. Obligations and expectations, information channels, social norms, and structural closure can make certain actions possible or less costly (Coleman 1988). The concept therefore illustrates a broader analytical move important for economic sociology: resources can be relationally located. Two actors with similar individual attributes may possess different capacities because their positions in networks of obligation, information, and trust differ.

Ostrom's behavioral research on collective action gives trust and reciprocity a more explicitly dynamic role. Experimental and field evidence led her to criticize models that rely exclusively on narrowly self-interested complete rationality in social dilemmas. Reciprocity, reputation, and trust can reinforce one another and help participants sustain cooperation under conditions in which short-run incentives alone would predict defection (Ostrom 1998). The mechanism is conditional rather than universal. Trust can be destroyed; reciprocity can be negative; reputations can be manipulated; and cooperative arrangements can fail when monitoring, communication, or sanctioning conditions deteriorate.

Granovetter's network account also helps explain why trust is neither simply a moral disposition nor a substitute for structure. Ongoing relations can generate information about conduct and raise the costs of opportunism, but the same embedded relations can support fraud, collusion, exclusion, or capture (Granovetter 1985). Dense social connection is therefore not equivalent to desirable coordination. Similarly, Powell's network forms depend on reputation and recurrent ties, yet their effectiveness is contingent on the distribution of knowledge, dependence, and relational position (Powell 1990).

The social-capital literature consequently introduces a normative caution. If social capital is defined only by its capacity to facilitate action, then the actions facilitated

may benefit one group while excluding others. Closure can strengthen internal cooperation while raising barriers to outsiders. Trust within a network can coexist with distrust across networks. Reciprocity can reproduce unequal obligations. The existence of relational resources therefore does not itself establish justice, efficiency, or social desirability.

For GRE, these traditions are foundational because they show that economically consequential capacities can emerge from relations rather than being reducible to assets owned by isolated agents. They also provide early examples of self-reinforcing relational dynamics: repeated trustworthy conduct can support reputation, reputation can support trust, and trust can make further cooperation possible. Chapter 2 should nevertheless resist turning that pattern immediately into GR's later theory of relational attractors or self-reinforcing realities. At this stage, the literature establishes the mechanisms and empirical objects from which such later questions can responsibly develop.

2.20.5 Institutional Change and Path Dependence

Institutional theory must explain persistence without treating institutions as immutable. North places institutional change at the center of long-run economic performance and emphasizes the interaction of formal rules, informal constraints, organizations, incentives, and learning (North 1990). Organizations adapt within an institutional framework while also becoming agents of institutional change. Because present choices are made under inherited rules and beliefs, institutional development is cumulative: existing arrangements shape the costs and possibilities of changing them.

The economics of path dependence provides more specific mechanisms for such historical dependence. David's analysis of QWERTY emphasizes technical interrelatedness, scale economies, and quasi-irreversibility as mechanisms through which early sequences can affect later technological trajectories (David 1985). Arthur formalizes related processes in settings with increasing returns, where adoption can reinforce the attractiveness of an already selected technology and make historically contingent events consequential for later outcomes (Arthur 1989). These contributions concern technology selection rather than institutions in general, but they provide analytical resources for distinguishing path dependence from the weaker claim that history matters.

Pierson extends increasing-return reasoning into political and institutional development, emphasizing timing, sequence, coordination effects, adaptive expectations, and the costs of reversing established arrangements (Pierson 2000). Institutional persistence can thus arise because an arrangement generates constituencies, complementary organizations, learned practices, sunk investments, or expectations that make alternative trajectories progressively more costly. Path dependence does not mean that change is impossible; it means that the probability and cost of later transitions depend partly on the sequence through which the current arrangement was produced.

Sociological institutionalism identifies different mechanisms of persistence and change. DiMaggio and Powell show that organizational similarity can emerge through coercive, mimetic, and normative pressures within organizational fields (DiMaggio and Powell 1983). Such processes can stabilize forms that actors adopt for

legitimacy or uncertainty reduction rather than because they are uniquely efficient. Institutional change may therefore involve shifts in professional standards, regulatory environments, field composition, models available for imitation, or the sources from which legitimacy is conferred.

Old institutionalism adds another historical dimension. Veblen's evolutionary orientation treats habits, institutions, technologies, and economic conduct as mutually conditioning elements of cumulative change (Veblen 1898). Commons places conflict, bargaining, legal development, and collective action inside institutional evolution (Commons 1931). These approaches do not offer the same mechanism as increasing-return models. Their importance lies in refusing to treat institutional change as an external shock applied to an otherwise stationary economy.

The conceptual inheritance for later GR and GRE can therefore be stated cautiously. Institutional economics and economic sociology establish that economic action is coordinated through historically variable architectures of rules, organizations, networks, expectations, authority, and relational resources. They also show that these architectures can persist through feedback, legitimacy, learning, complementarity, reputation, and increasing returns while remaining open to conflict and transformation. What they do not jointly provide is one unified account of how institutions, actors, relations, and capacities generate one another across levels. Later GR may formulate that broader problem, while GRE can ask how institutional configurations transform economic possibility, value creation, access, coordination, and distribution. The foundation supplied here is prior and more modest: institutions and social relations are constitutive explanatory objects, and their histories belong inside economic analysis rather than outside it.

2.21 Relational Sociology and Social Field Theory

Section 49 established that institutions, rules, conventions, networks, and relational resources can belong inside economic explanation rather than being treated as an external social background. The present section turns to sociological traditions that make relations and positions still more explicit objects of analysis. Its role is to reconstruct the intellectual resources through which actors, identities, structures, fields, and power came to be understood through patterns of interdependence rather than through attributes alone. Its objective is genealogical. Relational sociology, network analysis, figurational sociology, Bourdieuan field theory, and strategic-action-field theory do not share one ontology or one method. The discussion therefore proceeds through the relational constitution of actors, positions and structures, social fields, power, and dynamic multilevel relations before identifying a limited inheritance for later GR and GRE.

The vocabulary of this literature requires restraint because several terms can appear similar while carrying different theoretical commitments. A *relation* may refer to an interaction, an interdependence, a social tie, a structural equivalence, a constitutive dependence, or a position within a field. A *network* represents actors and ties without necessarily specifying a field's stakes, rules, or forms of capital. A *field* identifies a structured social arena in which positions acquire meaning through relations to other positions, but field theories differ over the mechanisms that generate action and change. Relational analysis can therefore challenge substantialist explanation with-

out committing sociology to a relation-only metaphysics. The value of the lineage lies in the analytical shift from isolated attributes toward patterned dependence, position, and interaction.

2.21.1 Relational Constitution of Social Actors

One important precursor appears in Simmel's attempt to define a distinctive object for sociology. Rather than treating society as an entity standing above individuals, Simmel analyzed recurrent *forms of interaction* through which association becomes socially patterned. Exchange, conflict, domination, sociability, group membership, and social types such as the stranger are intelligible through relations among participants and through the forms those relations assume (Simmel 1971). This does not dissolve individuals into relations. Simmel's work instead makes individuality and association mutually relevant: participation in multiple circles of interaction can differentiate persons while simultaneously locating them within social forms.

Elias develops a more explicitly processual rejection of the opposition between isolated individual and external society. His concept of *figuration* directs attention to changing configurations of interdependent people whose actions constrain and enable one another over time (Elias 1978). Individuals possess relative autonomy, but their opportunities, dependencies, habits, and power chances are formed within webs of interdependence that no single participant controls. A figuration can persist while particular participants change, yet it cannot exist independently of interdependent people altogether. Elias consequently provides a relational language that is neither methodological individualism nor a reification of society as a supra-individual substance.

These ideas become more explicit in later relational sociology. Emirbayer contrasts substantialist approaches, which begin from pre-given entities bearing properties, with relational approaches that treat social processes and transactions as primary explanatory objects (Emirbayer 1997). His intervention is methodological and programmatic rather than a single empirical theory. The important inheritance is the demand that actors and social units should not always be assumed to possess all analytically relevant identities and capacities prior to the relations under investigation. Some properties may be constituted, activated, or transformed through transactions.

Harrison White's network sociology develops a different mechanism. In *Identity and Control*, identities and social formations emerge under conditions of uncertainty through attempts at control, interaction, and networked social organization (White 2008). Here an identity is not merely an inner essence later connected to other identities. Social formations arise through recurrent relations, stories, disciplines, and control efforts. White's framework is considerably more specific than the general claim that persons are relationally constituted; it supplies a network-oriented account of how identities and social forms can stabilize and shift.

These traditions establish several possible meanings of relational constitution. Simmel emphasizes forms of interaction; Elias emphasizes interdependence and long-term figurations; Emirbayer emphasizes transactional and processual explanation; White develops identities and control within networked formations. They should not be collapsed into one thesis that actors have no properties apart from relations. A more defensible foundation is conditional: some identities, capacities, dispositions, opportunities, and constraints can only be adequately explained when the relations

through which they are produced or sustained are included in the analysis.

For later GRE, this matters because economic actors need not always enter analysis as fully constituted bearers of fixed preferences and capacities. Employment relations can form skills and expectations; credit relations can reorganize future options; organizational membership can confer authority; markets can classify participants and create reputational identities. The present chapter does not yet offer a GR theory of actor generation. It establishes that sociology already contains substantial resources for treating actorhood itself as partly relationally conditioned.

2.21.2 Positions and Relational Structures

A second lineage shifts attention from direct interaction to *position*. Network analysis is important because it distinguishes a person's attributes from the person's location within a patterned set of relations. Wellman's formulation of network analysis emphasizes structured relations among individuals and collectivities, complex network patterns, boundaries, clusters, reciprocal ties, and systems of power and dependency rather than aggregate characteristics considered independently of connection (Wellman 1983). A relational structure can therefore generate differences among actors who appear similar when described only by individual attributes.

Breiger's analysis of the duality of persons and groups provides an especially clear example. Shared memberships generate a dual structure: persons are related through the groups in which they participate, while groups are related through overlapping memberships (Breiger 1974). The same membership data can consequently be viewed from the side of actors or collectivities. This does not imply that persons and groups are ontologically identical. It demonstrates that one relational system can produce analytically linked structures at more than one level.

White, Boorman, and Breiger extend network analysis from individual ties toward roles and positions. Their blockmodel approach identifies sets of actors occupying similar relational locations across multiple types of ties and uses those patterns to interpret role and position structures (White et al. 1976). Position is therefore not simply rank on a scalar hierarchy. It can refer to a pattern of relations connecting one class of actors to other classes of actors. Two persons can occupy structurally similar positions even when they are not directly connected to one another.

This distinction between tie and position is foundational. A tie records or represents a specified relation between actors. A position summarizes how an actor or class of actors is situated within a broader relational pattern. A structure organizes multiple positions and relations. None of these concepts by itself establishes the meaning, legitimacy, or causal mechanism of the relation observed. A friendship network, interlocking directorate network, supply network, communication network, and authority structure can share formal properties while differing substantially in social content.

Bourdieu's relational sociology approaches position through a different theoretical architecture. His work links objective positions, distributions of forms of capital, habitus, and practice rather than treating social structure as a network of observed ties alone. Bourdieu and Wacquant explicitly describe this orientation as methodological relationalism and make "thinking relationally" central to sociological analysis (Bourdieu and Wacquant 1992). Positions gain significance through differences and relations within a structured space; the effects of capital depend on the field in which it

is recognized and can be mobilized. This produces a relational theory of social differentiation that cannot be reduced to network topology.

The distinction among *tie*, *position*, *role*, *structure*, and *field position* should therefore remain explicit. Network analysis often reconstructs position from patterned ties. Bourdieu reconstructs positions through distributions of capital and relations within fields. Elias describes power chances within changing figurations. These approaches can sometimes illuminate the same empirical object, but they encode different explanatory questions.

For economic analysis, the implication is substantial. A firm's capabilities cannot always be inferred from its internal assets if access to suppliers, information, finance, standards, distribution channels, or political authority depends on relational position. Likewise, a worker's opportunities can depend on network location, organizational membership, occupational field, credential recognition, or bargaining position. Relational structure thus adds a level of explanation between individual attributes and aggregate outcomes without requiring that every economic phenomenon be re-described as a network.

2.21.3 Social Fields

Field theory introduces a different way of organizing relational explanation. In Bourdieu's sociology, a field is a relatively structured arena of positions and position-takings in which actors and institutions struggle over stakes and over the forms of capital that possess efficacy within that arena. Field, habitus, and capital are mutually articulated rather than independent variables added after the fact (Bourdieu and Wacquant 1992). An actor's practices depend partly on dispositions acquired through history and partly on the actor's current position within a field whose structure is itself historically produced.

This approach prevents field from becoming a synonym for social context. A field has differentiated positions, stakes, distributions of resources, principles of evaluation, and forms of struggle. The same resource may possess different value across fields because recognition and convertibility vary. Cultural capital, scientific authority, economic capital, legal competence, or political access do not operate identically in every arena. Field analysis therefore links relational position to historically specific rules of relevance and forms of power.

Martin's reconstruction of field theory helps clarify the general explanatory ambition while also revealing its limits. He describes field theory as explaining regularities in action through an actor's position relative to others, with field forces understood through the structured relations of the field rather than as external commands alone (Martin 2003). His analysis also emphasizes that "field theory" names a family of approaches rather than one fully standardized model. Physical-field metaphors can be analytically productive, but sociological fields do not automatically inherit the mathematical or ontological properties of physical fields.

Fligstein and McAdam develop another field tradition through the concept of the *strategic action field*. Their framework describes mesolevel social orders in which actors possess shared understandings about purposes, positions, rules, and legitimate action, while incumbents and challengers occupy asymmetrical locations (Fligstein and McAdam 2012). Social skill concerns the capacity to induce cooperation and construct shared meanings. Fields can emerge, stabilize, enter crisis, and transform; they

can also be embedded within wider systems of fields rather than existing as isolated arenas.

The Bourdieuan and strategic-action-field traditions overlap in taking mesolevel relational arenas seriously, but they differ in vocabulary and emphasis. Bourdieu gives sustained attention to habitus, capital, symbolic power, reproduction, and the homology between social and mental structures. Fligstein and McAdam emphasize incumbents, challengers, governance units, social skill, exogenous shocks, field settlements, and inter-field dependence. Treating them as interchangeable would hide the theoretical work done by those differences.

Several conceptual separations follow. A field is not merely a network because field analysis usually includes stakes, evaluative principles, positions, and forms of power in addition to ties. A field is not simply an institution because multiple institutions and organizations may inhabit one field, while a single organization can participate in several fields. A field is not equivalent to a market, although markets can be studied as fields. Finally, field language does not establish that all social reality is field-structured.

For GRE, field theory supplies a useful foundation for examining economic arenas in which value, legitimacy, competence, and authority depend on position and on historically formed rules of recognition. Yet Chapter 2 should stop before converting this foundation into GR's later field-governance language. The established literature first shows that economic possibilities can be organized through structured arenas whose participants, stakes, and resources acquire meaning relationally.

2.21.4 Power and Relational Position

Relational sociology also changes the analysis of power. If opportunities and constraints depend on position, power cannot always be represented as a quantity possessed independently by an actor. Elias treats power through changing balances of dependence within figurations. Because interdependent actors need resources or actions from one another to different degrees, power differentials emerge from asymmetric dependencies rather than from an attribute called power residing inside one party (Elias 1978). The balance can change when dependencies, coalitions, alternatives, or institutional arrangements change.

Network analysis offers related but more formal possibilities. A position can matter because it controls access, bridges otherwise separated groups, lies on important paths of communication, or belongs to a structurally advantaged pattern of relations. Wellman's network perspective explicitly includes power, dependency, and coordination among the problems that relational structures can illuminate (Wellman 1983). Such accounts need not claim that network position exhausts power. Legal authority, material force, ownership, expertise, ideology, and institutional rules can generate power through mechanisms not reducible to topology.

Bourdieu develops power through field-specific and convertible forms of capital. Economic, cultural, social, and symbolic resources become effective according to the structure and history of the field, while symbolic power depends partly on recognition and misrecognition of legitimate classifications (Bourdieu and Wacquant 1992). Power is therefore relational in at least two senses: the value of resources depends on a structured arena, and domination concerns the relative positions from which actors can define legitimate distinctions, categories, and stakes.

Fligstein and McAdam place positional asymmetry directly inside strategic action fields. Incumbents generally possess greater influence over the existing settlement, while challengers have less advantageous positions; internal governance units can help reproduce field rules and stability (Fligstein and McAdam 2012). Their account nevertheless allows for transformation. Crisis, external change, shifts in allied fields, and strategic action can destabilize established positions and alter the settlement through which advantages were reproduced.

These traditions support a careful distinction between *resources* and *relational power*. Resources can contribute to power, but their efficacy depends on recognized rights, dependencies, alternatives, institutional location, and field-specific convertibility. Conversely, relational advantage may persist even when no single actor consciously designed it. A supplier occupying a bottleneck position, a platform controlling access to a user base, a credentialing organization defining entry standards, or a central bank possessing legally constituted authority may exercise very different kinds of power despite all being describable through asymmetric relations.

The normative implication should remain separate from the explanatory claim. Relational power is not inherently unjust, and relational dependence is not automatically domination. Some asymmetries may be temporary, functionally necessary, democratically authorized, or compensated by countervailing relations. Others can become extractive, exclusionary, or self-reinforcing. Chapter 2 therefore establishes analytical resources for identifying relational power without yet supplying GRE's normative theory of power, exploitation, or justice.

2.21.5 Dynamic and Multilevel Social Relations

The final foundation concerns dynamics and levels. Relational analysis becomes especially important when relations are changing, when actors participate in multiple structures simultaneously, and when processes at one level modify structures at another. Elias's figurational sociology is inherently dynamic: interdependencies, power balances, standards of conduct, personality structures, and state formation develop over long temporal sequences rather than remaining fixed while actors move within them (Elias 1978). This processual orientation resists the tendency to turn a snapshot of relations into a timeless structure.

Network sociology similarly provides tools for moving between levels. Breiger's person-group duality shows that membership relations can simultaneously generate structures among persons and among groups (Breiger 1974). White, Boorman, and Breiger show how multiple ties can be aggregated into role and position structures (White et al. 1976). White's later theory makes emergence itself central by examining how identities and social formations develop through recurrent networked processes (White 2008). These approaches differ, but all challenge a simple division in which micro actors and macro structures belong to disconnected analytical worlds.

Field theory adds another multilevel vocabulary. Bourdieu connects embodied dispositions, practices, positions, fields, and wider distributions of capital without reducing one level mechanically to another (Bourdieu and Wacquant 1992). Fligstein and McAdam explicitly place strategic action fields inside broader systems of fields, allowing changes in states, markets, professions, movements, or neighboring organizational arenas to alter the stability of a focal field (Fligstein and McAdam 2012). A social order can therefore be locally stable while remaining dependent on relations

extending beyond its apparent boundary.

This literature also warns against treating boundaries as self-evident. Network boundaries depend on which relations and actors are included. Field boundaries can be contested and historically variable. Organizational membership can connect actors across fields. Economic relations can cross legal jurisdictions and political boundaries. Multilevel analysis therefore requires explicit decisions about scale and boundary rather than assuming that “the market,” “the organization,” “the class,” or “society” is naturally given as the correct unit.

The broad relational inheritance can now be stated without collapsing its components. Simmel provides forms of interaction; Elias figurations and changing interdependence; network sociology ties, positions, structural equivalence, and person–group dualities; Bourdieu fields, capital, habitus, and symbolic power; Emirbayer a programmatic defense of relational and transactional explanation; and Fligstein and McAdam a theory of strategic action fields embedded within wider field systems. These traditions converge on the inadequacy of explaining social life solely through isolated attributes, yet they diverge over ontology, mechanism, method, scale, and the role of culture and agency.

For later GR and GRE, this is an important but limited foundation. The literature makes it possible to ask how actors, capacities, positions, and opportunities depend on relational configurations; how one relation alters the effects of another; how structures persist while their participants change; and how local fields are affected by wider systems. GR can later formulate stronger questions concerning relations that generate other relations, changes in the rules of relation formation, and cross-level generative feedback. GRE can investigate how those processes organize production, exchange, valuation, power, and access. None of those later moves follows automatically from relational sociology or field theory. The contribution of the present section is prior: social actors and economic possibilities can be constituted and differentiated through dynamic relational positions whose explanatory significance cannot always be recovered from isolated properties alone.

2.22 Capability and Human Development Approaches

The preceding sections reconstructed traditions that place economic action within institutions, relations, positions, and social fields. Capability and human-development approaches shift the evaluative question in another direction. Their central concern is whether resources, incomes, rights, services, and institutional arrangements become effective opportunities for persons to live forms of life they have reason to value. The role of this section is to reconstruct the intellectual foundations of that shift. Its objective is not to present the capability approach as a completed theory of development or as an early version of GRE, but to clarify the distinctions through which resources, capabilities, functionings, freedom, agency, and institutional conditions became analytically separable. The discussion proceeds from resources and conversion factors to capabilities, achieved functionings, freedom and opportunity, and the institutional conditions under which capabilities are formed and sustained.

The literature contains several related but non-identical projects. Sen develops the capability approach as an evaluative framework concerned with substantive freedom and human diversity rather than a fixed comprehensive doctrine of the good

(Sen 1985; Sen 1992; Sen 1999). Nussbaum develops a more specified philosophical version oriented toward central human capabilities, thresholds, dignity, and political principles (Nussbaum 2000). The human-development tradition associated with the United Nations Development Programme translates related concerns into a broad policy framework in which development concerns people's opportunities and choices rather than aggregate income alone (United Nations Development Programme 1990). Alkire and later capability scholarship examine how such a deliberately plural framework can be operationalized without reducing it to one scalar measure (Alkire 2002; Robeyns 2005). These lineages overlap substantially, but their differences over specification, valuation, measurement, and political justification should remain visible.

2.22.1 Resources and Conversion Factors

A foundational move in the capability literature is the distinction between the possession of resources and the effective opportunities resources make possible. In *Commodities and Capabilities*, Sen redirects welfare analysis from commodities or utility toward what a person is able to do or be with the means available to that person (Sen 1985). Two persons with the same commodity bundle can obtain different practical possibilities from it because bodies, environments, social norms, public services, family arrangements, and other circumstances affect how resources can be converted into valuable states and activities. Equality of resources can therefore coexist with substantial inequality in effective opportunity.

The distinction develops a problem already visible in Sen's earlier entitlement analysis. Access to food, income, or other goods does not depend simply on aggregate availability; it depends on the relations through which people can command resources (Sen 1981). The capability approach extends the evaluative question further. Even where a person possesses a resource, the resource's contribution to life depends on what that person can actually make of it. A bicycle can provide mobility for one person while being unusable by another because of bodily impairment, unsafe infrastructure, prohibitive social norms, or an absence of accessible roads. The same nominal resource can therefore have heterogeneous consequences across persons and settings.

Later capability literature commonly organizes these differences through the language of *conversion factors*. Robeyns distinguishes personal, social, and environmental factors that mediate conversion from means into effective opportunities and achieved functionings (Robeyns 2005). Personal conversion factors include bodily condition, age, skills, and other individual characteristics. Social conversion factors include norms, discrimination, institutions, power relations, and public policies. Environmental conversion factors include geographical, infrastructural, ecological, and technological conditions. This classification is analytical rather than exhaustive. Its significance lies in preventing resource possession from being treated as if it were already a sufficient description of practical freedom.

This shift also separates the capability approach from a narrow interpretation of human capital. Education and health can increase productive capacities and earnings, but their significance need not be exhausted by their contribution to output. Sen's development framework treats education, health, political participation, and social opportunity as constitutive of substantive freedom as well as potentially instrumental to economic performance (Sen 1999). A person's literacy may increase

productivity, but it can also enlarge communication, political participation, access to knowledge, self-direction, and the range of lives the person can realistically pursue.

The analytical implication is precise. Resources are important, but they are generally *means* whose significance depends on conversion conditions. Conversion factors are not themselves automatically capabilities; they help determine whether particular capabilities become available. This prevents three levels from being conflated: what a person possesses, the conditions under which those means can be used, and the effective opportunities that result. For later economic analysis, this is a major conceptual inheritance because distributions of nominal resources cannot by themselves describe distributions of effective economic possibility.

2.22.2 Capabilities

A *capability* concerns a person's genuine opportunity to achieve valuable beings and doings. Sen's language is deliberately oriented toward substantive freedom rather than a simple inventory of internal attributes (Sen 1992; Sen 1999). Capability therefore should not be reduced to skill, competence, talent, or human capital. A person may possess a skill without having the social permission, material support, legal standing, institutional access, or environmental conditions required to exercise it. Conversely, institutions can sometimes create an effective opportunity even where the relevant opportunity does not arise from an individually possessed skill.

The idea of a capability set makes the distinction especially clear. Evaluation can concern not only the life actually achieved but also the feasible combinations of functionings from which a person can choose (Sen 1985; Sen 1992). Two people may display the same observed functioning while possessing very different alternatives. A person who fasts despite having adequate food and a person who is involuntarily hungry can share a similar nutritional outcome while differing radically in freedom. The capability perspective therefore gives evaluative significance to the opportunity set behind an observed achievement.

Sen intentionally leaves the capability approach incomplete in several respects. The framework identifies an evaluative space but does not itself provide one universally fixed list of capabilities, one weighting system, or one institutional blueprint for every application. Public reasoning, context, purpose, and explicit valuation remain necessary (Sen 1992; Sen 1999). Alkire's work on operationalization takes this incompleteness seriously: practical use requires identifying relevant capabilities and making value judgments, but operationalization need not erase plurality by forcing every dimension into a comprehensive doctrine or single metric (Alkire 2002).

Nussbaum develops a more specified version of the capabilities approach. Her account identifies central human capabilities and argues that political principles should secure threshold levels of these capabilities for persons (Nussbaum 2000). This introduces a stronger substantive specification than Sen usually accepts. The difference is theoretically important. Sen's framework retains greater openness about capability selection and weighting, whereas Nussbaum offers a philosophical account intended to support constitutional and political guarantees. Both approaches treat utility and resource possession as insufficient, but they differ over how much substantive content the theory itself should specify in advance.

The capability concept consequently occupies an intermediate analytical position. It is richer than formal entitlement because an officially recognized right may lack

effective conditions of exercise. It is also different from achievement because a capability can exist even when a person chooses not to realize it. And it is broader than individual skill because capabilities depend on relations among persons, institutions, resources, infrastructures, norms, and environments. The capability approach thereby relocates evaluation from possession alone toward effective possibility.

2.22.3 Functionings

Functionings refer to achieved beings and doings: being adequately nourished, being educated, participating in social life, moving safely, caring for others, working under certain conditions, or taking part in collective decisions are examples of the kinds of achievements capability analysis can examine (Sen 1985; Sen 1992). Functionings therefore describe realized aspects of life rather than the full range of alternatives available to a person. The distinction between capability and functioning separates effective opportunity from achievement.

This distinction creates both normative and empirical questions. In many contexts, achieved functionings matter directly. Severe malnutrition, avoidable mortality, illiteracy, or exclusion cannot be dismissed merely because a formal opportunity is said to exist. At the same time, exclusive attention to observed functionings can conceal differences in freedom. Similar achievements can arise through choice, constraint, coercion, necessity, or the absence of alternatives. Capability analysis therefore asks what opportunities lay behind the observed state rather than treating achievement alone as a complete measure of advantage.

The capability-functioning distinction also complicates measurement. Functionings are often easier to observe than opportunity sets. Capabilities can involve counterfactual alternatives that were available but not chosen, making empirical identification more demanding (Robeyns 2005). Practical applications therefore frequently use combinations of direct functioning indicators, information about constraints and access, and institutional evidence as imperfect proxies for substantive opportunity. Alkire's work makes this operational problem explicit: a multidimensional evaluative framework requires judgments about relevant dimensions, informational adequacy, participation, and the practical purpose of the assessment (Alkire 2002).

The literature on adaptive preferences supplies an additional reason not to identify welfare with reported satisfaction or revealed preference. Long-standing deprivation can shape aspirations, expectations, and the interpretation of what is feasible or deserved. Nussbaum's discussion of women's options makes adaptive preference a central challenge for policy evaluation: acquiescence to constrained circumstances cannot automatically be treated as evidence that those circumstances provide adequate opportunity (Nussbaum 2000). Sen's broader capability framework likewise resists using utility alone as the informational basis for judging deprivation because subjective satisfaction can adapt to persistent disadvantage (Sen 1992).

This does not make individual preferences irrelevant. It changes their analytical status. Preferences, choices, and reported satisfaction become evidence situated within a wider account of opportunity, social formation, and agency. A capability analysis can therefore examine both whether a valued functioning is achieved and whether the person had meaningful alternatives. The resulting evaluative space is multidimensional: achievement, opportunity, agency, and the conditions under which preferences form can each matter without being reduced to one another.

2.22.4 Freedom and Opportunity

Freedom is central to Sen's development approach, but the relevant freedom is more demanding than formal permission or the mere existence of multiple nominal options. In *Inequality Reexamined*, Sen distinguishes achievement from freedom and separates aspects of well-being from broader agency concerns (Sen 1992). *Development as Freedom* subsequently treats expansion of substantive freedoms as both a constitutive component and an instrumental condition of development (Sen 1999). Political liberties, economic facilities, social opportunities, transparency guarantees, and protective security can interact in expanding or constraining what people are effectively able to do.

The capability perspective therefore separates *formal choice* from *effective opportunity*. A legal right to education has limited capability significance where schools are inaccessible, discriminatory, unsafe, or unaffordable. Formal permission to work may coexist with exclusion from transportation, childcare, documentation, networks, or the social recognition needed to obtain employment. Conversely, institutional supports can transform the same nominal right into a substantially different opportunity. Freedom consequently depends on the organization of enabling conditions, not only on the absence of direct prohibition.

Sen also distinguishes well-being from agency. A person can pursue objectives concerning other persons, public goods, political causes, communities, or principles even where those commitments do not maximize that person's own welfare (Sen 1992; Sen 1999). Agency widens the evaluative subject beyond passive receipt of benefits. People can participate in shaping institutions, articulating priorities, contesting deprivation, and deciding which opportunities matter. This is one reason development cannot be represented adequately as delivery of resources to otherwise passive recipients.

The human-development approach institutionalized a closely related shift in policy language. The first *Human Development Report* defines development in terms of enlarging people's choices and explicitly rejects GNP, income, commodity production, and capital accumulation as sufficient measures of human development (United Nations Development Programme 1990). Health, education, material resources, political freedom, rights, and self-respect enter a wider picture of human possibility. The human-development approach is not identical with Sen's capability framework, but it shares the movement from aggregate economic means toward the lives and opportunities those means help make possible.

Freedom in this lineage is therefore both evaluative and institutional. It concerns the range of lives available to persons, the conditions under which choices can be made, and the agency through which persons can participate in determining social priorities. A larger count of options does not necessarily imply greater substantive freedom when options are unusable, coercively structured, or disconnected from what a person has reason to value. The capability literature consequently turns attention from abstract choice sets toward the quality and accessibility of opportunity.

2.22.5 Institutional Conditions of Capability Formation

The phrase *institutional conditions of capability formation* is used here as an organizing label for a problem distributed across the capability and human-development

literatures. It does not designate a single canonical theory shared by Sen, Nussbaum, Alkire, or the UNDP tradition. The common problem is that effective opportunities depend on social arrangements whose formation and maintenance cannot be inferred from a person's resource endowment alone. Schools, health systems, legal rights, public infrastructures, care arrangements, labor institutions, political freedoms, family relations, gender norms, public security, and environmental conditions can each alter the conversion of means into capabilities.

Drèze and Sen's analysis of development and participation gives public action a central role in this process. Their account connects the removal of deprivation and expansion of effective freedom to complementary economic, social, and political institutions, including education, health care, social security, gender equality, civil rights, democratic participation, and public accountability (Drèze and Sen 2002). Capability expansion is therefore not simply a matter of raising private purchasing power. Public goods, institutional access, social norms, political voice, and collective provision can alter the effective opportunities associated with a given income.

Nussbaum's work similarly makes institutional and social conditions indispensable. Her treatment of gender justice shows how family organization, religion, law, education, bodily security, and socially adaptive expectations can affect whether central capabilities are genuinely available (Nussbaum 2000). The capability perspective therefore enables analysis of deprivation that would remain invisible if evaluation stopped at formal rights or household resources. A person can belong to a resource-owning household and nevertheless lack effective control over resources, mobility, bodily integrity, political participation, or access to education.

Human-development practice develops the same insight at a policy scale. The 1990 Human Development Report treats income as one means among others and connects human development to health, knowledge, resources for a decent standard of living, political freedom, rights, and self-respect (United Nations Development Programme 1990). Alkire's work then shows why operationalization must remain attentive to multidimensionality and explicit valuation rather than assuming that one observable indicator represents all relevant freedoms (Alkire 2002). Capability formation is thus simultaneously material, social, institutional, and evaluative.

These traditions provide an important foundation for GRE while leaving substantial questions open. They establish that economic advantage cannot be inferred directly from resources, income, or formal rights; that conversion conditions mediate effective opportunity; that capabilities differ from achieved functionings; that agency and substantive freedom matter; and that institutions participate in producing or restricting the opportunity sets available to persons. Later GRE can build on this inheritance by examining how capabilities themselves are generated, maintained, eroded, converted, and transmitted through changing relations and institutions. It can also ask how one person's capability expansion affects the capabilities of others, how collective capabilities become possible, and how the institutions that convert resources into opportunities are themselves reproduced or transformed. Those stronger generative-relational questions are deferred. The present section establishes the theoretical resources that make them intelligible.

2.23 Care, Feminist, and Social Reproduction Economics

The preceding sections reconstructed capability approaches that distinguish resources from the substantive opportunities people can actually exercise. Care, feminist, and social-reproduction traditions deepen a related problem from another direction: the economic conditions of life include activities, dependencies, institutions, and relations that are only partially visible in market exchange, wage statistics, or conventional measures of output. The role of this section is to reconstruct the theoretical lineages through which care, reproductive labor, dependency, unpaid activity, and social reproduction became economic objects in their own right. Its objective is not to combine these traditions into a single feminist theory of the economy, and still less to present them as completed forms of GRE. The discussion instead distinguishes care ethics, feminist economics of paid and unpaid care, and Marxian-feminist theories of social reproduction before examining the conceptual resources they provide for later relational analysis.

These literatures overlap while asking different questions. Care ethics investigates the moral and political significance of caring relations, dependency, responsibility, and attentiveness (Tronto 1993; Held 2006; Kittay 1999). Feminist economics asks how conventional economic boundaries, models, labor categories, and accounting systems treat household production, care work, gendered constraints, and well-being (Folbre 1994; England 2005; Waring 1988; Power 2004). Social-reproduction theory asks how labor-power, persons, households, communities, and the social conditions required for production are reproduced across time (Benería 1979; Vogel 1983; Fraser 2014). Their objects can intersect, but care is not identical with unpaid labor, unpaid labor is not identical with social reproduction, and social reproduction is not exhausted by activity within households.

2.23.1 Care Relations

Care entered modern feminist theory partly through a critique of moral and political theories organized around abstract, independent, and interchangeable agents. The resulting literature is internally diverse. Tronto's *Moral Boundaries* treats care as a central activity of human life while rejecting its confinement to a supposedly private women's morality (Tronto 1993). Care is politically organized: societies distribute responsibilities for attending to needs, performing care, receiving care, and avoiding care work unequally. Gender, class, race, citizenship, and institutional position can therefore affect not only who receives adequate care but also whose time and labor become available to provide it.

Held similarly develops an ethics centered on caring relations rather than only on the virtues or choices of isolated individuals (Held 2006). Her approach does not make care the sole moral value. It asks how care, trust, mutual consideration, justice, equality, and rights can be related without assuming that impartial rules exhaust moral life. This relational emphasis matters economically because many activities conventionally modeled as services or household tasks are also interactions whose quality depends on attention, responsiveness, continuity, trust, and knowledge of particular persons. A unit of care cannot always be described adequately by its duration or monetary price alone.

Kittay makes dependency especially central. *Love's Labor* argues that dependency is not an exceptional deviation from an otherwise autonomous human condition; infancy, illness, disability, aging, and other forms of dependence are recurring features of human life (Kittay 1999). The person who depends on care is only one side of the institutional problem. The caregiver or “dependency worker” may also require resources, time, income, recognition, and support. A social order that acknowledges the needs of dependents while privatizing the costs borne by caregivers can therefore reproduce inequality through the organization of care itself.

These arguments make care a relation without implying that every care relation is benign. Dependence can coexist with affection, obligation, coercion, hierarchy, exhaustion, exploitation, professional responsibility, or reciprocal commitment. Tronto's political treatment of care is particularly important here because it makes the allocation of caring responsibilities a question of power as well as morality (Tronto 1993). Care can be indispensable while the institutional arrangement through which it is provided remains unequal. The analytical object is consequently broader than the caregiver's motive: it includes the distribution of needs, responsibilities, resources, authority, and possibilities of refusal.

Care relations also complicate the boundary between market and nonmarket action. England's survey of care-work theories identifies several distinct explanations for the low valuation or difficult organization of paid care, including devaluation associated with feminized work, public-good characteristics, the leverage employers can obtain from workers' intrinsic commitments, concerns over commodifying emotion, and arguments against treating love and money as mutually exclusive (England 2005). The coexistence of payment and care therefore cannot be interpreted through a simple opposition between altruistic relations and market relations. Paid care can remain relational and morally significant; unpaid care can be coercively allocated or unequally supported.

For economic theory, the foundational contribution of these traditions is to identify care as an activity whose outputs and conditions are partly relational. The quality of care can depend on continuity, responsiveness, trust, knowledge, time, and institutional support, while the burdens and benefits of care are distributed across persons and organizations. This does not make care analytically ineffable or exempt from economic inquiry. It makes the relevant economic object richer than a commodity quantity considered independently of the relation through which the activity is performed.

2.23.2 Reproductive Labor

A second lineage concerns the labor through which persons and laboring capacities are maintained and renewed. Benería's analysis of reproduction, production, and the sexual division of labor was an early contribution to feminist political economy precisely because it resisted treating reproductive activity as an external background to production (Benería 1979). Domestic labor, childrearing, food preparation, household maintenance, and related activities can affect the reproduction of the labor force and the organization of paid employment even when they do not themselves appear as wage labor.

Marxian-feminist social-reproduction theory develops this problem more systematically. Vogel's reconstruction centers the reproduction of labor-power and asks how

generational replacement, daily maintenance, domestic labor, and the gendered organization of reproduction relate to capitalist production (Vogel 1983). This differs from an account in which capitalism and patriarchy simply operate as two independent systems whose effects are subsequently added together. The analytical task is to explain how the reproduction of labor-power is organized within a wider social formation and why that organization can be gendered without assuming that every reproductive activity takes place outside markets or under one invariant household form.

The term *reproductive labor* consequently covers more than biological reproduction. It can include work required to sustain persons, households, and capacities over time: preparing food, cleaning, caring for children or adults, maintaining social relations, providing emotional support, and enabling workers to return to paid activity. Yet the category should not be stretched without limit. Himmelweit's discussion of the "discovery" of unpaid work warns that extending a concept of work modeled on commodity-producing wage labor to every domestic activity can itself obscure important differences among labor, care, relationship, obligation, and activity (Himmelweit 1995). Recognition of unpaid activity as economically consequential need not require every form of care or relational life to be redescribed exhaustively in the image of wage labor.

This caution helps distinguish three propositions. First, activities outside paid employment can be necessary to the reproduction of persons and productive capacities. Second, their exclusion from wage statistics does not eliminate their economic effects. Third, conceptual recognition as economically consequential does not mean that every such activity is best understood solely through the category of labor. Feminist economics has repeatedly worked across this tension: making invisible work visible without assuming that visibility requires translating all human activity into the categories through which markets already recognize work.

Folbre's analysis of the costs of social reproduction places this issue within structures of constraint (Folbre 1994). Decisions about children, care, household labor, and employment are made by persons, but the choices available to them depend on gendered expectations, family arrangements, public policy, labor markets, income, and other institutional conditions. The unequal distribution of reproductive costs therefore cannot be explained adequately either by individual preference alone or by a homogeneous household assumed to maximize one shared objective. Household decisions are embedded in bargaining positions and institutional rules that affect who can shift costs onto whom.

The reproductive-labor tradition therefore widens the temporal unit of economic analysis. Production at one moment depends on capacities whose maintenance occurred previously and whose future renewal cannot be taken for granted. Workers arrive at workplaces with bodies, skills, health, language, habits, social identities, and obligations that were not produced entirely within the firm. Children who require care today can become workers, citizens, caregivers, or dependents in later periods. Reproductive labor consequently links present production to intergenerational and life-course processes whose costs and benefits may fall on different actors at different times.

2.23.3 Dependency and Interdependence

The care and social-reproduction literatures also challenge theories that treat independence as the normal baseline from which dependency appears as an exceptional condition. Kittay's analysis makes dependency structurally important to equality because persons pass through periods in which they cannot secure their own basic needs and because those who care for them can themselves become economically or politically vulnerable (Kittay 1999). Fineman develops a related critique of the autonomous and self-sufficient subject, arguing that dependency and caretaking responsibilities are pervasive features of social life rather than private anomalies to be absorbed by families without public consequence (Fineman 2004).

Dependency and interdependence should nevertheless remain distinct. Dependency can describe an asymmetrical condition in which one person's well-being depends heavily on another person's care or on an institution. Interdependence refers more broadly to mutual or system-level dependence among persons, organizations, and infrastructures. A newborn infant and an adult caregiver are interdependent in a broad social sense, but their immediate capacities and responsibilities are not symmetrical. Treating all dependency as mutual interdependence can therefore conceal unequal vulnerability; treating all persons as simply dependent can obscure meaningful differences in autonomy and responsibility.

Feminist economics adds a distributional dimension to this problem. Folbre argues that societies face a collective problem in allocating the costs of care for children, older persons, and others whose needs cannot be met through individual self-provision alone (Folbre 1994; Folbre 2001). Caring labor can generate benefits extending beyond the immediate recipient. The education, health, socialization, and maintenance of persons can benefit employers, communities, future citizens, and public institutions that did not bear corresponding costs. Where responsibilities remain concentrated within households or on particular groups, the production of socially valuable capacities can coexist with private economic penalties for those who provide care.

This helps explain why dependence is not only an interpersonal phenomenon. It is institutionally mediated. Public education, health systems, pensions, childcare, disability support, labor law, immigration rules, household income, transport, housing, and working-time arrangements can redistribute both the need for direct care and the burdens of providing it. Market income can purchase some forms of care, but access to money does not abolish dependence; it changes the relations through which care is organized. Similarly, public provision can socialize some costs while leaving other burdens within families or communities.

The dependency literature therefore supplies a corrective to both atomistic individualism and romanticized relationality. Persons are not independent units that only later choose whether to enter caring relations, but neither does dependence imply that every relation is constitutive in the same way or normatively desirable. Economic analysis must be able to represent vulnerability, unequal need, asymmetric responsibility, and institutional mediation. The important inheritance for later work is the recognition that capacities commonly attributed to individuals can depend on networks of care and support whose organization is economically consequential.

2.23.4 Unpriced and Underrecognized Value

A fourth line of feminist-economic inquiry concerns valuation and measurement. Waring's critique of national accounting made visible a basic asymmetry: activities can be indispensable to the reproduction of households and economies while remaining absent, marginal, or differently treated within official measures of economic production (Waring 1988). The absence of an activity from a monetary aggregate does not establish that it has no value. It establishes that the accounting boundary and valuation convention do not assign it the same status as activities counted within that aggregate.

This distinction is important because *unpriced*, *unpaid*, *unmeasured*, and *undervalued* are different properties. Unpaid household care has no wage transaction, but paid care can still be underpaid relative to other occupations. An activity can be measured in time-use data without receiving a market price. A service can carry a price while dimensions of quality, emotional labor, continuity, or relational responsibility remain poorly represented by that price. Conversely, placing an imputed monetary value on unpaid work can improve visibility without resolving every question about its meaning, distribution, or institutional organization.

England's review is useful precisely because it identifies several mechanisms through which care can be economically undervalued (England 2005). A devaluation explanation emphasizes the lower rewards assigned to work culturally associated with women or racialized groups. A public-good account emphasizes benefits to others that individual purchasers may not fully internalize. A "prisoner of love" mechanism concerns the possibility that strong intrinsic commitments weaken caregivers' bargaining position. Other approaches focus on the tensions or compatibilities between monetary exchange and intimate or emotional relations. Low wages in care occupations therefore need not have one universal cause.

Himmelweit adds a conceptual caution to the valuation project (Himmelweit 1995). Expanding the category of work can make domestic activity visible, but the concepts used for visibility can themselves reshape what is being described. If every valuable activity is recognized only by assimilating it to wage labor, economic analysis may reproduce the very hierarchy it seeks to overcome by making market-like work the model of intelligibility. Recognition can consequently require multiple descriptive and evaluative languages rather than a single monetary translation.

Power's formulation of *social provisioning* provides one influential feminist-economic response. It treats paid and unpaid care as fundamental economic activities and combines concern for well-being with analysis of political-economic processes, power, ethical values, and intersecting differences such as class and race (Power 2004). This approach does not imply that all values are incommensurable or that prices are analytically irrelevant. It changes the starting boundary of the economy: provisioning human life becomes an economic object even where its organization crosses households, markets, states, communities, and ecological conditions.

The valuation problem therefore has at least two dimensions. One concerns *recognition*: whether an activity enters economic representation at all. The other concerns *valuation*: what measure, standard, or institutional process is used once the activity has been recognized. These dimensions can diverge. Greater statistical visibility may coexist with persistent inequality in pay, time burdens, authority, or access to support. Conversely, activities can be socially honored while those performing them remain

economically dependent. Feminist economics thus turns valuation into a question about boundaries, metrics, bargaining power, and institutional recognition rather than only a question about assigning prices.

2.23.5 Relational Conditions of Social Reproduction

The phrase *relational conditions of social reproduction* is used here as an organizing label for a problem distributed across care ethics, feminist economics, and social-reproduction theory. It is not a canonical category shared by Tronto, Folbre, Vogel, Fraser, or Power. The common problem is that the reproduction of persons, capacities, households, labor-power, and institutions depends on relations whose maintenance is itself historically organized. Care relations, gender relations, employment relations, kinship, public provision, migration regimes, housing arrangements, educational institutions, and fiscal systems can all alter who performs reproductive activity, under what conditions, and with what resources.

Vogel's social-reproduction analysis makes the reproduction of labor-power central to Marxist-feminist theory (Vogel 1983). Fraser extends the problem by describing capitalist accumulation as dependent on background conditions that include social reproduction, public power, and ecological processes even while accumulation can destabilize those conditions (Fraser 2014). These arguments differ in scope, but both resist an image of production as a self-contained sphere capable of reproducing all of its own conditions internally. The apparent autonomy of the formal economy can partly depend on analytical and institutional boundaries that place some necessary activities elsewhere.

Folbre's structures-of-constraint approach adds another dimension. The organization of reproduction is affected by relations among gender, age, family, markets, states, and other institutions that shape individual choice without eliminating agency (Folbre 1994). Power's social-provisioning approach similarly treats economic activity as a set of interdependent social processes rather than as exchange among already self-sufficient agents (Power 2004). These perspectives make it possible to ask not only how much care is supplied but how the relations through which care is supplied affect future capacities, bargaining positions, inequalities, and institutional possibilities.

The temporal structure is especially important. Care provided in one period can preserve health, transmit knowledge, sustain attachment, support recovery, or enable later participation in education and employment. Conversely, underprovision of care can accumulate into later constraints. Yet the capacity to provide care is also reproduced or depleted through working time, income, housing, public services, emotional resources, migration status, and the availability of other caregivers. Social reproduction therefore concerns both the reproduction of persons and the reproduction of the conditions under which reproductive activity can continue.

These traditions also caution against assuming that successful reproduction is normatively sufficient. An unequal household, exploitative labor regime, or exclusionary welfare system can reproduce itself effectively. Reproduction describes persistence or renewal; it does not by itself establish justice, flourishing, or legitimacy. Likewise, a crisis of reproduction can impose severe harms while also opening possibilities for institutional change. Analysis must therefore distinguish the capacity of a social order to reproduce itself from the distribution of burdens, capabilities, recognition, and power within that order.

For later GRE, the inherited theoretical resources are substantial but incomplete. Care ethics establishes the moral and political significance of dependency and caring relations. Feminist economics makes unpaid work, care, provisioning, measurement boundaries, and gendered constraints economically visible. Social-reproduction theory links the maintenance of persons and laboring capacities to the reproduction of wider social and economic orders. Later generative-relational analysis can build on these lineages by examining how care relations generate or erode capabilities, how reproductive burdens alter subsequent bargaining positions and economic trajectories, how institutions convert private care into public capacities, and how the reproduction of one relation changes the conditions under which other relations can persist or transform. Those stronger claims are deferred. The present section establishes the lineages that make such questions intellectually and economically intelligible.

2.24 Commons, Cooperative, and Solidarity Economic Traditions

The preceding sections reconstructed institutional, relational, capability, care, and social-reproduction approaches that widened the economic object beyond exchange among already constituted individuals. The present section turns to another cluster of traditions in which resources, production, infrastructure, and livelihood are organized through forms of shared access, collective rule-making, democratic ownership, reciprocity, and solidarity. Its role is genealogical. Its objective is to distinguish common-pool-resource analysis, collective-governance theory, cooperative production, shared-infrastructure approaches, and solidarity-economic traditions before identifying the conceptual resources they leave available for later GR and GRE. These traditions frequently intersect in practice, but they address different analytical problems and should not be collapsed into a single theory of “the commons.”

Several distinctions are therefore necessary at the outset. A *common-pool resource* describes a class of resource problem characterized by costly exclusion and subtractive appropriation; it does not by itself specify a property regime. A *commons* ordinarily involves a resource together with a community, rules, practices, or institutions through which access and use are organized. A *cooperative* is an organizational form whose members jointly own and democratically control an enterprise under specified principles (International Cooperative Alliance 1995). A *shared infrastructure* is a resource or system that enables multiple downstream activities and can be governed through public, private, commons-based, or hybrid arrangements. *Solidarity economy* refers to a wider family of associational practices and movements in which economic activity is organized around collective or social purposes, democratic participation, reciprocity, mutual aid, and related principles (Laville 2010). The overlap among these categories is economically important precisely because their meanings are not identical.

2.24.1 Common-Pool Resources

Modern commons scholarship developed partly in response to a powerful diagnosis of collective-resource failure. Hardin’s “tragedy of the commons” presented a stylized setting in which individually rational appropriation from a shared pasture produces

collective depletion when users receive private gains while distributing much of the cost of overuse across the group (Hardin 1968). The argument became highly influential because it made a structural problem visible: when access is difficult to exclude and withdrawals reduce what remains available, individually advantageous action can be incompatible with sustained collective use.

The subsequent common-pool-resource literature altered the meaning of this problem. Ostrom's empirical work showed that the relevant institutional possibilities cannot be represented adequately by a simple choice between privatization and centralized state control (Ostrom 1990). Users of fisheries, irrigation systems, forests, grazing lands, groundwater basins, and other resources have in some settings developed durable arrangements for defining access, monitoring use, sanctioning violations, resolving conflicts, and modifying rules. These cases do not refute the possibility of tragedy. They establish that resource characteristics do not determine one inevitable governance outcome.

This point requires a distinction between *resource type* and *property regime*. A common-pool resource can be managed under private property, public authority, communal property, open access, or combinations of these. Open access is therefore not synonymous with commons governance. A resource can be physically or legally shared while lacking institutions capable of limiting appropriation, financing maintenance, or resolving disputes. Conversely, collectively governed access can involve defined membership, exclusion of outsiders, graduated rights, obligations to contribute, or differentiated forms of use. The institutional question concerns how access, appropriation, provision, monitoring, sanctioning, and rule revision are organized under particular material and social conditions.

Ostrom's comparative analysis is important because it treats institutional performance as conditional rather than deriving a universal blueprint from successful cases. Long-enduring arrangements often exhibit boundaries, locally adapted rules, monitoring, graduated sanctions, conflict-resolution mechanisms, and opportunities for users to participate in rule modification, yet the configuration and importance of these features vary by setting (Ostrom 1990). Scale, mobility of the resource, observability, ecological dynamics, heterogeneity among users, external authorities, and histories of cooperation can all affect what forms of collective governance are feasible.

Common-pool-resource analysis consequently shifts economic attention from the abstract proposition that scarcity produces rivalry to the institutional organization of rivalry. Scarcity can be mediated through quotas, rotational access, territorial rights, seasonal restrictions, contribution requirements, community monitoring, pricing, or other arrangements. Different rules distribute not only quantities of a resource but also monitoring burdens, decision rights, uncertainty, risk, and future access. The economic object is therefore simultaneously material and institutional.

For later GRE, this literature provides a foundation for asking how shared resources and institutional capacities co-develop over time. Chapter 2 should stop short of converting that foundation into a general GR theory. The established lesson is narrower: collective-resource problems are generated through the interaction of resource characteristics, user relations, rules, information, and enforcement, and the institutional form through which a shared resource is governed is itself an explanatory variable.

2.24.2 Collective Governance

The commons literature also contributed to a broader theory of collective governance. Ostrom's institutional analysis rejects the assumption that effective coordination requires one sovereign center capable of specifying and enforcing all relevant rules. Her later work on polycentric governance emphasizes systems containing multiple formally independent centers of decision-making whose jurisdictions, functions, and interactions can overlap (Ostrom 2010). Such arrangements can include user associations, municipalities, courts, regulatory agencies, firms, customary authorities, and higher-level governments rather than one homogeneous category of "community governance."

Polycentricity matters because many collective-action problems operate across scales. A local irrigation association may be able to monitor water withdrawals more effectively than a distant ministry while still depending on public courts, watershed regulation, infrastructure finance, or regional conflict resolution. Local knowledge can improve rule fit without guaranteeing fairness or ecological adequacy. Central authorities can supply resources or legal recognition while also imposing rules poorly adapted to local conditions. The relevant question becomes how different centers of authority are related, which functions they perform, how information travels among them, and how conflict among jurisdictions is managed.

Ostrom's Institutional Analysis and Development framework gives this problem a more general form. Rules-in-use, material conditions, community attributes, positions, actions, information, control, and payoffs can be analyzed as components of action situations rather than treated as one undifferentiated institutional context (Ostrom 2005). This is useful for Chapter 2 because it establishes that collective governance has an internal architecture. Participation in a governing arrangement can involve different rights to access, withdraw, manage, exclude, monitor, sanction, authorize, or revise rules. A collective institution is therefore not reducible to the number of people nominally included in it.

The literature also cautions against romanticizing collective governance. Communities can reproduce hierarchy, exclusion, gendered authority, ethnic boundaries, unequal bargaining power, or control by locally dominant actors. Monitoring can become surveillance; strong boundaries can protect a resource while excluding groups whose livelihoods depend on it; locally legitimate practices can conflict with wider legal or ecological obligations. Collective governance denotes a mode of institutional organization, not an automatic certificate of justice.

A second caution concerns the relation between autonomy and external support. Durable commons can require recognition by public authorities, legally enforceable boundaries, scientific information, infrastructure investment, or access to wider conflict-resolution systems. The International Cooperative Alliance's principle of autonomy and independence similarly coexists with cooperation among cooperatives and concern for community rather than implying organizational isolation (International Cooperative Alliance 1995; International Cooperative Alliance 2017). Self-governance can therefore be institutionally nested.

The foundational contribution of collective-governance theory is to make rule-making capacity itself an economic resource. Participants may possess a shared asset yet lack institutions through which they can revise rules, coordinate investment, resolve disputes, or respond to ecological change. Conversely, governance capacity

can allow a group to adapt the relation between resource use and resource renewal. Later GRE can build on this distinction when examining how governance capabilities are generated, distributed, and transformed, but the present section establishes only the inherited institutional vocabulary.

2.24.3 Cooperative Production

Cooperative traditions approach collective economic organization from a different direction. The modern cooperative movement is commonly associated with the Rochdale Pioneers of 1844, whose organization became an important prototype for later cooperative principles, while other cooperative and mutual forms developed through distinct national and sectoral histories. The contemporary International Cooperative Alliance defines a cooperative as a voluntary association formed to meet common economic, social, and cultural needs through a jointly owned and democratically controlled enterprise (International Cooperative Alliance 1995). This definition encompasses consumer, worker, producer, agricultural, housing, financial, and other cooperatives rather than one invariant firm type.

The cooperative idea also has a significant place within nineteenth-century political economy. Mill treated cooperative associations as a possible transformation of the relation between labor and enterprise. In his discussion of the future of the laboring classes, he emphasized the possibility that workers participating in the benefits and governance of production could alter incentives, independence, class relations, and the social meaning of work (Mill 1848). Mill's account is normative and developmental as well as economic; it should not be read as a modern formal theory of the labor-managed firm.

Twentieth-century economic theory subsequently examined worker-managed firms through more explicit behavioral assumptions. Ward's model of the labor-managed firm showed that changing the objective and decision rights attributed to an enterprise changes predicted responses to prices, labor, and output relative to the conventional profit-maximizing firm (Ward 1958). Vanek developed a broader theory of labor-managed market economies concerned with enterprise equilibrium, income sharing, investment, decentralized decision-making, and institutional form (Vanek 1970). These contributions are important because they demonstrate formally that the theory of the firm depends on assumptions about who controls the organization, which returns they receive, and what objective the enterprise is modeled as pursuing.

The formal literature should nevertheless be separated from the institutional diversity of actual cooperatives. A worker cooperative governed by worker-members differs from a consumer cooperative, a producer cooperative, a mutual financial institution, or a multi-stakeholder cooperative. Democratic member control can coexist with delegated management, professional expertise, wage differentials, external borrowing, contractual obligations, and competition in conventional markets. Joint ownership does not eliminate governance problems; it changes the distribution of residual claims, decision rights, membership obligations, and accountability through which those problems are addressed.

The ICA principles further indicate that cooperative organization is not defined solely by ownership shares. Voluntary and open membership, democratic member control, member economic participation, autonomy, education, cooperation among

cooperatives, and concern for community form a normative-institutional identity whose application has changed historically and remains subject to interpretation (International Cooperative Alliance 1995; International Cooperative Alliance 2017). Cooperative production thus combines an enterprise form with a governance tradition. Its economic significance can involve incentive alignment, distribution of surplus, control over investment, employment security, knowledge sharing, local anchoring, or bargaining power, but the presence and strength of these effects are empirical questions rather than consequences of the label alone.

For later GRE, cooperative traditions supply a particularly useful distinction between participation in production and participation in the governance of production. They also make visible the possibility that ownership, control, surplus allocation, and membership can be organized relationally in ways that differ from investor-owned firms. The section does not treat cooperative organization as intrinsically superior or as a completed form of generative return. It establishes a historical and theoretical lineage in which productive organization itself becomes an object of democratic and institutional design.

2.24.4 Shared Infrastructures

Commons reasoning has also expanded beyond natural resources. Shared infrastructures create a different analytical problem because their value often lies in enabling heterogeneous downstream activities rather than in allocating a fixed stock among competing appropriators. Frischmann develops a demand-side theory of infrastructure in which roads, communication networks, environmental resources, basic research, and other infrastructural resources can generate social value by serving as inputs into a wide range of productive and social activities (Frischmann 2012). Decisions about access can therefore affect forms of value that are difficult to infer from the immediate willingness to pay of a single user.

The knowledge-commons literature further demonstrates why natural-resource analogies require adjustment. Hess and Ostrom analyze knowledge as a shared resource subject to questions of access, preservation, intellectual property, enclosure, collective action, and institutional design (Hess and Ostrom 2007). Knowledge differs materially from a fishery or grazing field because one person's use of an idea does not ordinarily subtract the same idea from another person's use. Scarcity can instead arise through access restrictions, attention, preservation costs, congestion of supporting systems, quality control, curation, or the resources required to produce and maintain knowledge.

Digital production provides another extension. Benkler's analysis of commons-based peer production uses free and open-source software and related projects to show how distributed contributors can organize significant productive activity through mechanisms that are not reducible to market prices or managerial command (Benkler 2002). The argument depends on conditions such as modularity of tasks, heterogeneity of motivations and capacities, low-cost communication, and mechanisms for integrating distributed contributions. Peer production is therefore a specific coordination form, not a general synonym for voluntary cooperation.

These literatures make the category of *shared infrastructure* analytically useful because access and production can be separated. A road, protocol, codebase, research repository, database, library, standard, or communication network may be used by

many downstream actors whose activities differ substantially. The infrastructure can be publicly owned, privately owned but regulated for access, cooperatively owned, openly licensed, or governed through hybrid arrangements. Shared use is therefore a functional relation between a resource and multiple productive activities; it does not specify ownership or governance by itself.

The distinction between resource creation and resource use is equally important. Open access to a knowledge resource may increase downstream experimentation while leaving unresolved who finances maintenance, verification, moderation, preservation, or technical infrastructure. A peer-production community can create a widely shared resource while still depending on paid labor, firms, foundations, public research institutions, or physical infrastructures situated elsewhere. Commons-based access does not remove the problem of reproducing the conditions under which the shared resource remains usable.

For GRE, the intellectual inheritance is substantial. Shared infrastructures show that value can be generated downstream by enabling activities whose identities and uses are not fully known in advance. Knowledge commons and peer production show that coordination can sometimes proceed through open contribution, shared standards, reputation, community governance, and distributed integration. Later generative-relational analysis can investigate how infrastructures enlarge or restrict future relation formation and how the benefits generated through shared foundations are captured, returned, or dissipated. Those are later claims. The present lineage establishes that infrastructure and commons governance cannot be reduced to ordinary commodity exchange.

2.24.5 Reciprocity and Solidarity

Commons and cooperative traditions also intersect with older theories of reciprocity and newer traditions of social and solidarity economy. Mauss's analysis of the gift is foundational because it treats exchange as embedded in obligations to give, receive, and reciprocate rather than as an isolated transfer between utility-maximizing strangers (Mauss 1990). Gift relations can carry legal, moral, religious, political, and status meanings at the same time. Reciprocity in this lineage is therefore not equivalent to immediate equivalence of value or simultaneous bilateral exchange.

Polanyi gives reciprocity a different theoretical location. His substantive account treats the economy as an instituted process and distinguishes patterns through which economic life can be integrated, including reciprocity, redistribution, and exchange (Polanyi 1957). The importance of this distinction lies in rejecting the assumption that market exchange supplies the universal template for every form of economic coordination. Reciprocity can organize flows through socially structured relationships; redistribution can organize movement toward and from a center; exchange can operate through price-making markets. Historical economies can combine these patterns rather than corresponding to one pure type.

The modern solidarity-economy literature develops these concerns within democratic and associational economic practice. Laville describes solidarity economy as a diverse international movement involving cooperativism, associations, self-management, participatory democracy, and efforts to democratize economic activity (Laville 2010). In this tradition, solidarity is not simply a private feeling of altruism. It can be institutionalized through organizations, reciprocal commitments, collective

ownership, public support, mutual aid, and forms of economic participation that join productive activity to social or political purposes.

Cooperative principles offer one organizational articulation of this relation. The ICA identifies self-help, self-responsibility, democracy, equality, equity, and solidarity among cooperative values, while the principle of cooperation among cooperatives extends economic coordination beyond the boundary of an individual enterprise (International Cooperative Alliance 1995). Such inter-cooperation can involve federations, purchasing networks, shared finance, education, insurance, or common infrastructures. Solidarity can therefore acquire organizational form rather than remaining an interpersonal disposition.

These traditions should nevertheless remain analytically separate. Reciprocity can occur inside households, markets, associations, or political communities without producing a cooperative enterprise. A cooperative can operate successfully while its relations with nonmembers remain conventional market relations. A commons can depend heavily on rules and sanctions rather than on generalized solidarity. Solidarity-economy organizations can combine market revenue, public subsidy, unpaid participation, redistribution, and reciprocal activity. The historical field is plural precisely because no single institutional principle coordinates all of these arrangements.

A further caution concerns normative evaluation. Reciprocity can sustain exclusionary communities; solidarity can be bounded to insiders; democratic organizations can reproduce informal hierarchy; collectively owned assets can be captured by a subset of members. The existence of a shared resource or participatory rule does not establish distributive, relational, or procedural justice. Conversely, the persistence of market exchange within a cooperative or solidarity economy does not by itself negate collective governance. Institutional combinations require analysis at the level of actual rights, obligations, access, decision procedures, and distributions of benefit and burden.

The conceptual inheritance for later GR and GRE can therefore be stated with some precision. Commons scholarship establishes that shared-resource outcomes depend on institutions and collective capacities. Cooperative traditions establish that ownership, control, production, and surplus allocation can be organized through democratic membership. Shared-infrastructure approaches show how open or collectively governed foundations can enable heterogeneous downstream activities. Reciprocity and solidarity traditions identify economic coordination that is structured through obligation, association, mutual aid, and collective purpose as well as price and command. None of these traditions alone supplies a complete generative-relational economics. Together they make it possible to ask later how shared resources, governance capacities, cooperative relations, infrastructures, and solidaristic commitments are generated, how they reproduce or transform the relations among participants, and how value created through collective arrangements circulates, returns, or becomes captured. The present section therefore provides foundations for those later questions without resolving them in advance.

2.25 Evolutionary Economics

The preceding sections reconstructed institutional, relational, capability, care, commons, and solidarity traditions that widened economic analysis beyond static ex-

change among already constituted agents. The present section turns to evolutionary economics, a heterogeneous family of approaches united less by one formal model than by a sustained concern with cumulative change, novelty, heterogeneity, selection, organizational memory, technological development, and historically conditioned transformation. Its role is genealogical. Its objective is to reconstruct the concepts of variation, selection, retention, innovation, and coevolution as they developed across institutionalist, Schumpeterian, Darwinian, and Nelson–Winter lineages before identifying what those concepts make available for later GR and GRE. The discussion therefore treats biological evolution as one source of conceptual resources rather than as a template that can be transferred mechanically into economic explanation.

The term *evolutionary* has been used in economics in several importantly different senses. Veblen used it to criticize taxonomic and equilibrium-centered conceptions of economic life and to emphasize cumulative causation, habits, institutions, and changing material conditions (Veblen 1898). Schumpeter centered economic development on innovation and the disruption of established combinations (Schumpeter 1934). Nelson and Winter later constructed an explicit evolutionary theory of firms and industries around routines, search, innovation, differential performance, and selection (Nelson and Winter 1982). Alchian developed a separate selection argument in which uncertainty and competitive survival can generate observed regularities without requiring complete foresight by firms (Alchian 1950). Hodgson subsequently emphasized both the intellectual importance and the hazards of importing evolutionary concepts from biology into economics (Hodgson 1993). These traditions overlap, but variation, selection, retention, innovation, and coevolution do not carry identical mechanisms across them.

2.25.1 Variation

An evolutionary explanation requires heterogeneity. If all relevant actors, routines, technologies, organizational forms, and strategies were identical and remained so, there would be little for a selective process to differentiate. Yet economic variation is not analogous to a single biological mechanism of mutation. It can arise through deliberate search, error, experimentation, recombination, imitation with modification, entrepreneurial judgment, scientific discovery, organizational learning, institutional conflict, or changes in material and political conditions. Evolutionary economics therefore begins by treating difference among economic forms as an explanatory object rather than as temporary noise around a representative agent.

Veblen's evolutionary critique already placed cumulative variation inside economic conduct. Habits of thought, institutions, technological practices, and material circumstances change together over historical time; economic behavior is consequently formed within a moving institutional environment rather than generated repeatedly from an invariant psychological calculus (Veblen 1898). Variation in this tradition is historical and institutional. New practices arise from changing conditions and from tensions among inherited habits, technical possibilities, and collective arrangements.

Nelson and Winter give variation a more organizationally specific form. Firms possess routines that stabilize recurrent behavior, but they also engage in search when performance is unsatisfactory, when technological opportunities emerge, or when

competitive environments change (Nelson and Winter 1982). Search can produce modified techniques, products, organizational procedures, investment strategies, or other departures from established routines. The resulting variation is partly intentional but not fully designed: firms search under bounded knowledge, uncertain outcomes, and heterogeneous inherited capabilities. What can be tried depends on what the organization already knows how to do.

This point separates evolutionary variation from an abstract random-shock model. Economic novelty often has a genealogy. A firm may experiment in a direction because its engineers possess particular skills, because previous investments have created complementary capabilities, because regulations permit one organizational form rather than another, or because a scientific development makes a new technological path imaginable. Variation can therefore be locally contingent while remaining historically structured. The space of possible variants is neither fixed nor equally accessible to all actors.

Hodgson's reconstruction of evolutionary economics is useful precisely because it cautions against a literal biological analogy. Economic variation can be reflexive, purposive, institutionally mediated, symbolically represented, and transmitted through teaching or documentation in ways that differ from genetic variation (Hodgson 1993). Later generalized-Darwinian work has argued that variation, inheritance, and selection can still provide high-level explanatory principles for social evolution, while recognizing that the mechanisms realizing those principles differ across biological and social domains (Hodgson and Knudsen 2010). Chapter 2 need not resolve that debate. The foundational point is that evolutionary economics treats economic heterogeneity as generated and historically conditioned rather than merely assumed.

For later GRE, this lineage leaves an important analytical question: what generates the set of alternatives upon which later selection can act? Evolutionary economics already makes clear that selection cannot explain variation by itself. The origins, accessibility, and distribution of economic alternatives require separate explanation.

2.25.2 Selection

Selection concerns differential persistence or expansion among heterogeneous economic forms. Here again, evolutionary economics contains several distinct mechanisms. Alchian's classic argument begins from uncertainty. Firms need not maximize profits through complete knowledge in order for competitive environments to favor some behaviors over others. Practices compatible with positive realized profits can survive while others disappear, so observed regularities may partly reflect environmental selection rather than perfect *ex ante* optimization (Alchian 1950). The mechanism is deliberately different from a claim that managers consciously solve an optimization problem.

Nelson and Winter place selection within an industry population of heterogeneous firms. Firms differ in routines, productivity, technologies, and search behavior. Market competition, profitability, investment, entry, and exit can alter their relative weights over time (Nelson and Winter 1982). Selection therefore operates on organizations carrying historically accumulated routines and capabilities. It can change an industry's composition even when no individual firm instantaneously adopts the globally best technique.

Metcalfe develops a related evolutionary interpretation of competition in which

economic variety is a precondition for competitive change and innovation is a major source of differences among firms (Metcalfé 1998). Competition in this view is a process that transforms population shares rather than merely a static state described by an equilibrium price vector. This places market coordination and evolutionary selection in relation without making them identical. Price competition can be one selective mechanism, while credit access, regulation, standards, procurement, network position, professional legitimacy, intellectual property, and political authority can also affect which organizational or technological forms persist.

Selection therefore does not imply that whatever survives is efficient, optimal, or normatively desirable. A technology can persist because switching costs are high; an organizational form can expand because it controls infrastructure or finance; a standard can dominate through network effects; an institution can survive because it benefits actors capable of defending it. Selection describes differential continuation under specified conditions. It does not transform survival into a welfare criterion.

Nor is the selection environment external and fixed. Firms alter markets through innovation; technologies change input requirements and complementary infrastructures; regulation responds to new industries; user practices reshape demand; and successful organizational forms can influence the rules under which subsequent competition occurs. Evolutionary economists therefore increasingly moved from simple selection metaphors toward models in which the environment itself changes with the population being selected.

For later GR and GRE, the inheritance is again methodological rather than doctrinal. Selection directs attention to differential persistence among heterogeneous relations, routines, institutions, and organizations. It also imposes a discipline: an evolutionary explanation should specify the mechanism and level of selection rather than invoke “selection” as a generic synonym for historical change.

2.25.3 Retention

Selection can have cumulative consequences only if economically consequential differences persist long enough to influence later behavior. Evolutionary economics therefore requires some account of retention, inheritance, memory, or reproduction. In biological evolution, inheritance is associated principally with genetic transmission. Economic systems possess no single equivalent mechanism. Retention can occur through organizational routines, skills, records, standards, legal rules, infrastructures, habits, professional training, technical artifacts, organizational culture, supply relations, and institutions.

Nelson and Winter’s concept of routine is central to this problem. Routines are recurrent patterns through which organizations remember and reproduce productive and organizational capabilities (Nelson and Winter 1982). They can govern technical procedures, information processing, hiring, investment, coordination, or search. Their importance is not that firms never depart from them, but that economic action cannot be reconstructed anew from complete calculation at every moment. Organizations inherit practical repertoires that condition what they can reliably do.

Retention also helps explain why capabilities are unevenly distributed. A technique written in a manual may not be equivalent to the organizational capacity to perform it. Skills may depend on tacit knowledge, coordinated teams, accumulated experience, specialized equipment, supplier relations, or institutional support. The

persistence of an economic form can therefore depend on a bundle of complementary carriers rather than on the survival of an abstract idea alone.

Dosi's distinction between technological paradigms and technological trajectories provides another account of cumulative retention. Once a technological paradigm has become established, technical problem-solving often proceeds along relatively structured trajectories, while more discontinuous changes are associated with the emergence of new paradigms (Dosi 1982). Retention here concerns more than organizational memory. It includes stabilized problem definitions, heuristics, technical competencies, investment commitments, and expectations about promising directions of improvement.

Retention is consequently compatible with transformation. Routines can be modified during enactment; standards can be revised; institutions can reinterpret inherited rules; skills can be recombined; and technological trajectories can encounter bottlenecks that redirect search. Evolutionary persistence is not simple repetition. The object retained may be a capacity for patterned variation rather than an invariant behavior.

This distinction matters for later GRE because historical continuity can operate through many carriers. An economic relation may persist because contracts are renewed, because infrastructures make alternatives costly, because participants acquire relation-specific skills, because law recognizes a status, or because expectations become mutually reinforcing. Evolutionary economics supplies the broader lesson that continuity itself requires mechanisms. GR can later ask how such carriers of retention are generated and how their persistence changes the conditions of subsequent variation.

2.25.4 Innovation

Innovation occupies a distinctive position in evolutionary economics because it can generate variation while simultaneously altering the environment in which future selection occurs. Schumpeter's theory of economic development describes development through the carrying out of "new combinations": new goods, new methods of production, new markets, new sources of supply, and new forms of organization (Schumpeter 1934). The entrepreneur is defined by the function of carrying out such combinations rather than by permanent ownership of a particular firm. Economic development is therefore distinguished from the circular reproduction of an already established configuration.

This Schumpeterian lineage makes novelty endogenous to economic development. Innovation is not merely an external technological shock applied to an otherwise stationary market system. Credit, entrepreneurship, organizational power, knowledge, competition, and institutional arrangements help determine whether a technically possible novelty becomes economically operative. Later Schumpeterian analysis also emphasizes the destructive side of innovation: new combinations can render existing competencies, capital goods, organizational forms, and market positions obsolete.

Nelson and Winter translate part of this insight into an organizational evolutionary framework. Innovation emerges from search performed by firms with heterogeneous routines and capabilities; successful innovations affect profitability and growth, changing the population of firms and the direction of subsequent search (Nelson and Winter 1982). The relation between innovation and selection is there-

fore recursive. Innovation supplies new variants, while prior selection shapes the organizations and capabilities from which later innovation can emerge.

Dosi adds a further distinction between innovation within an established technological trajectory and more discontinuous changes associated with new paradigms (Dosi 1982). His argument also rejects one-directional accounts in which either scientific advance or market demand alone determines technological change. Scientific knowledge, unresolved technical problems, economic incentives, institutions, and previous technological commitments interact in shaping what directions become technically and economically plausible.

Innovation should therefore not be equated with invention. An invention can remain economically marginal; an innovation involves incorporation into productive, organizational, or market practice. Nor does innovation imply improvement in every evaluative dimension. A new technology can increase productivity while intensifying environmental damage, surveillance, labor displacement, dependence, or concentration of power. Evolutionary economics explains novelty and diffusion; normative evaluation requires additional criteria.

The later GRE relevance lies in treating innovation as a transformation of capacities and relations rather than only the appearance of a new product. An innovation can create new complementarities, dependencies, professions, infrastructures, standards, and categories of economic actor. Chapter 2 should preserve this as an inherited problem rather than pre-empt the later GR theory of generativity.

2.25.5 Coevolution

The concept of coevolution extends evolutionary economics beyond the idea that one population adapts to an independently given environment. Economic change frequently involves reciprocal transformation among technologies, firms, industrial structures, institutions, skills, demand patterns, infrastructures, and regulatory arrangements. When change in one domain alters the selective conditions of another, which in turn feeds back into the first, the analytical problem is coevolutionary.

Nelson's account of the coevolution of technology, industrial structure, and supporting institutions gives this problem a clear sectoral formulation (Nelson 1994). Technologies develop along trajectories; firm and industry structures change as technical opportunities and competitive conditions change; institutions develop in response to new economic pressures and capabilities. The causal architecture is therefore not one-directional. Institutional arrangements can accelerate or inhibit technological development, while technological change can generate new institutional demands.

Murmann's comparative study of the synthetic-dye industry provides a historically grounded extension of this approach. Differences among British, German, and American firms cannot be explained adequately through firm capabilities, national institutions, or technological knowledge in isolation. The development of firms, technological knowledge, educational institutions, patent systems, and national industrial structures formed a coevolutionary process with different outcomes across countries (Murmann 2003). The example is useful because it demonstrates that coevolution need not imply synchronized or harmonious change. Complementarities can emerge unevenly; one domain can lag another; and historically contingent institutional configurations can redirect industrial development.

Coevolution also modifies the interpretation of selection and retention. A routine that is advantageous under one technological regime may become maladaptive after infrastructure or regulation changes. An institution that initially supports innovation can later stabilize incumbents and inhibit entry. A new technological capability can alter what kinds of regulation are administratively feasible. Retention mechanisms can therefore help reproduce a system while also becoming objects of selection when complementary domains change.

This literature provides an important foundation for later GR because it relaxes the assumption that the conditions of economic change remain fixed while actors change within them. Yet coevolution is still not identical to GR's later concept of generativity. Coevolution generally establishes reciprocal historical dependence among changing domains. A stronger generative analysis asks how those interactions produce new actors, relations, capacities, constraints, evaluative categories, and transformation rules that were not available in the same form beforehand.

The intellectual inheritance of evolutionary economics can therefore be summarized without turning Chapter 2 into a new evolutionary theory. Variation makes heterogeneity endogenous; selection explains differential persistence under specified environments; retention identifies mechanisms through which historically accumulated differences endure; innovation introduces novelty capable of reorganizing competitive and institutional conditions; and coevolution analyzes reciprocal change among multiple domains. None of these concepts by itself establishes progress, efficiency, justice, or a universal Darwinian ontology. Together, however, they provide GRE with an indispensable vocabulary for economic processes in which the relevant actors, capabilities, technologies, institutions, and environments are historically changing rather than analytically fixed.

2.26 Ecological Economics

The preceding sections reconstructed evolutionary approaches to economic change after examining institutions, capabilities, care, commons, and social reproduction. The present section turns to ecological economics, a heterogeneous interdisciplinary tradition concerned with the dependence of economic activity on material, energetic, and ecological processes. Its role is genealogical. Its objective is to reconstruct five conceptual resources that later become important for GRE: material and energy flows, ecological constraints, human–ecological interdependence, intergenerational relations, and regeneration or ecological capacity. The discussion proceeds by distinguishing ecological economics from narrower applications of conventional allocation theory to environmental problems while also avoiding the opposite reduction in which economic value, institutions, or social conflict are dissolved into biophysical accounting. Costanza's early programmatic statement described ecological economics as inquiry into relationships between ecosystems and economic systems in the broadest sense and explicitly presented environmental and resource economics as only part of that wider field (Costanza 1989). This section therefore treats ecological economics as a plural research tradition rather than as one settled model of nature, value, or sustainability.

Several lineages converge in this tradition without becoming equivalent. Biophysical economics emphasizes throughput, energy, materials, and thermodynamic ir-

reversibility. Systems approaches analyze feedback, accumulation, delay, resource depletion, and pollution. Sustainability theory studies the scale of economic activity relative to ecological capacities and disputes the substitutability of manufactured and natural capital. Social–ecological research examines institutions and ecosystems as coupled systems. Resource economics develops formal accounts of depletion and intergenerational allocation. Ecological economics inherits from all of these while adding questions concerning scale, uncertainty, irreversibility, valuation, distribution, and the relation between human economies and the ecological conditions that sustain them. The resulting conceptual field is broader than an account of environmental externalities alone.

2.26.1 Material and Energy Flows

A foundational move in ecological economics is to represent the economy as materially open rather than as a self-contained circulation of money and commodities. Production requires energy and material inputs drawn from ecological systems; consumption and production return residuals, heat, emissions, and transformed matter to those systems. Monetary circulation can therefore remain balanced while physical stocks, sinks, and energetic conditions change substantially. The economic process is embedded in a material throughput that cannot be reconstructed from prices alone.

Ayres and Kneese provided an influential material-balance formulation of this problem. Their analysis connected production, consumption, residuals, and environmental externalities through the conservation of matter: materials entering economic activity do not disappear when market transactions are completed, but eventually become products, wastes, emissions, or accumulated stocks (Ayres and Kneese 1969). The significance of this argument is methodological as much as environmental. Pollution cannot always be treated as an accidental side effect attached to an otherwise closed production process. Residual generation follows from the material transformation through which production and consumption occur.

Georgescu-Roegen developed a stronger thermodynamic critique. In *The Entropy Law and the Economic Process*, he argued that economic activity transforms available low-entropy matter and energy into less available forms and that the economic process therefore cannot be represented adequately as a reversible mechanical circulation (Georgescu-Roegen 1971). This argument became one of the principal intellectual foundations of ecological economics. It directs attention toward irreversibility, qualitative degradation, and the physical conditions of reproduction over time.

Thermodynamic reasoning nevertheless requires restraint when translated into economics. The entropy law does not by itself determine prices, rights, distributive institutions, technological choices, or normative priorities. Nor does it establish an energy theory of economic value. A physical accounting of joules or tonnes and an economic theory of valuation answer different questions. Ecological economics is strongest when biophysical constraints and social valuation remain connected but analytically distinct.

The systems tradition reinforced this attention to stocks, flows, feedback, and delay. *The Limits to Growth* modeled interactions among population, industrial production, food, nonrenewable resources, and pollution in a finite global system (Meadows et al. 1972). Whatever one concludes about particular scenarios, the work helped make coupled accumulation, delayed feedback, and overshoot legitimate economic ques-

tions. A system may continue expanding for a period even while depleting stocks or degrading sinks whose consequences arrive later. Material throughput therefore introduces temporal structures that are poorly represented by instantaneous exchange alone.

For later GRE, the inheritance is not the proposition that economic reality should be reduced to physical flows. It is the more limited requirement that relational economic analysis remain capable of following the material and energetic carriers through which production, consumption, infrastructure, and ecological consequence are connected. A relation that appears economically productive at one boundary may simultaneously transfer material costs or sink burdens elsewhere.

2.26.2 Ecological Constraints

Ecological economics also changes the status of constraint. In conventional allocation problems, constraints often enter as given resource endowments, technologies, or feasibility conditions. Ecological analysis asks how those constraints are produced by biophysical processes, how quickly they can change, whether they contain thresholds, and whether economic activity alters the future feasible set itself. The relevant issue is therefore not simply scarcity within a fixed environment but the changing ecological scale within which economic activity takes place.

Daly's operational principles of sustainable development express this shift in deliberately biophysical terms. Renewable-resource use should remain within regenerative capacity, waste emissions within assimilative capacity, and depletion of nonrenewable resources should be accompanied by investment in renewable substitutes capable of supporting future services (Daly 1990). These principles are not a complete theory of sustainability, but they make explicit that economic throughput must be evaluated against processes of renewal and absorption rather than only against contemporaneous willingness to pay.

The associated natural-capital literature sharpened a dispute over substitutability. Costanza and Daly argued that maintaining natural-capital stocks is a prudent minimum condition under substantial uncertainty and questioned the assumption that manufactured capital can safely substitute for ecological functions without important limits (Costanza and Daly 1992). This position differs from resource-economic approaches in which sufficiently productive investment may compensate for depletion. The disagreement is substantive: it concerns which ecological functions are replaceable, at what scale, under what knowledge, and with what consequences if substitution fails.

The modern planetary-boundaries literature expresses a related concern at Earth-system scale. Steffen and colleagues identify biophysical processes whose perturbation can move the Earth system away from the relatively stable conditions under which contemporary human societies developed (Steffen et al. 2015). Planetary boundaries are not market prices, welfare weights, or legal limits. They are a scientific framework for reasoning about nonlinear Earth-system change and risk. Their economic relevance arises when production and consumption alter the processes upon which later social and economic possibilities depend.

Ecological constraints should therefore not be interpreted as a static catalogue of immutable ceilings. Technologies, institutions, consumption patterns, ecological restoration, and substitution can change pressures and capacities. At the same time,

the possibility of adaptation does not imply universal substitutability. Some losses are irreversible at relevant human timescales; some processes exhibit thresholds; and some ecological functions cannot be recreated simply by increasing another category of capital. Ecological economics makes these uncertainties part of the economic problem rather than external qualifications added afterward.

This creates a useful distinction for later GRE: a constraint can be exogenous to a local economic model while remaining historically endogenous to the larger social-ecological system. Economic activity may consume, regenerate, relocate, or transform the very capacities that condition subsequent activity. Chapter 2 records this as an inherited analytical possibility rather than yet converting it into a full generative formalism.

2.26.3 Human–Ecological Interdependence

A third lineage moves beyond the language of environmental impact toward reciprocal human–ecological interdependence. The environment is not simply an external recipient of economic externalities, and the economy is not simply a subsystem whose behavior is mechanically determined by ecology. Institutions, technologies, cultural practices, infrastructures, and ecosystems develop through reciprocal influence. The analytical problem is therefore one of coupled systems with heterogeneous causal processes.

Norgaard's coevolutionary account is an important formulation of this position. He describes development as coevolution among ecological and cultural systems and criticizes explanations that imagine one universal trajectory of progress through increasing human control over nature (Norgaard 1994). The coevolutionary perspective makes both directions of change visible: social organization alters ecological processes, while ecological changes reshape technologies, knowledge, livelihoods, institutions, and cultural possibilities.

Ostrom's framework for social–ecological systems provides a more institutionally structured approach. It identifies resource systems, resource units, governance systems, users, interactions, and outcomes as analytically connected components whose relationships vary across cases (Ostrom 2009). The framework does not assume that either ecological variables or institutional variables alone determine sustainability. It instead supports comparative inquiry into how attributes at several levels combine to produce different outcomes.

The ecosystem-services and natural-capital literature adds another route into interdependence. Costanza and colleagues emphasized that ecological systems perform functions critical to human life and economic activity and attempted to estimate the magnitude of those services in monetary terms (Costanza, d'Arge, et al. 1997). The historical importance of this work does not require treating monetary valuation as exhaustive. Ecosystems can be economically consequential even where their contributions are difficult to price, imperfectly substitutable, culturally contested, or necessary for conditions that precede market exchange itself.

This point also limits the metaphor of nature as a stock of assets. Natural-capital language can make ecological dependence legible to economic analysis, but it can obscure ecological relations if every function is imagined as a separable asset with a market-equivalent substitute. Ecological economics therefore contains an enduring tension between valuation strategies that translate ecological functions into economic

metrics and pluralist approaches that preserve biophysical, cultural, ethical, and relational dimensions that resist complete commensuration.

Human–ecological interdependence consequently expands the domain of economically relevant relation. Food systems connect soils, water, climate, labor, knowledge, institutions, and infrastructures. Cities depend on distant energy and material systems. Public health depends on environmental conditions shaped by production and settlement. Ecological changes can alter migration, livelihoods, conflict, insurance, public finance, and future productive capacity. These relations are neither purely ecological nor purely economic, and their causal structure frequently crosses institutional and spatial boundaries.

For later GRE, this lineage opens the possibility of analyzing ecological systems not only as constraints on economic actors but also as participants in the generation of economic capacities and vulnerabilities. The stronger ontological question of whether ecosystems should themselves be treated as economic subjects, agents, or rights-bearing entities belongs elsewhere. Chapter 2 requires only the more modest conclusion that economic possibility is partly constituted through relations with non-human systems.

2.26.4 Intergenerational Relations

Ecological economics also makes time ethically and analytically unavoidable. Resource depletion, infrastructure, pollution stocks, biodiversity loss, climate change, and ecological restoration distribute consequences across generations that do not co-exist symmetrically in markets or political institutions. Present actors can alter the opportunity sets of future persons who cannot bargain with them directly. Intergenerational analysis therefore connects ecological constraint to questions of capital, substitution, uncertainty, and justice.

Mainstream resource economics developed one influential route into this problem. Solow's analysis of exhaustible resources asks under what conditions an economy using a finite natural-resource stock can sustain consumption across generations and emphasizes the possibilities created by reproducible capital and substitution (Solow 1974). Hartwick subsequently derived the well-known result that, in a particular aggregate model, investing resource rents in reproducible capital can support constant per-capita consumption along an efficient path (Hartwick 1977). These results are important precisely because they show that intergenerational sustainability can be formulated inside conventional growth and capital theory.

Ecological economics does not simply discard this lineage. It questions the conditions under which its compensating substitutions are adequate. If a depleted ecological function has no close substitute, if thresholds are uncertain, if ecological losses are irreversible, or if different forms of capital contribute qualitatively different conditions of life, then maintaining an aggregate capital value may be insufficient. Costanza and Daly's natural-capital argument makes this disagreement explicit by treating uncertainty about substitutability as a reason for preserving ecological stocks rather than assuming replacement in advance (Costanza and Daly 1992).

Intergenerational relations also expose the limitations of preference aggregation restricted to presently existing market participants. Discount rates, property rights, public debt, conservation rules, infrastructure standards, and environmental law can redistribute ecological possibilities through time even where future persons have no

present voice. These mechanisms do not establish one correct theory of intergenerational justice. They demonstrate that temporal relations can be institutionally mediated and economically consequential despite the absence of contemporaneous exchange.

The distinction between sustainability and justice should remain visible. A trajectory may preserve some aggregate measure of productive or natural capital while distributing risks and benefits unequally. Conversely, a normatively attractive distribution at one date may still erode ecological conditions required for continuation. Ecological economics therefore contributes to Chapter 2 by making the temporal reproduction of opportunity an explicit economic object, while the fuller normative evaluation of intergenerational relations remains connected to the justice traditions reconstructed earlier.

For later GRE, the important inheritance is the possibility that economic evaluation must track not only present allocations but also how current relations alter the capacities available to subjects who appear later in historical time. The relevant relation can be real and causally structured even when its parties are not simultaneously present.

2.26.5 Regeneration and Ecological Capacity

The final concept concerns ecological capacity. Sustainability is sometimes described negatively as avoiding depletion or remaining within limits. Ecological traditions also contain a more dynamic vocabulary of renewal, assimilation, resilience, recovery, and regeneration. These concepts direct attention toward the processes through which ecological systems maintain or reconstitute capacities over time.

Daly's operational principles already distinguish a renewable stock from the regenerative process that renews it and a waste sink from the assimilative process through which some residuals can be absorbed (Daly 1990). This distinction matters economically. The same current stock can support very different future possibilities depending on rates of renewal, degradation, extraction, and recovery. Ecological capacity is therefore not adequately described by a snapshot of available resources.

Holling's classic distinction between resilience and stability further complicated equilibrium-centered representations of ecology. Resilience concerns the capacity of ecological systems to absorb disturbance while maintaining important relationships, whereas stability concerns return toward an equilibrium condition after disturbance (Holling 1973). Later uses of resilience have expanded far beyond this original ecological problem, sometimes too loosely. In the present genealogy, its importance is narrower: persistence, recovery, and transformation cannot be inferred from the size of a resource stock alone.

Social-ecological analysis adds institutions to this problem of capacity. Ostrom's framework makes sustainability dependent on interactions among ecological attributes, users, governance arrangements, monitoring, and feedback rather than on ecological variables in isolation (Ostrom 2009). Norgaard's coevolutionary perspective similarly implies that ecological and social capacities can change together (Norgaard 1994). Regeneration may therefore depend on social restraint, collective maintenance, knowledge, infrastructure, rights, and governance as well as on biophysical processes.

The language of regeneration nevertheless requires the same normative caution

applied earlier to resilience and evolutionary survival. A system can reproduce or recover while preserving unequal access, harmful production, exclusion, or ecologically undesirable states. Regeneration is a claim about the renewal or enhancement of some specified capacity; it does not by itself establish what ought to be regenerated, for whom, at what scale, or under which distribution of burden and authority.

This genealogy prepares the transition to circular and regenerative economic thought in the next section. Ecological economics supplies the biophysical foundation: throughput is material, sinks and stocks have capacities, renewal takes time, and ecological systems can lose or recover functions. Circular-economic traditions will ask how production and consumption can be reorganized to reduce virgin throughput, waste, and loss through reuse, repair, recycling, and redesign. The two problems overlap but are not identical. A materially circular process can still exceed energy, land, biodiversity, or sink constraints, while ecological regeneration can involve processes that are not reducible to closing industrial material loops.

For later GRE, ecological economics therefore leaves a precise but incomplete inheritance. Economic relations operate within material and energetic flows; they encounter ecological limits; they depend on nonhuman systems; they transmit consequences across generations; and they can degrade or support the capacities upon which subsequent economic activity depends. GR and GRE can later ask how those capacities become generated, eroded, regenerated, and redistributed through evolving relations. Chapter 2 stops at the foundation: ecological capacity is historically dynamic and economically consequential, while its full generative-relational representation remains to be developed.

2.27 Circular and Regenerative Economic Thought

Ecological economics establishes that economic activity is materially open, ecologically embedded, and dependent on regenerative capacities that cannot be inferred from monetary circulation alone. The present section turns from that biophysical foundation to traditions that ask how production and consumption might themselves be reorganized around recirculation, product-life extension, restoration, and renewal. Its role is genealogical. Its objective is to reconstruct five conceptual resources that later become important for GRE: circular resource flows, reuse and recirculation, regenerative production, systemic value retention, and the limits of circularity and regeneration as economic models. The discussion distinguishes industrial ecology, circular-economy strategies, cradle-to-cradle and regenerative-design traditions, and critical circular-economy research. These traditions overlap, but they do not define the same analytical object and should not be treated as stages of a single unified doctrine.

Circular economic thought emerged from several antecedents rather than from one founding theory. Industrial ecology asked whether industrial systems could be reorganized so that residuals from one process became inputs to another. Product-life approaches shifted attention from throughput reduction toward durability, repair, reuse, remanufacture, and the preservation of embodied labor and material value. Circular-economy frameworks later assembled these concerns into broader strategies for closing or slowing resource loops. Regenerative design went further in a different direction by asking whether human systems could participate in the re-

newal and development of ecological capacities rather than merely reduce damage. Critical scholarship then exposed conceptual ambiguity, rebound effects, thermodynamic limits, spatial displacement, and the weak treatment of social justice in many circular-economy formulations. The resulting field is therefore best read as a contested family of approaches to recurrence, retention, renewal, and system redesign.

2.27.1 Circular Resource Flows

One intellectual foundation of circular economic thought lies in industrial ecology. Frosch and Gallopoulos proposed an “industrial ecosystem” in which wastes from one industrial process could become resources for another, reducing the dependence of production on continuous extraction and disposal (Frosch and Gallopoulos 1989). The analogy to ecological systems was deliberately organizational: the industrial economy could be examined as a network of material and energy transformations whose outputs need not terminate at the boundary of each individual firm. This reframing made the connections among facilities, sectors, and residual streams analytically visible.

Chertow’s later account of industrial symbiosis gave this idea greater institutional specificity. Industrial symbiosis concerns collaborative exchanges of materials, energy, water, and by-products among organizations that would otherwise be treated as separate production units (Chertow 2000). Geographic proximity can matter because transport costs and material characteristics shape feasible exchanges, but proximity alone does not generate symbiosis. Firms must identify compatible flows, develop information channels, coordinate investments, establish reliable expectations, and often create governance arrangements capable of sustaining multi-party exchange. Circularity therefore already contains a relational and institutional problem: a technically reusable residual becomes an economic input only when organizational relations allow the conversion to occur.

The circular-economy literature subsequently generalized these linked flows beyond industrial by-product exchange. Stahel’s product-life approach emphasizes maintaining goods, components, and materials in economically useful circulation for longer periods through maintenance, reuse, repair, upgrading, and remanufacture (Stahel 2016). The analytical boundary shifts from a single production event toward the life history of products and assets. A durable object can move through several users, service arrangements, repair cycles, ownership configurations, and component recoveries before its constituent materials are recycled or discarded.

These lineages establish a useful distinction between a *linear flow* and a *recirculating flow*, but the distinction should remain physically and institutionally precise. A material stream can circulate through several economic uses while still requiring virgin inputs, energy, infrastructure, chemicals, transport, or replacement materials. Circularity is therefore a property of specified flows within a defined boundary rather than an automatic description of an entire economy. Haas and colleagues’ material-flow assessment of the global economy illustrates this point empirically: recycling and recirculation coexist with large primary material inputs, energetic uses, long-lived stocks, and outputs that cannot simply be returned to production (Haas et al. 2015).

The scale of observation also matters. A factory can appear circular because its residuals are exported to another facility; a regional industrial network can

appear circular while relying on imported primary materials; a national accounting boundary can omit ecological burdens displaced through international supply chains. Circular resource analysis therefore requires specification of what circulates, through which organizations, across which spatial boundary, over what period, and with which additional inputs. Circularity becomes analytically useful when it describes a concrete configuration of flows rather than functioning as a synonym for sustainability.

For later GRE, the inheritance is limited but important. Industrial ecology and circular-flow analysis show that one process can alter the resource conditions of another process and that economic value can depend on relations among material streams, organizations, infrastructures, and temporal stages. The stronger question of how those relations generate new capacities or transform the conditions of future economic action remains beyond the present genealogy.

2.27.2 Reuse and Recirculation

Circular economic thought also differentiates among ways of extending the economic life of products, components, and materials. Reuse, maintenance, repair, refurbishment, remanufacture, repurposing, and recycling all recirculate something, but they preserve different portions of the prior product's organization and require different levels of additional processing. Treating them as one undifferentiated act of "recycling" obscures the economic significance of product integrity, embedded labor, technical function, information, and user relations.

Stahel's circular-economy formulation gives priority to strategies that preserve products and components because much of the economic effort embodied in manufacturing can remain available when an object is maintained, repaired, reused, or remanufactured (Stahel 2016). Material recycling, by contrast, can recover material while destroying much of the product-specific structure into which labor, design, energy, and organizational knowledge had previously been invested. Circularity therefore contains a temporal hierarchy of possible interventions: extending a functioning product's life is analytically different from recovering constituent materials after the product has been dismantled.

Bocken and colleagues formalize related distinctions through product-design and business-model strategies for slowing and closing resource loops (Bocken et al. 2016). Slowing loops concerns durability, long product life, maintenance, and service arrangements that reduce the frequency with which products must be replaced. Closing loops concerns bringing materials back into production after use. Resource efficiency can reduce material intensity, but efficiency alone does not establish either slower or closed circulation. These distinctions help prevent a circular economy from being reduced to end-of-pipe waste management.

Cradle-to-cradle design develops another influential lineage. Braungart, McDonough, and Bollinger contrast eco-effectiveness with strategies focused primarily on minimizing negative emissions or increasing efficiency. Their design framework seeks material cycles in which outputs are intentionally specified for continued use within biological or technical systems (Braungart et al. 2007). The importance of this tradition for Chapter 2 lies less in any universal claim that all materials can circulate indefinitely than in its shift of attention toward design at the beginning of the product life cycle. Future recirculation possibilities depend partly on earlier decisions

concerning material composition, separability, toxicity, modularity, repairability, and the institutional arrangements through which products return.

Recirculation is consequently shaped before the moment of disposal. A product that is technically repairable may remain practically unrepairable if spare parts, diagnostic information, skilled labor, legal permissions, or service infrastructures are unavailable. A reusable object can become disposable when business models, warranty rules, fashion cycles, software support, or ownership structures shorten its effective life. Conversely, institutional changes can make previously discarded products economically recoverable. The circulation of material objects is therefore mediated by informational, legal, organizational, and cultural relations as well as by engineering properties.

This mediation also means that reuse cannot be evaluated only through the fact of recurrence. Secondary markets can broaden access or preserve embodied value, but they can also move obsolete, hazardous, or low-quality goods to actors with less bargaining power. Repair can support local capability and employment, while repair restrictions can concentrate technical control elsewhere. Remanufacturing can reduce primary material demand under some conditions, while new logistics and processing requirements create other resource burdens. Circularity identifies a pattern of recirculation; evaluation of that pattern requires additional ecological, economic, and normative criteria.

For later GRE, reuse and recirculation provide an important temporal insight: value-bearing configurations can persist, be partially retained, be decomposed, and re-enter new processes. Yet recirculation alone does not tell us whether a later configuration reproduces an earlier economic relation or generates a qualitatively different one. That distinction becomes central when circularity is compared with regeneration and, later, with generativity.

2.27.3 Regenerative Production

Regenerative economic thought intersects with circularity while asking a different question. Circular approaches commonly begin from the flow of products, components, or materials and seek to reduce waste, slow throughput, or close loops. Regenerative traditions begin more directly from the condition and developmental capacity of living systems. Their characteristic concern is whether human activity can participate in the renewal, restoration, or enhancement of the ecological and social conditions upon which subsequent activity depends.

Lyle's *Regenerative Design for Sustainable Development* is an important early formulation of this orientation. Regenerative design treats ecological processes as active systems of renewal and asks how human design can work with cycles of energy, water, nutrients, landscape, and settlement rather than organize development around one-way consumption (Lyle 1994). The concept of regeneration therefore shifts attention from a static resource stock toward processes that maintain or restore capacities through time.

Reed later sharpened the distinction between reducing environmental damage and participating in the health of living systems. His regenerative-development argument criticizes sustainability practice when it becomes predominantly an exercise in efficiency and proposes a whole-systems, place-based approach in which human activity is situated within ecological relationships (Reed 2007). Mang and Reed further de-

velop this approach as a methodology grounded in place, developmental processes, and the evolving relations among human and ecological systems (Mang and Reed 2012). In this lineage, regeneration cannot be represented adequately as a checklist of independently optimized environmental indicators because the object of intervention is the continuing capacity of an interconnected living system.

Cradle-to-cradle design intersects with this regenerative language through its concept of eco-effectiveness. Braungart and colleagues seek production systems whose material outputs can contribute positively to subsequent biological or technical cycles rather than simply become less harmful residuals (Braungart et al. 2007). This formulation expands the design objective from reducing quantities of waste toward creating outputs with specified future roles. Yet the biological and technical cycles of cradle-to-cradle design should not be identified automatically with the place-based developmental claims of regenerative design. One is organized strongly around product and material specification; the other places greater emphasis on the evolving health and potential of living systems and places.

The distinction between circular and regenerative production can therefore be stated positively. Circularity concerns recurrence and recirculation within specified economic or material flows. Regeneration concerns renewal or development of a specified capacity. The two can coincide, but neither entails the other. A highly circular industrial loop can circulate toxic materials efficiently or reproduce an ecologically damaging scale of production. A regenerative ecological project can depend on non-circular external inputs while restoring soil fertility, watershed function, habitat, or other capacities. Analytical clarity requires identifying the object whose circulation or regeneration is being claimed.

Regeneration also raises a problem of evaluation. A system can regenerate one capacity while degrading another. Agricultural production might restore soil organic matter while depending on exploitative labor. A community enterprise might renew local skills while increasing pressure on water or land. An ecosystem can recover toward a state that is ecologically persistent but socially undesirable for particular human groups. Regenerative language therefore does not itself provide a complete economic or normative criterion. It describes a temporal relation between activity and the future capacity of a specified system.

For later GRE, the regenerative lineage offers a richer temporal vocabulary than conservation alone. Economic activity can consume capacities, maintain them, restore them, or contribute to their development. The later generative-relational question concerns how capacities of many kinds—ecological, technical, institutional, epistemic, and social—are produced through relations and how their transformation changes future possibilities. Chapter 2 retains regeneration as an inherited concept without yet converting it into that broader framework.

2.27.4 Systemic Value Retention

The phrase *systemic value retention* is used here as an organizing label for a problem distributed across circular-economy, industrial-ecology, and product-life literatures. The issue is what remains available when an object, component, material, capability, or infrastructure passes through successive economic uses. Circularity can preserve more than physical matter: a maintained product can retain function, embodied labor, design, reliability, user familiarity, organizational knowledge, and access to an

established service network. Different modes of recirculation retain different portions of these prior investments.

Stahel's emphasis on product-life extension makes this particularly visible. Maintenance, reuse, and remanufacture can preserve a larger share of a product's accumulated organization than material recovery after destruction (Stahel 2016). Bocken and colleagues' distinction between slowing and closing loops similarly implies that temporal extension and material recovery should not be treated as equivalent strategies (Bocken et al. 2016). An economy that recycles a high proportion of discarded material after very short product lives may be materially more circular than a linear economy while still destroying substantial functional and economic value prematurely.

Industrial symbiosis extends the retention problem from products to interorganizational systems. A by-product can retain economic usefulness when another organization possesses a compatible process, transport connection, technical standard, contractual relation, and demand for the material (Chertow 2000). The same physical residual may therefore be valuable in one relational configuration and burdensome in another. What is retained is not reducible to matter alone; it includes the relational conditions that make the matter usable.

Systemic analysis also reveals that value retention at one level can coincide with value loss elsewhere. Extending the life of an incumbent technology can preserve material and financial value while delaying adoption of a less harmful alternative. Maintaining asset value for owners can increase maintenance burdens for users. Recycling can preserve material while destroying cultural significance or local employment. A circular business model can retain revenue streams while shifting environmental or care costs outside the accounting boundary. The language of value retention therefore requires specification of the relevant value form, subject, time horizon, and system boundary.

This problem becomes more difficult when values are heterogeneous. Economic exchange value, use value, ecological function, cultural significance, technical optionality, and social capability need not rise and fall together. The value-pluralism traditions reconstructed earlier in Chapter 2 already caution against assuming a common cardinal measure for every relevant form of value. Circular-economy strategies therefore cannot be evaluated by a single generic quantity called "retained value" unless the measure and its exclusions are made explicit.

The systemic qualifier also draws attention to sequence. Retention at one moment can affect later options. Repair can preserve a device long enough for another user to access it. Modular design can leave components available for later recombination. Open technical standards can preserve compatibility across generations of equipment. Conversely, proprietary lock-in, contamination, mixed materials, or information loss can destroy future recirculation possibilities before the physical object is discarded. A circular system is therefore partly constituted by the preservation of pathways through which future reuse remains feasible.

For later GRE, this literature prepares questions concerning circulation, retention, dissipation, and conversion across heterogeneous value forms. The present section stops before a distinct GRE theory of value recirculation. Its narrower conclusion is that circularity changes the temporal location of economic loss and preservation and that the value preserved through recirculation depends on material design, institutional relations, knowledge, infrastructure, and evaluative perspective.

2.27.5 Limits of Circularity and Regeneration as Economic Models

The expansion of circular-economy discourse has generated an equally important critical literature. Kirchherr, Reike, and Hekkert's analysis of 114 definitions shows that circular economy is used in substantially different ways, often with emphasis on reduce–reuse–recycle activities and comparatively weak attention to systemic change, social equity, and future generations (Kirchherr et al. 2017). Geissdoerfer and colleagues likewise show that circular economy and sustainability overlap without being conceptually identical (Geissdoerfer et al. 2017). Circularity can therefore function as a useful analytical principle while remaining insufficient as a complete theory of sustainable economic organization.

The first limitation is physical. Cullen argues that a perfectly closed circular economy should be treated as a theoretical benchmark rather than as an attainable perpetual-motion system (Cullen 2017). Materials degrade, disperse, mix, corrode, or become uneconomic to recover; collection and separation require energy and infrastructure; and energy itself cannot be recirculated indefinitely without degradation. The thermodynamic foundations reconstructed in ecological economics therefore remain binding. Circular design can reduce primary throughput and waste, but it cannot abolish material and energetic dependence.

Empirical material-flow analysis reinforces this caution. Haas and colleagues show that large economies remain dominated by primary extraction, energetic uses, additions to long-lived stocks, and material outputs that are not immediately available for recycling (Haas et al. 2015). A circularity indicator can consequently improve while total throughput or ecological pressure remains high. The environmental significance of circular strategies depends on absolute scale, displaced production, energy systems, material quality, and the timing of stock turnover as well as on the fraction of material entering a secondary loop.

The second limitation concerns rebound. Zink and Geyer analyze how secondary production can lower prices, create additional demand, or fail to displace primary production sufficiently, thereby offsetting part of the intended environmental benefit of recycling or reuse (Zink and Geyer 2017). The existence and magnitude of rebound are empirical questions rather than automatic outcomes. Their importance is theoretical: a circular intervention changes markets and behavior, and its system-level consequence cannot always be inferred from the efficiency of the intervention considered in isolation.

The third limitation concerns system boundaries and governance. Korhonen, Honkasalo, and Seppälä identify physical, spatial, temporal, and organizational limitations in circular-economy reasoning and question formulations that imply a frictionless closure of economic loops (Korhonen et al. 2018). Materials and environmental burdens can be shifted geographically; one firm's waste reduction can depend on another sector's increased processing; benefits and costs can occur at different times; and the actors capable of redesigning products may differ from those responsible for collection or end-of-life treatment. Circularity therefore requires coordination across organizations whose incentives, authority, information, and capacities are heterogeneous.

A fourth limitation is normative. The recurrence of material or economic flows does not establish the justice of the relations through which they circulate. A circu-

lar supply chain can retain exploitative labor relations, concentrated ownership, unequal exposure to hazardous processing, or exclusion from repair and reuse infrastructures. A community can regenerate ecological capacity while distributing benefits and burdens unequally. The justice of a circular or regenerative arrangement must therefore be assessed through additional distributive, procedural, relational, and historical criteria. Circularity and regeneration describe properties of processes; neither supplies a complete account of legitimate economic order.

These limitations clarify a final distinction important for the architecture of this book. *Circularity* concerns recurrence, recirculation, or loop closure within a specified flow. *Regeneration* concerns the renewal or development of a specified capacity. *Generativity*, in the later GR sense, concerns the production and transformation of capacities, subjects, relations, structures, and conditions that can alter what becomes possible subsequently. A process can be circular while repeatedly reproducing the same damaging institutional structure. A regenerative process can restore a capacity while leaving the relations governing access to that capacity unchanged. A generative transformation can create new relations or capabilities without itself being materially circular. These distinctions prevent circulation, renewal, and generation from being treated as equivalent simply because all are dynamic.

Circular and regenerative traditions nevertheless make an indispensable contribution to the genealogy of GRE. They direct attention away from terminal transactions toward sequences of use, maintenance, return, recovery, renewal, and redesign. They show that the economic significance of a resource depends on the infrastructures and relations through which it can re-enter activity. They also make visible a temporal question that conventional allocation analysis can obscure: whether an economic process preserves, depletes, restores, or reorganizes the capacities required for later processes. GRE will eventually extend this inheritance toward heterogeneous value conversion, recirculation, generative return, capture, dissipation, and transformation of generative capacity. Chapter 2 remains at the theoretical foundation. Circularity, regeneration, and generativity are connected problems whose differences are as important as their overlap.

2.28 Relational Value and Relational Goods

The preceding sections have reconstructed several traditions in which economic value appears through production, exchange, institutional organization, ecological dependence, care, commons governance, and circular or regenerative processes. The present section narrows the genealogy to theories in which the value of a good, practice, or activity depends partly on the relations through which it is constituted, realized, shared, interpreted, or sustained. Its role is to distinguish several intellectual lineages that are often grouped under a broad relational vocabulary but that identify different analytical objects. Its objective is to reconstruct five such objects: value within relations, relational goods, collective and community value, cultural and symbolic value, and forms of economic value that cannot be represented adequately through isolated possession alone. The discussion proceeds comparatively across moral philosophy, environmental valuation, economic sociology, relational-goods research, commons scholarship, cultural economics, and the anthropology of commodities. GR and GRE enter only in the closing synthesis as later frameworks that may connect these inherited problems without treating them as already equivalent.

The term *relational* requires particular discipline in this context. It can indicate that a person's valuation is shaped by a relationship, that a good can be enjoyed only through interaction, that a good acquires meaning from a social relation, that a relation itself is treated as valuable, or that access to a shared institutional or ecological relation conditions the realization of other values. These claims differ in ontological strength and empirical content. Likewise, relational value, relational goods, public goods, commons, social capital, cultural value, and symbolic capital identify different theoretical problems. The genealogy becomes useful for GRE only if those differences remain visible.

2.28.1 Value within Relations

One route toward relational value begins in pluralist theories of valuation. Anderson argues that goods differ not only in the amount of value assigned to them but also in the modes through which they are appropriately valued and in the social relations through which their value is realized (E. Anderson 1993). Love, respect, friendship, citizenship, market use, and impersonal calculation do not simply represent different quantities on one common scale. They can involve different practical attitudes and different relationships among persons. The evaluative question therefore includes how an object or person is valued and which social relation the act of valuation expresses.

This approach matters economically because the same material transfer can realize different forms of value in different relationships. Payment to a contractor, a gift between friends, support within a household, compensation for care, and a public entitlement may involve similar monetary magnitudes while expressing different relations of obligation, authority, reciprocity, or membership. The economic significance of the transfer cannot always be reconstructed from price and quantity alone. Anderson's argument concerns normative modes of valuation rather than a general relational ontology, but it establishes a foundation for analyzing value as partly dependent on the social relation through which an object, service, or person is treated.

Zelizer develops a related problem within economic sociology. Her concept of *relational work* describes the practical activity through which people differentiate social relations, establish boundaries around them, match them with appropriate transactions, and select media of exchange that fit the relationship (Zelizer 2012). Monetary exchange therefore does not automatically erase intimacy, care, family relation, friendship, or professional obligation. Participants continually negotiate which transfers are appropriate, what they mean, and how they should be represented. Economic media are interpreted through social relations, while economic transactions can also reaffirm, contest, or transform those relations.

A different use of relational value appears in environmental ethics and sustainability research. Chan and colleagues introduce *relational values* to describe preferences, principles, and virtues associated with relationships among people and between people and nature, especially where the relevant concern is inadequately represented by a simple intrinsic-versus-instrumental dichotomy (Chan et al. 2016). Stewardship, care, identity, responsibility, belonging, and living well with others can matter because of the relationship itself and the commitments it carries. This environmental usage should remain conceptually distinct from relational goods in welfare or public-choice theory. It concerns values associated with relationships and responsibilities,

rather than necessarily a jointly consumed good produced through interaction.

The anthropology of exchange adds another perspective. Appadurai argues that value can be studied through the social and political organization of commodity circulation, drawing attention to the ways objects become desirable, exchangeable, restricted, or prestigious through historically situated regimes of exchange (Appadurai 1986). In this lineage, value is neither a timeless substance residing in the object nor merely an isolated subjective preference. It develops through relations among objects, persons, exchange situations, cultural classifications, and political conditions.

These approaches establish several distinct meanings of value within relations. A relation can shape the mode of valuation; the value can concern the relationship itself; a transaction can acquire meaning from the relation in which it occurs; and an object's value can change through its social trajectory. The common inheritance is analytical rather than doctrinal: value may require reconstruction of relations and practices that are invisible when valuation is represented only as an attribute attached to an isolated object or individual preference.

2.28.2 Relational Goods

The concept of *relational goods* gives this problem a more specific form. Uhlaner's analysis of political participation introduces relational goods into rational-choice reasoning as objectives whose value depends on interaction with, or identification with, other persons (Uhlaner 1989). Participation may therefore generate benefits that are conditional on the participation or presence of others. This changes the standard free-rider problem because an individual's payoff can partly arise from acting with particular others rather than solely from consuming the final public outcome.

Uhlaner's formulation is important precisely because it remains compatible with an individual-choice framework. Relational goods enter the individual's payoff structure, but their realization depends on social interaction or shared identity. This distinguishes them from ordinary private goods that can be enjoyed independently and from standard public goods whose benefits are available impersonally once provided. A political meeting, common celebration, collective action, or shared activity can matter because the participant values being involved with others in a particular way.

Gui develops the economic analysis further by treating interpersonal encounters as productive processes (Gui 2000). An encounter can generate ordinary outputs, such as information or service delivery, while simultaneously producing relational goods through communication, recognition, affect, trust, or the quality of interaction. Gui also introduces the idea of *relational assets*: relation-specific conditions such as mutual knowledge, familiarity, or social climate that affect the quality of later encounters and can themselves be strengthened or depleted through interaction. The economic process therefore has a recursive interpersonal dimension. Today's encounter can alter the relational conditions of tomorrow's encounter.

This formulation gives relational goods a temporal structure. Their production and consumption can occur together; their quality can depend on the participation of several actors, and previous interactions can affect later productive possibilities. A workplace, school, cooperative, neighborhood, or service relation can consequently have economic characteristics that are poorly represented when interaction is modeled only as a vehicle for transferring independently produced goods between pre-formed individuals.

Donati reconstructs a stronger relational-sociological interpretation and explicitly contrasts it with rational-choice accounts (Donati 2019). Both approaches recognize goods that can be enjoyed only through sharing with others, but they differ over what the good fundamentally is. A rational-choice formulation can represent relational goods as benefits individuals obtain from shared interaction. Donati instead treats some relational goods as emergent properties of the relationship itself, generated through reciprocal orientations among participants. This is a stronger ontological claim and should not be silently imported into every economic use of the term.

The relational-goods literature therefore contains an internal disagreement that is important for Chapter 2. One can recognize interaction-dependent benefits without treating relations as emergent entities with their own causal properties. Conversely, a relational-sociological theory may claim that the relation itself becomes a real social good irreducible to the aggregation of individual utilities. GR can later engage this disagreement, but the genealogy should preserve it.

Several neighboring concepts should also remain separate. A relational good is not automatically a public good; Uhlaner's formulation often depends on identifiable co-participants rather than anonymous non-rival consumption. It is not identical with social capital, which usually refers to resources available through networks, obligations, trust, or institutionalized relations. It is not equivalent to cooperation, since actors can cooperate instrumentally without valuing the relation itself. The distinctive issue is whether some valuable output or experience exists only through a particular configuration of participation and relation.

2.28.3 Collective and Community Value

The relational-goods literature leads toward a broader question concerning value that exists at collective or community scales. Collective value need not imply a mysterious value possessed by a group independently of its members. It can arise because some valued conditions depend on shared institutions, common practices, reciprocal expectations, collective memory, public spaces, infrastructures, ecological relations, or capacities for coordinated action. Their significance is partly located in the pattern of relation through which persons can participate in them.

The commons tradition provides one established route into this problem. Ostrom's analysis of common-pool resources shows that collective governance can generate capacities that cannot be understood by examining resource units or isolated appropriators alone (Ostrom 1990). Monitoring, rule-making, sanctioning, conflict resolution, trust, and recognized boundaries can make continued access and sustainable use possible. The value realized by participants consequently depends partly on an institutional relation among users and between users and the resource. This does not make the resource itself a relational good in the narrower sense. The point is that collective institutional capacity can become a condition for realizing individual and shared values.

Gift and reciprocity traditions reveal another form of collective value. Mauss analyzes exchange systems in which giving, receiving, and reciprocating participate simultaneously in legal, moral, religious, political, and status relations (Mauss 1990). Polanyi later distinguishes reciprocity, redistribution, and market exchange as different instituted patterns through which economic activity is organized (Polanyi 1957). These traditions show that value circulation can participate in the reproduction of

membership and social relation. What is sustained is not only a sequence of transfers but also a pattern of obligation, recognition, alliance, and collective continuity.

Collective and community value can therefore include a capacity to continue acting together. A neighborhood association, scientific community, cooperative, language community, commons institution, or cultural association may generate value through shared rules, accumulated knowledge, mutual expectations, common infrastructures, and opportunities for participation. Some of these benefits can be assigned to individuals; others concern the continued existence and quality of the collective relation that makes future participation possible.

The concept remains normatively ambiguous. A cohesive community can exclude outsiders, enforce oppressive roles, concentrate authority, or stabilize unjust practices. Collective persistence is therefore not equivalent to collective value in a normative sense, and collective value for insiders can coexist with costs imposed on non-members. The question of who constitutes the relevant community, who participates in defining its goods, and whose burdens are externalized remains essential.

For later GRE, the useful inheritance is the idea that some economic values depend on collective capacities and shared relational conditions rather than on independently possessed objects alone. The stronger claims concerning the generation, return, distribution, and justice of collective value belong to later parts of the book.

2.28.4 Cultural and Symbolic Value

Cultural and symbolic approaches extend the relational problem from interpersonal interaction toward classification, distinction, representation, and historically shared meaning. Bourdieu's analysis of taste demonstrates that judgments of cultural worth are structured through social position, education, habitus, distinction, and struggles over legitimate culture (Bourdieu 1984). Cultural goods therefore operate within relations of classification and social difference. Their significance cannot be reconstructed solely from production cost or market price because practices of recognition and distinction participate in making particular objects, styles, credentials, or tastes socially consequential.

Bourdieu's broader vocabulary of symbolic power also shows that classifications can have effects because they are socially recognized. Symbolic value is consequently relational in a specific sense: prestige, legitimacy, distinction, and authorized classification depend on recognition within structured social fields. This does not mean that symbolic capital is simply another name for relational value. Symbolic capital refers to resources and forms of recognized legitimacy operating within relations of power and classification; the broader relational-value problem includes many forms of value without this specific field-theoretic structure.

Cultural economics develops another lineage. Throsby distinguishes economic value from cultural value and treats cultural value as multidimensional, potentially involving aesthetic, symbolic, spiritual, historical, social, and authenticity-related dimensions that do not collapse into a single monetary measure (Throsby 2001). His concept of cultural capital further directs attention to assets that embody cultural value and can transmit cultural benefits across time. A heritage site, artistic practice, language, archive, or cultural institution can consequently possess economic effects while also sustaining forms of significance that monetary valuation represents only partially.

The anthropology of commodities adds historical mobility to this picture. Kopytoff argues that commoditization is itself a cultural and cognitive process: societies classify which things may become commodities, which should remain outside market exchange, and when an object can move from one status to another (Kopytoff 1986). An heirloom, sacred object, artwork, document, body part, or public asset may therefore acquire different economic and moral statuses during its social biography. The object remains materially continuous while its admissible relations of ownership, exchange, use, and valuation change.

Appadurai similarly treats commodity status and value as situated within social trajectories and political regimes of exchange (Appadurai 1986). Together with Zelizer's relational work, these approaches undermine the assumption that a transaction medium carries one fixed meaning across contexts. Price can be analytically important while remaining insufficient to describe the cultural and relational transformation through which something becomes saleable, giftable, sacred, prestigious, publicly protected, or excluded from exchange.

The lineage therefore separates several dimensions that are frequently conflated. Cultural value concerns forms of significance constituted through cultural practices and histories. Symbolic value concerns recognition, classification, prestige, or legitimacy within structured social relations. Commodity status concerns the social authorization of exchangeability. Market price concerns the terms of a particular exchange. Their interaction is empirically important, but none can be substituted automatically for the others.

2.28.5 Economic Value beyond Isolated Possession

The preceding traditions collectively challenge a representation of economic value in which every relevant good appears as an object possessed by an isolated individual. Ownership and individual possession remain important economic institutions, especially where exclusion, transfer rights, collateral, control, liability, or inheritance matter. The point of the relational literature is narrower: some economically relevant values are realized through access, participation, recognition, shared use, institutional membership, reciprocal relation, cultural meaning, or continued connection rather than through possession alone.

The capability approach offers one parallel foundation. Sen's distinction between resources and capabilities shows that possession of a resource does not determine the substantive opportunity it affords (Sen 1999). Conversion depends on personal, social, and environmental conditions. A library, transport system, digital infrastructure, public space, school, or health system can therefore matter economically because it enters a relation of access and capability formation. Individual ownership of the underlying asset is not required for the participant to realize significant value from it.

Shared-resource theory offers a second route. Frischmann treats infrastructures as shared inputs whose social value can arise through heterogeneous downstream activities that cannot always be predicted or priced in advance (Frischmann 2012). The value of a road, communications network, knowledge resource, standard, or research infrastructure may therefore depend on the field of activity it enables for many users. Its economic significance can exceed the sum of direct payments collected for access, especially where openness allows unanticipated complementary uses to emerge.

Relational goods provide a third route. In Gui's account, an encounter can produce a good whose realization is inseparable from participation in the encounter itself (Gui 2000). The relevant value cannot be stored and transferred like an ordinary asset while preserving all of its properties. Friendship, collegiality, mutual recognition, civic participation, or a trusting service relation may rely on continuing relations that are altered when one party withdraws or when the institutional setting changes.

Cultural and symbolic theories add still another route. The value of a cultural object may depend on provenance, collective memory, authenticity, recognition, or the institution within which it is preserved. A symbolic status can depend on continuing social acknowledgment. A commons can depend on a governance relation that maintains access and ecological capacity. In each case, a possession-based metric records only one dimension of the economic situation.

This wider view does not require the conclusion that all value is relational or that property and individual preference cease to matter. It instead enlarges the set of economically relevant relations. Some values are attached principally to objects or states; some depend on what a person can do with resources; some emerge through interaction; some reside in shared institutional capacity; some are sustained through cultural recognition; and some depend on ecological or infrastructural relations that no individual participant can reproduce alone.

The theoretical inheritance for GRE can therefore be stated cautiously. Existing literatures already provide multiple ways to understand value as relation-dependent, jointly realized, culturally constituted, institutionally enabled, or symbolically recognized. They also reveal that these forms of value may be vulnerable to disruption when the sustaining relation disappears. Later GRE can investigate how such values are generated, maintained, transformed, circulated, captured, returned, or dissipated across changing relational systems. Chapter 2 does not yet supply that generative theory. Its contribution is to establish that an economics restricted to isolated possession would exclude several well-developed traditions in which relations participate directly in the constitution or realization of economically significant value.

This foundation also prepares the normative problem that follows. Once some valuable goods and capacities depend on relations, institutions, shared meanings, and conditions of participation, questions of justice cannot be exhausted by asking who possesses how much of a distributable object. They also concern the procedures, relations, recognition structures, and generative conditions through which valuable possibilities become available or unavailable in the first place.

2.29 Justice Theory and Generative Justice

The preceding sections have reconstructed traditions in which value, capability, care, commons governance, ecological capacity, regeneration, and relational goods expand the objects that economic analysis may need to evaluate. The present section turns from the objects of value to the standards by which their distribution, production, circulation, and institutional organization may be judged. Its role is to reconstruct several major traditions of justice theory that later make a generative-relational account of justice possible without treating that later account as their necessary conclusion. Its objective is to distinguish distributive, procedural, relational, and generative questions, and then to clarify why circulation, return, and the continued ca-

capacity to generate value introduce an additional normative problem. The method is genealogical and comparative: Rawlsian, capability, entitlement, procedural, recognition, relational-egalitarian, and generative-justice approaches are allowed to retain their disagreements. GR and GRE enter only at the end as later frameworks that may place these inherited questions into a common temporal and relational analysis.

The distinctions are important because the word *justice* can refer to different objects of evaluation. A distribution can be criticized because persons receive unequal or inadequate shares. A decision can be criticized because the procedure is arbitrary or exclusionary. A social order can be criticized because persons stand in relations of domination, stigma, dependency, or unequal authority even when some material inequalities have been reduced. A historical process can also be questioned because it extracts value, depletes the capacities that generated it, or closes the conditions under which affected persons and communities could participate in future generation. These dimensions can interact, but none can be inferred automatically from another. The genealogy of justice theory is therefore most useful when it identifies several evaluative questions rather than compressing them into one master criterion.

2.29.1 Distributive Justice

Modern theories of distributive justice ask how benefits, burdens, opportunities, rights, resources, or other socially significant goods should be distributed among persons. Rawls gives one of the most influential formulations by treating the basic structure of society as a primary subject of justice and asking which principles free and equal persons would select under fair conditions of choice (Rawls 1999). His account does not simply prescribe equality of final holdings. Equal basic liberties, fair equality of opportunity, and the difference principle perform different roles, and the distributive question is located within the institutional organization of social cooperation rather than reduced to a direct division of an already fixed stock.

Rawls is especially important for the present genealogy because the object of distribution is partly institutional. The basic structure shapes life prospects through property regimes, legal rules, political institutions, educational opportunities, labor markets, and other arrangements. Distribution therefore concerns more than the final pattern visible at one moment. Institutional arrangements help produce the positions and expectations whose distribution is later observed. Even so, Rawlsian justice remains distinguishable from the stronger generative problem developed later in this section: the fact that institutions shape prospects does not by itself amount to a theory of how the capacities and relations that generate future value should be reproduced, returned to, or transformed.

Sen changes the evaluative space. His capability approach argues that equality or inequality should not be assessed only through resources, primary goods, income, or subjective utility because persons differ in their ability to convert means into valuable beings and doings (Sen 1992; Sen 1999). What matters includes the substantive freedoms people actually possess. Two persons can hold the same resource bundle while facing radically different opportunities because of disability, social norms, public infrastructure, care responsibilities, environmental conditions, or other conversion factors. Distributive justice consequently becomes partly a question about the distribution of effective capability rather than only the distribution of commodities.

The capability approach also complicates the relation between distribution and

generation. Education, health, public infrastructure, social recognition, political participation, and care can be valued as present achievements, but they can also enlarge or diminish what people will later be able to do. Sen's framework does not thereby become a theory of generative justice, yet it provides an important foundation for asking whether justice concerns the distribution of future capability as well as present goods. This is one reason GRE should preserve the capability tradition as a distinct inheritance rather than absorb it into a generalized language of value.

Nozick provides a sharply different challenge to distributive reasoning. His entitlement theory argues that justice in holdings is historical: whether a holding is just depends on processes of acquisition, transfer, and, where injustice has occurred, rectification, rather than on whether the resulting distribution conforms to a preferred end-state pattern (Nozick 1974). Whatever one concludes about Nozick's substantive principles, the methodological contrast is significant. It demonstrates that identical present distributions can be evaluated differently when their histories differ. A theory of justice may therefore need to ask not only *what* persons possess but *how* the present arrangement came about.

Rawls, Sen, and Nozick should not be synthesized into one distributive doctrine. Rawls evaluates a fair basic structure; Sen emphasizes capabilities, realizations, and comparative removal of injustice; Nozick makes legitimate historical entitlement central. Their disagreement establishes a broader foundation: the currency of justice, the institutional site of justice, and the relevance of historical process are themselves contested. Later generative-relational analysis can inherit this plurality without deciding in advance that one evaluative space exhausts the others.

2.29.2 Procedural Justice

Procedural justice shifts attention from the pattern of outcomes to the process through which decisions, allocations, classifications, and authoritative judgments are made. Rawls distinguishes several forms of procedural justice according to the relation between an independent criterion of a correct outcome and the procedure used to reach it (Rawls 1999). The distinction makes clear that a just procedure is not merely a technically efficient route to a result. Procedures can themselves be part of what justice evaluates.

This insight becomes particularly important where no uncontested independent criterion determines the unique correct outcome. Elections, adjudication, collective bargaining, regulatory decision making, research assessment, and participatory governance often require rules governing voice, representation, evidence, contestation, revision, and authority. A procedure can allocate standing and agenda-setting power before any final distribution is known. The design of decision processes can therefore alter which interests become visible, which forms of knowledge count, and which alternatives remain available for consideration.

Empirical procedural-justice research adds another dimension. Tyler's work on legal authority shows that people's assessments of fairness and legitimacy depend substantially on how authorities exercise power, including opportunities for voice, neutrality, respectful treatment, and trustworthy decision making, rather than solely on whether individuals receive preferred outcomes (Tyler 2006). This does not convert perceived procedural fairness into a complete moral theory. A procedure may be experienced as legitimate while operating within unjust background institutions. The

empirical literature instead shows that procedures have independent social effects: they shape legitimacy, compliance, trust, and willingness to cooperate.

Procedural justice also introduces a temporal problem. Procedures are not only devices that produce decisions; repeated procedures can train participants, distribute political competence, create or erode trust, stabilize roles, and establish expectations about who may speak and who must listen. A participatory institution may generate capacities for later collective action, while an opaque or humiliating process can diminish them. This observation prepares a later generative question, but the distinction must remain clear: procedural justice concerns the fairness and legitimacy of decision processes; generative justice asks additionally what those processes do to the capacities and relations from which future action and value creation become possible.

Thus outcome and procedure remain analytically distinct. A favorable outcome can be reached through an exclusionary procedure, while a fair procedure can yield an outcome that some participants regard as substantively inadequate. Later GR/GRE should retain this distinction rather than treating procedural participation as sufficient evidence of distributive or relational justice.

2.29.3 Relational Justice

A third family of theories argues that justice cannot be reduced to distributive shares or procedural form because the relations in which persons stand to one another are themselves normatively significant. Young's critique of the distributive paradigm emphasizes domination, oppression, decision-making power, cultural representation, institutional position, and group difference as justice-relevant phenomena that cannot always be represented as quantities of goods allocated among already independent individuals (Young 1990). The question becomes partly whether social structures place some persons under the arbitrary power, silencing, marginalization, or normative authority of others.

Anderson develops a related account of democratic equality. Her critique of luck-egalitarian approaches redirects attention from compensating persons for undeserved disadvantages toward creating a community of equals in which people relate without oppression, hierarchy, stigma, or second-class standing (E. S. Anderson 1999). Scheffler similarly identifies an important strand of egalitarian thought in the ideal of social relations among persons who regard one another as equals rather than in equal distribution alone (Scheffler 2003). Relational equality consequently does not make distribution irrelevant. Material inequalities matter partly because they can produce or express relations of domination, dependency, subordination, or unequal status.

Recognition theory introduces another route to relational justice. Honneth analyzes injuries of misrecognition through their effects on socially mediated self-relation and moral experience (Honneth 1995). Fraser, by contrast, resists reducing justice to recognition and argues for an integrated analysis of redistribution and recognition oriented toward parity of participation; her exchange with Honneth makes the disagreement explicit (Fraser and Honneth 2003). Material deprivation and status subordination can reinforce one another, but they remain analytically distinguishable. A person can receive resources while remaining institutionally stigmatized, or enjoy cultural recognition while lacking the material conditions for

effective participation.

Relational justice therefore enlarges the evaluative object from *what people have* to *how people stand in relation to one another*. Authority, dependence, vulnerability, recognition, participation, and the capacity to contest decisions become relevant. Yet the relational perspective should not be treated as automatically superior to distributional analysis. Relations are partly sustained through resources, law, organizational position, infrastructure, and access to capabilities. The distributive and relational dimensions can be mutually constitutive without being reducible to one another.

This distinction also matters for GR. A relation can be causally productive while normatively objectionable. Exploitative labor relations, exclusionary communities, highly coordinated authoritarian organizations, and discriminatory institutions can generate trust among insiders, capacities, identities, or economic output. Generativity is therefore not itself a criterion of justice. A later generative-relational theory must specify which forms of generation, for whom, under which relations, and with what effects on the possibility of future participation and contestation.

2.29.4 Generative Justice

The phrase *generative justice* already names an established theoretical and practical tradition and should not be presented as terminology invented by GR or GRE. Eglash and Garvey's early formulation connected bottom-up social organization, sustainability, egalitarianism, and dynamical ideas of self-organizing social ecologies (Eglash and Garvey 2014). Eglash subsequently developed a more explicit account organized around the generation, alienation, and circulation of value (Eglash 2016). This lineage provides one of the most direct predecessors for GRE's later concern with generative value and therefore requires explicit attribution as well as conceptual differentiation.

Eglash's framework begins from a critique of extractive arrangements in which value is separated from the human, ecological, or expressive sources that generate it. Its normative alternative emphasizes unalienated value, participation by value generators in the benefits of generation, control over conditions of production, and self-sustaining paths through which value can circulate rather than being removed in ways that degrade the source of future generation (Eglash 2016). The framework therefore differs from a theory concerned only with redistribution after extraction has already occurred. It asks whether the social or ecological source remains capable of generating and whether those who participate in generation retain meaningful control and benefit.

This shift is important because it changes the temporal position at which justice is evaluated. Distribution commonly examines the allocation of goods or opportunities within an institutional order. Generative justice asks about the production process, the source of value, the continued capacities of generators, and the pathways through which generated value moves. A transfer that improves the final distribution can coexist with an extractive structure that repeatedly recreates deprivation. Conversely, a system that returns material, knowledge, authority, capability, or ecological resources to the sites from which value is generated may alter the conditions producing future distributions.

Later work on computational reparations extends this framework through the idea of unalienated circular value flow and argues that reparative transformation should support value generators in controlling production conditions, protect gener-

ated value from extraction, and circulate value in ways that benefit the human and non-human communities involved in generation (Eglash, Robinson, et al. 2024). This is a substantive research programme, not merely a metaphor for fairness. It links justice to institutional design, technology, labor, ecology, community governance, and the reproduction of generative capacity.

GR/GRE inherits this tradition but should not simply rename it. Eglash's generative justice provides a normative and design-oriented framework centered especially on labor, ecological, and expressive/social value, unalienation, bottom-up organization, and circular return. Later GRE may investigate a broader range of heterogeneous value forms, relations among value domains, conversions that are only partially commensurable, and changes in the conditions through which new relations and capacities become possible. Those extensions require argument; they cannot be claimed as implicit in the predecessor literature. Chapter 2 therefore records generative justice as an existing lineage that makes the later GRE problem intelligible while preserving the boundary between inheritance and reconstruction.

2.29.5 Circulation, Return, and Generative Value

The final foundation concerns the relation between justice and the movement of value after it has been generated. Eglash's formulation is especially important because it treats circulation back toward value-generating sources as part of justice rather than as an optional distribution undertaken after production (Eglash 2016; Eglash, Robinson, et al. 2024). Ecological nutrients returned to soils, revenues and productive authority retained by workers or communities, knowledge circulated among participants, and social resources reinvested in the relations that generated them illustrate different kinds of return. These examples should not be collapsed into one homogeneous substance called value. They indicate a family of problems concerning whether generative sources are reproduced, strengthened, depleted, or alienated through subsequent circulation.

This perspective connects with several lineages already reconstructed in this chapter. Marxian circulation and reproduction show that production cannot be separated from the conditions of the next production cycle. Feminist social-reproduction theory shows that laboring capacities depend on care and reproductive activity that can be externalized from formal economic accounting. Ecological economics shows that production depends on regenerative and assimilative capacities that extraction can degrade. Commons theory shows that shared resources persist only where governance and maintenance reproduce conditions of access and cooperation. Capability theory shows that resources matter through the opportunities they help people realize. None of these traditions is equivalent to generative justice, but together they make it possible to see return as more than monetary redistribution.

For GRE, *generative value* should therefore be approached cautiously at this foundational stage. Eglash's prior work establishes a clear precedent for value that remains connected to and circulates through its generative sources. GRE's later task is to investigate how heterogeneous forms of value are generated, converted, circulated, returned, captured, dissipated, and regenerated across relational systems. The relevant return may be material, ecological, epistemic, institutional, capability-forming, cultural, or relational. Because these forms can be only partially commensurable, return cannot be assumed to mean restoration of an equivalent quantity on one com-

mon scale.

This also distinguishes *return* from several neighboring concepts. Return is not identical to compensation, because compensation can occur without restoring generative capacity. It is not identical to redistribution, because redistribution can move goods among recipients without altering the relation between value generation and extraction. It is not identical to reciprocity, because return can occur through institutional or ecological pathways without a dyadic exchange of benefits. And it is not identical to circularity, because a circular flow can reproduce an unjust or degrading relation. The normative question concerns what is returned, to which generative source or community, through which institutional pathway, and whether the return sustains or enlarges future capacities without imposing unjust burdens elsewhere.

A generative-relational perspective therefore adds a temporal question to established justice theory: how do present arrangements distribute the *capacity to participate in the generation of future possibilities*? This question should remain provisional here. It points toward later GRE analyses of capacity generation, option-space formation, generative foreclosure, intergenerational generativity, and the justice of relation formation and transformation. Chapter 2 does not yet provide those theories. Its task is to establish that distributive, procedural, relational, capability, reproductive, ecological, and Eglashian generative-justice traditions together supply a sufficiently rich intellectual foundation for asking them.

The genealogy yields a final set of distinctions that later GRE must preserve. Distributive justice evaluates shares, resources, capabilities, or holdings; procedural justice evaluates decision processes and participation; relational justice evaluates standing, domination, recognition, and the quality of social relations; generative justice, in Eglash's established usage, evaluates value generation, alienation, control of production conditions, and circulatory return; and later GR/GRE may ask how the relations and capacities from which future possibilities emerge are themselves generated and distributed. These objects interact, but no one of them provides a complete substitute for the others. Justice in a generative-relational economy will therefore require attention both to what people receive and to the processes, relations, and future-generating conditions through which economic life remains possible.

2.30 Systems Theory and Cybernetic Traditions

The preceding sections have reconstructed economic and social theories in which institutions, relations, capabilities, reproduction, ecological capacity, circularity, value, and justice become historically organized rather than appearing as isolated attributes of already constituted actors. The present section turns to a different intellectual lineage: the twentieth-century development of systems theory and cybernetics. Its role is to establish the conceptual resources through which wholes, environments, feedback, regulation, self-organization, and adaptation became objects of systematic analysis across biology, engineering, organization theory, and the social sciences. Its objective is not to treat these traditions as a single systems doctrine, but to distinguish several problems that were often connected historically while remaining analytically different. The section therefore moves from the system–environment distinction to feedback, regulation and control, self-organization, and open or adaptive systems. Its method is genealogical and comparative. General systems theory, classical cybernet-

ics, management cybernetics, autopoiesis, nonequilibrium self-organization, and sociological systems theory are reconstructed as partially overlapping lineages whose differences remain important for later GR and GRE.

A systems vocabulary can easily become so general that it ceases to discriminate among mechanisms. Almost any object can be called a system once elements, relations, and a boundary have been specified. Feedback can describe a causal loop without implying successful regulation. Regulation can preserve selected variables without implying centralized command. Self-organization can refer to internally generated reorganization, emergent pattern formation, or self-production, depending on the theoretical tradition. Openness can refer to exchange of matter, energy, information, or other resources with an environment, while organizational closure in autopoietic theory concerns a different property altogether. The value of the systems and cybernetic traditions therefore lies less in one universal vocabulary than in the set of distinctions they made available for studying organized persistence and change.

2.30.1 System and Environment

General systems theory gave the system itself a methodological status that differed from both atomistic decomposition and discipline-specific description. Von Bertalanffy argued that formally similar organizational problems could arise across otherwise heterogeneous domains and that scientific analysis therefore required concepts adequate to wholes, organized relations, and open systems rather than only isolated components (Bertalanffy 1968). His programme did not require that organisms, organizations, physical systems, and societies be materially identical. Its claim was that certain structural or organizational forms could be studied at a level abstract enough to permit comparison across domains.

The distinction between a system and its environment is indispensable to this move. A system becomes analytically identifiable only through some specification of what belongs to the focal organization, what remains outside it, and which exchanges or perturbations cross the boundary. In von Bertalanffy's treatment of living organisms, the importance of the environment is especially clear because living systems are open: they maintain themselves through continuing inflows and outflows rather than through isolation from surrounding conditions (Bertalanffy 1968). A relatively persistent organization can therefore coexist with continuing turnover of material components. Persistence of system organization is not identical to persistence of every element composing it.

The system–environment distinction is nevertheless not a neutral act of description. Different research questions can produce different boundaries around the same empirical domain. A household may be treated as a unit in one model, while relations among household members become the focal system in another. A firm can be analyzed as an organization interacting with markets, as a set of internal regulatory processes, or as one node within a wider production network. Systems analysis consequently requires explicit boundary specification rather than assuming that the relevant system is naturally given in advance.

Later sociological systems theory gives the system–environment distinction a stronger theoretical role. Luhmann makes the distinction central to a theory in which social systems are constituted through communication and differentiated from environments that remain more complex than the systems themselves (Luh-

mann 1995). This is not simply von Bertalanffy's open-system biology transferred to sociology. Luhmann's social systems are organized through a distinctive theory of communication, self-reference, and operational differentiation. The comparison is therefore useful precisely because it demonstrates how the same vocabulary of system and environment can carry different ontological and explanatory commitments.

The systems lineage leaves later GR with a basic but limited inheritance. Relations can be studied within organized wholes, and any such analysis must specify a boundary and an environment. Yet the identification of a system does not establish that the boundary is permanent, ontologically ultimate, or causally exogenous. A later generative-relational analysis can therefore inherit system–environment distinctions while asking how boundaries, memberships, and relevant environments themselves become formed, contested, and transformed. That stronger question should not be attributed retrospectively to general systems theory as a whole.

2.30.2 Feedback

Cybernetics made feedback one of the central concepts for understanding organized behavior across machines and organisms. Rosenblueth, Wiener, and Bigelow had already analyzed behavior through relations between inputs, outputs, and purposeful activity before Wiener's *Cybernetics* consolidated control and communication into a wider interdisciplinary programme (Rosenblueth et al. 1943; Wiener 1948). Feedback shifts explanation away from a strictly one-directional causal sequence. An output can alter conditions that become relevant to subsequent inputs, so the consequences of action can enter the process that generates later action.

This recursive structure does not by itself determine what the loop will do. Negative feedback is commonly associated with error correction or stabilization because deviations from a reference condition can produce responses that counteract the deviation. Positive feedback can amplify an initial difference because the consequence of a process strengthens the conditions that produce further change in the same direction. The same system can also contain several loops with different delays, gains, timescales, and points of intervention. The presence of feedback therefore does not entail homeostasis, stability, or self-correction.

Wiener's cybernetics connected feedback to communication and information. A regulator must in some way receive signals concerning relevant states or deviations and convert those signals into responses capable of affecting later system behavior (Wiener 1948). This connection helped make control problems comparable across servomechanisms, physiology, nervous systems, and other organized processes. Yet the analogy remains methodological rather than a demonstration that biological, mechanical, and social feedback possess the same meaning or mechanism.

Feedback also has a distinct significance for economic and social analysis. Expectations can alter behavior in ways that influence the conditions to which those expectations respond. Rules can change behavior, which changes the distribution of cases to which the rule is subsequently applied. Prices, investment, institutional legitimacy, network participation, and technological adoption can each enter reinforcing or counteracting loops. Such applications require mechanism-specific analysis: naming a loop does not explain the social relations, delays, information channels, power structures, or institutional conditions through which the loop operates.

For later GR, the cybernetic legacy is therefore recursive rather than teleological.

Consequences can re-enter the conditions of subsequent generation, but a feedback loop is not yet a generative theory. Feedback may reproduce a previously specified target, amplify deviation, or destabilize an existing arrangement without generating new categories, relations, capacities, or rules. GR can inherit the causal importance of recursive effects while retaining a separate question concerning when recursion changes the architecture through which later feedback itself becomes possible.

2.30.3 Regulation and Control

Regulation gives feedback an evaluative or functional orientation by specifying variables, ranges, or conditions whose maintenance matters to the system under study. Ashby's cybernetics is particularly important because it formalizes regulation through the relation among disturbances, regulators, outcomes, and variety (Ashby 1956). His law of requisite variety expresses a limit on regulation: a regulator cannot reliably compensate for a range of disturbances if its own available responses are insufficiently differentiated for the task. Regulation is therefore constrained by informational and behavioral variety rather than secured merely by the existence of an authority or control center.

This insight should not be translated too quickly into political language. In cybernetics, *control* can refer to the capacity of a mechanism to keep selected variables within an acceptable range despite disturbance. It does not necessarily mean centralized domination, coercion, or hierarchical command. A distributed set of local processes can regulate a system, and centralized authority can fail to regulate one if it lacks adequate information, response variety, or temporal responsiveness. Political power and cybernetic control can interact, but they remain different concepts.

Ashby's framework also clarifies why regulation is selective. Every regulator implicitly or explicitly privileges some variables and some acceptable ranges. Maintaining temperature, liquidity, organizational viability, ecological stock, or inflation within a specified range are different regulatory projects because they define different essential variables and different disturbance structures. Successful regulation of one variable can also destabilize another. A regulatory analysis is therefore incomplete until it identifies what is being maintained, against which disturbances, by which mechanisms, and at whose cost.

Management cybernetics extends these problems to organizations. Beer's viable-system work treats organizations as recursively organized systems that must coordinate operations, manage internal complexity, respond to environments, and maintain viability across several levels of organization (Beer 1972). Its importance for the present genealogy lies in taking organizational complexity seriously rather than assuming that a single command center can directly control every relevant process. Viability requires differentiated functions, information channels, coordination, and sufficient regulatory variety.

Regulation and control nevertheless remain narrower than governance in the sense used later in GRE. Regulation asks whether selected variables can be maintained or guided under disturbance. Governance also raises questions concerning who defines the target, how legitimate authority is constituted, which actors bear regulatory burdens, which possibilities are excluded, and whether the regulated order should continue to exist. A system can be cybernetically well regulated and normatively objectionable. Conversely, a legitimate governance arrangement can

face severe regulatory limits. This distinction will matter later when GRE studies the generation and transformation of governance relations rather than equating governance with system stabilization.

2.30.4 Self-Organization

Self-organization introduces a different problem. Regulation generally presupposes some relevant organization whose variables are to be maintained or controlled. Self-organization asks how organized pattern can arise or change without being fully specified by an external organizer. Ashby's 1947 paper is an early cybernetic formulation of this problem: a determinate dynamic system can nevertheless undergo internally induced changes of organization and behavior (Ashby 1947). The significance of the argument lies in separating determinacy from a permanently fixed organization. A system can follow determinate dynamics while its internal configuration changes in ways that alter subsequent behavior.

Von Foerster later made self-organization and the role of the observer central problems within cybernetics, including the relation between self-organizing systems and their environments (Foerster 2003). This lineage gradually shifted cybernetics from the observation and control of systems toward reflexive questions concerning observation, recursion, and the conditions through which organization is identified. The move is important because what counts as organization often depends on a description of relevant variables, scales, and regularities rather than appearing independently of every observational standpoint.

A different lineage develops through nonequilibrium thermodynamics. Nicolis and Prigogine analyze self-organization through dissipative structures and pattern formation in systems maintained away from equilibrium by flows of energy or matter (Nicolis and Prigogine 1977). Here self-organization concerns the emergence of macroscopic order through nonlinear physical processes and fluctuations under nonequilibrium conditions. This should not be identified with Ashby's cybernetic reorganization or with social self-organization merely because the same word is used. The mechanisms, state variables, and explanatory objects differ.

Autopoiesis introduces still another concept. Maturana and Varela characterize living organization through networks of processes that recursively produce the components involved in producing and maintaining that organization (Maturana and Varela 1980). Their emphasis on organizational closure should not be confused with thermodynamic isolation. A living system can exchange matter and energy with an environment while remaining operationally organized through processes that reproduce the network constituting the living unity. Autopoiesis is therefore neither simply feedback nor a synonym for spontaneous order.

The diversity of these traditions makes a broad equation between self-organization and desirable decentralization untenable. Self-organized patterns can be fragile, exclusionary, extractive, or destructive. They can arise under strong boundary conditions and external resource flows. They may preserve an organization, transform it, or produce a pattern with no normative significance at all. Self-organization consequently describes a family of generative mechanisms rather than an ethical endorsement of whatever emerges without centralized design.

For later GR, self-organization supplies an especially important precursor because it makes the production of organization itself an explanatory object. Yet GR will need

a wider vocabulary when the generated outcomes include new subjects, social categories, institutions, relations, interpretive schemes, capacities, or rules of subsequent generation. Self-organization establishes that organization need not be imposed externally in finished form. It does not by itself establish a general theory of how heterogeneous social relations generate one another across history.

2.30.5 Open and Adaptive Systems

The final lineage concerns systems that persist through continuing interaction with changing environments. Von Bertalanffy's open-system perspective rejects the assumption that living organization can be understood adequately as a closed equilibrium system. Organisms maintain relatively stable organization through continuous exchange, transformation, and throughput (Bertalanffy 1968). Openness therefore concerns dependence on environmental flows as well as exposure to disturbance. A system can remain recognizable precisely because it is continually exchanging components with what lies beyond its boundary.

Adaptation introduces an additional question: how does the system alter its states, responses, or organization in relation to changing conditions? Ashby's work on regulation makes adaptation intelligible partly through changes that maintain essential variables within viable ranges despite disturbances (Ashby 1956). Beer's management cybernetics similarly treats viability as requiring an organization capable of responding to environmental complexity rather than preserving one rigid internal state (Beer 1972). Neither framework implies that every adaptation is optimal. Persistence can result from satisficing adjustment, institutional protection, redundancy, learning, environmental modification, or the disappearance of alternatives.

Autopoietic theory again complicates the vocabulary. Maturana and Varela emphasize that living systems do not simply receive environmental instructions and reproduce them internally. Environmental perturbations occur in relation to a system whose organization constrains the transformations it can undergo (Maturana and Varela 1980). This differs from a model in which the environment directly specifies the system's internal state. Adaptation can therefore involve a history of structural change under continuing coupling rather than passive conformity to an external template.

The idea of an adaptive system should also be distinguished from the later theory of complex adaptive systems developed more fully in Section 61. Here the term serves a broader historical purpose: it identifies the systems and cybernetic move from static organization toward persistence through changing interactions, feedback, regulation, and reorganization. Complexity theory later adds population-level adaptation, distributed agents, nonlinear interaction, multiscale organization, and emergent macro-patterns in more specific ways. Keeping these genealogies separate prevents *adaptation* from becoming a generic synonym for any successful historical change.

Several limits of the systems vocabulary are now visible. A system can adapt by narrowing the options of some participants, shifting costs into its environment, excluding disturbances from measurement, or reorganizing itself in ways that preserve the system while degrading broader social or ecological conditions. Viability of the focal system is not equivalent to welfare, justice, sustainability, or desirable development. System boundaries can conceal externalized burdens, just as regulatory targets can privilege some variables over others. The ethical and political evaluation of adap-

tation therefore requires concepts that systems theory alone does not supply.

The intellectual inheritance for GR and GRE can now be stated precisely. Systems theory contributes organized wholes, boundaries, environments, openness, and multilevel dependence. Cybernetics contributes recursive causation, feedback, regulation, information-sensitive control, variety, and viability. Self-organization traditions make the production of organization itself analyzable, while autopoiesis makes self-production and organizational closure central theoretical problems. None of these traditions is equivalent to Generative Relational Theory. A later GR framework asks the stronger historical question of how systems, boundaries, actors, relations, regulatory criteria, and even the mechanisms of adaptation are themselves generated and transformed through relational processes.

This distinction also prepares the next scientific lineage. Systems and cybernetics make recursion, regulation, adaptation, and organized persistence intelligible, but they do not by themselves provide the full geometric and temporal vocabulary needed to analyze state spaces, trajectories, attractors, bifurcations, critical transitions, and explicitly time-dependent dynamics. Those resources belong to the dynamical-systems traditions considered next. Chapter 2 therefore treats systems theory and cybernetics as indispensable foundations for GRE's later formal work while preserving their historical specificity and their limits.

2.31 Dynamical Systems and Nonlinear Change

Systems theory and cybernetics established conceptual resources for feedback, regulation, self-organization, adaptation, and organized persistence. Dynamical-systems theory adds a more explicitly temporal and geometric vocabulary for describing how states evolve, how families of possible evolutions are organized, and how qualitative patterns of motion can change. The role of this section is to reconstruct that vocabulary before it is used later in GR and GRE. Its objective is to distinguish five analytical objects that are frequently compressed into a general language of “dynamics”: state spaces, trajectories, attractors, bifurcations and critical transitions, and explicitly time-dependent forms of evolution. The discussion proceeds from the representation of possible states to the organization of motion and then to transformations in the governing dynamics. Its method is formal and genealogical. Mathematical concepts are introduced at the level needed to clarify their intellectual contribution, while their transfer to economic and social analysis remains subject to ontological suspension and model-specific justification (Strogatz 2024; Hirsch et al. 2012).

The dynamical-systems tradition changes the unit of analysis in a consequential way. A single observation describes where a modeled system is at one time; a dynamical analysis studies the rule or family of rules through which states are related across time. Stability, recurrence, oscillation, convergence, divergence, and sensitivity thereby become properties of organized evolution rather than static attributes of isolated states. Nonlinearity further permits effects whose magnitude and direction depend on the current state, interaction structure, or parameter regime. Small differences can decay in one region of a state space and expand in another. Several long-run patterns can coexist. A gradual parameter change can reorganize the qualitative structure of possible trajectories. These possibilities make dynamical systems especially important to later relational and generative work, while the mathematical

vocabulary itself does not establish that an economy or society possesses a single fixed state space or evolution law.

2.31.1 State Spaces

A dynamical model begins by specifying a space of possible states. The state is intended to contain the variables required, at the level of the model, to locate the system at a given time and to determine its subsequent evolution together with the governing rule. Depending on the problem, the state space may be a finite set, a Euclidean space, a manifold, or a higher-dimensional or functional space. The term *phase space* is often used when the state variables include quantities such as positions and momenta or, more generally, when the geometric organization of possible motion is central. Modern expositions of dynamical systems treat this move from individual equations to the geometry of the state space as foundational because equilibria, periodic orbits, invariant sets, basins, and bifurcations are all defined relative to a specified space of possible states (Hirsch et al. 2012; Strogatz 2024).

For a continuous-time autonomous system, a standard representation assigns a state $x(t)$ in a state space X and specifies a vector field f that gives the instantaneous rate of change. Equation 2.1 states the generic form.

$$\dot{x}(t) = f(x(t)), \quad x(t) \in X. \quad (2.1)$$

Equation 2.1 is deliberately minimal. It says nothing by itself about the material composition of the modeled system, the observability of the state, or the adequacy of the chosen variables. Its analytical contribution is to separate two objects: the current state $x(t)$ and the evolution rule f . Discrete-time systems make the same distinction through iterated maps, where a rule assigns a successor state to a current state. Continuous and discrete formulations can therefore support a shared qualitative vocabulary even though their mathematical behavior and available theorems differ in important respects.

State-space construction is already an act of theoretical specification. A model of population dynamics may use population sizes as state variables; a model of market adjustment may use prices and quantities; an epidemiological model may partition a population into compartments. Each representation determines which differences count as differences of state and which details are suppressed. If relevant historical information is omitted, two observations represented by the same modeled state may evolve differently because the state description is insufficient. The apparent failure can reflect memory, hidden variables, delayed effects, stochastic influences, or an inappropriate boundary around the modeled system. Dynamical-systems language therefore makes state specification explicit rather than eliminating the epistemic problem of choosing what belongs in the state.

This point matters strongly for economic and social inquiry. Many social descriptions use variables whose meaning depends on institutions, classifications, legal arrangements, or historical conventions. A variable such as “employment,” “capital,” “creditworthiness,” or “household” can remain numerically measurable while its constitutive relations change. A state space built from such variables can be useful without being historically invariant. The state-space concept contributes a disciplined question: which distinctions must be represented for the modeled evolution to be

intelligible? It does not guarantee that one representation remains adequate across institutional transformation.

The geometric viewpoint also distinguishes a state space from the empirical world it represents. Coordinates are analytical choices; dimensions may summarize heterogeneous processes; distances can be meaningful in one model and arbitrary in another. Transformations of coordinates can preserve relevant dynamical structure when the representations are appropriately related, while coarse-graining can remove distinctions that matter to the evolution. Later GRE can use state-space methods to organize economic processes, but the passage from an observed economy to a mathematical state space requires explicit choices concerning entities, relations, scales, variables, and measurement.

The inheritance from this first strand is therefore precise. Dynamical-systems theory provides a language in which possibilities can be represented together rather than as disconnected observations. It makes the geometry of possible states available for analysis and prepares the study of paths through that geometry. GR can inherit this representational resource while retaining a further question concerning the historical generation of the variables, dimensions, boundaries, and distinctions from which a state space is constructed.

2.31.2 Trajectories

Once a state space and evolution rule have been specified, dynamical analysis turns from possible states to trajectories. A trajectory records the ordered states generated from an initial condition under the model's dynamics. In continuous time, a flow describes how states are carried through the state space as time varies; in discrete time, repeated application of a map generates an orbit. The collection of trajectories produces a phase portrait through which equilibria, cycles, separatrices, recurrent regions, and other qualitative structures can be studied without requiring a closed-form solution for every initial condition (Hirsch et al. 2012; Strogatz 2024).

The trajectory perspective introduces history in a mathematically specific sense. Two states that are close at one instant can have different pasts and, depending on the dynamics, different futures. Conversely, trajectories originating from distinct initial states can converge toward the same long-run behavior. The dynamical object of interest is consequently larger than a sequence of independent snapshots. Temporal ordering, direction of motion, rates of change, and the geometry of neighboring trajectories can all matter to explanation.

Stability provides one central way to compare trajectories. An equilibrium is stable when sufficiently small perturbations remain controlled in an appropriate sense; asymptotic stability additionally requires nearby trajectories to approach the equilibrium over time. Related concepts apply to periodic orbits and invariant sets. Stability is therefore a property of responses to perturbation within a specified model and neighborhood. It should be distinguished from persistence observed over a finite historical period. An institution can appear empirically persistent because disturbances have been weak, because stabilizing mechanisms operate, because alternatives are blocked, or because the variables used to represent institutional change are too coarse. Dynamical stability becomes an explanatory claim only after the relevant state space and perturbations have been specified.

Nonlinear dynamics makes the relation between initial conditions and later tra-

jectories especially important. Lorenz's analysis of a deterministic nonlinear model of atmospheric convection demonstrated that bounded deterministic equations can generate nonperiodic trajectories with strong sensitivity to small differences in initial conditions (Lorenz 1963). The significance of this result extends beyond the specific meteorological model. Determinism in the evolution rule does not entail practical long-run predictability. A system can be governed by deterministic equations while finite precision in observations or initial conditions sharply limits forecasting horizons.

Sensitivity should also be kept distinct from randomness. Chaotic dynamics can arise in deterministic systems, whereas stochastic dynamics introduce probabilistic elements into the evolution law or disturbances. Empirical time series can make these sources difficult to distinguish, especially under limited data and measurement error. For social and economic inquiry, the distinction cautions against treating irregular observed motion as sufficient evidence of either randomness or deterministic chaos. Identification requires more than visual resemblance to a complicated trajectory.

Trajectories also make path dependence easier to formulate with precision. In a fixed dynamical system, a current state that fully specifies the system can in principle contain the information needed for future evolution. Historical dependence may then appear through the state itself, through multiple basins reached from different initial conditions, through hysteresis, or through variables that encode accumulated effects. In many empirical settings, however, the researcher observes only a projection of a richer state. Apparent dependence on the path can therefore arise because relevant historical variables remain outside the observed state description. Dynamical-systems theory does not dissolve the concept of history; it forces the analyst to ask where history enters the formal representation.

For later GRE, the trajectory concept is valuable because economic processes frequently concern transitions rather than isolated outcomes: accumulation, institutional change, capability formation, technological diffusion, debt dynamics, ecological degradation, and reconstruction all unfold through ordered histories. Yet a social trajectory is not automatically equivalent to a trajectory generated by a fixed vector field. The formal vocabulary becomes informative when a model states what counts as the state, which rule links states over time, and which forms of perturbation or uncertainty are relevant. The later generative-relational programme inherits the analytical priority of histories while allowing the structures that generate those histories to become historical objects in their own right.

2.31.3 Attractors

Attractors organize the long-run behavior of families of trajectories. In broad terms, an attractor is an invariant dynamical object toward which a set of nearby trajectories approaches under the evolution of the system. Depending on the system, attractors can take the form of stable equilibria, periodic orbits, invariant curves, or more complicated sets. The associated *basin of attraction* identifies the initial conditions whose trajectories approach the attractor. This vocabulary gives a geometric representation of convergence without requiring every trajectory to become identical at each finite time (Strogatz 2024; Hirsch et al. 2012).

The distinction between an attractor and its basin is conceptually important. The attractor describes an asymptotic organization of motion; the basin describes the re-

gion of initial conditions connected to that organization under the specified dynamics. A system with several attractors can therefore display multistability: different initial conditions, perturbations, or histories can lead toward different long-run regimes even when the governing equations and parameter values are the same. Basin boundaries then become significant because a perturbation that remains within one basin can have a qualitatively different long-run consequence from a perturbation that crosses into another.

The language of attraction can mislead when transferred into ordinary social language. A mathematical attractor need not represent a goal, preference, intention, welfare maximum, or normatively desirable state. Attraction is a property of trajectories under an evolution law. A poverty trap, ecological collapse, segregated configuration, or unstable political-economic arrangement could in principle possess attracting dynamics within a model. Conversely, a socially desirable condition may be dynamically fragile. Normative evaluation and dynamical attraction therefore belong to different analytical dimensions.

The Lorenz system supplied an especially influential illustration of complicated bounded dynamics. Lorenz showed that a low-dimensional deterministic nonlinear system could produce bounded, nonperiodic motion and extreme sensitivity to initial conditions (Lorenz 1963). Subsequent dynamical-systems work developed the geometric and topological analysis of chaotic invariant sets and strange attractors much further. The broader lesson is that long-run organization need not reduce to convergence toward a fixed point or simple periodic cycle. A bounded region of state space can sustain persistent aperiodic motion whose detailed trajectory remains difficult to forecast.

Attractor language has consequently traveled into ecology, economics, political analysis, and theories of social reproduction. Such travel can be analytically productive when the analogy is disciplined. To claim that an institutional order, trust relation, market regime, or pattern of inequality functions as an attractor requires more than observing persistence. The analyst needs some account of the relevant state variables, the mechanisms that move the system through the state space, the neighborhood from which return or convergence occurs, and the perturbations under consideration. Without those elements, “attractor” operates mainly as a metaphor for persistence or recurrence.

This distinction is especially relevant to GR and GRE because later chapters will use attractor-like reasoning to study self-reinforcing relational formations. The dynamical-systems lineage contributes a rigorous conceptual separation among current state, long-run invariant organization, basin structure, perturbation, and return. GR can then ask a stronger generative question: how are the attractor, its basin, and the dynamics that create the basin historically produced or modified? A social process may alter the very relations that previously stabilized it, creating new modes of reproduction or removing old ones. That problem extends the inherited dynamical vocabulary without being contained in the mathematical definition of an attractor itself.

Attractors also provide a useful bridge between persistence and contingency. A system can display strong local persistence once it enters a basin while remaining contingent with respect to the historical events that brought it there. Conversely, a basin can shrink or disappear as parameters change. This combination helps explain why dynamical-systems theory became important to later thinking about lock-in, re-

silience, regime shifts, and critical transitions. Those applications depend, however, on the next distinction: qualitative change in the organization of trajectories cannot be inferred merely from movement within an unchanged phase portrait.

2.31.4 Bifurcation and Critical Transition

Bifurcation theory studies qualitative changes in dynamical behavior as parameters vary. A parameterized family of dynamical systems can preserve the same broad phase portrait over one range of parameter values and then undergo a structural change at a critical value. Equilibria can appear or disappear, stability can change, periodic motion can emerge, or invariant structures can reorganize. The principal contribution of bifurcation theory is therefore to distinguish motion within a dynamical regime from changes in the regime's qualitative organization (Kuznetsov 2023; Strogatz 2024).

Classical local bifurcations illustrate several different mechanisms. In a saddle-node bifurcation, equilibria can be created or annihilated in pairs. A transcritical bifurcation can exchange stability between intersecting equilibrium branches. Pitch-fork bifurcations arise in systems with suitable symmetry and reorganize equilibria through symmetry-breaking or its reverse. A Hopf bifurcation can convert the stability of an equilibrium into nearby oscillatory behavior through the emergence or disappearance of a periodic orbit. These names classify local mathematical structures; they do not supply substantive explanations for the empirical mechanisms represented by the variables and parameters.

The bifurcation perspective clarifies why gradual changes in a condition can produce discontinuous changes in observed behavior. If a slowly varying parameter moves a system toward a point where the qualitative structure of the dynamics changes, a small additional parameter change can be associated with a large shift in the realized state or long-run regime. This provides one mathematical route to abrupt transition. Other routes also exist. Noise can induce movement between coexisting basins, rapid forcing can generate rate-dependent transitions, and a large external perturbation can cross a basin boundary without any underlying bifurcation. Abrupt empirical change therefore does not uniquely identify a bifurcation mechanism.

The literature on critical transitions develops one important application of this reasoning. Scheffer and colleagues review systems in which approaching thresholds can be associated with declining recovery rates and statistical indicators linked to *critical slowing down* (Scheffer et al. 2009). Near some bifurcations, the dominant restoring dynamics weaken, so perturbations decay more slowly and time series can show changes such as increased autocorrelation or variance. These signals are conditional diagnostic resources rather than universal predictors. Their interpretation depends on the type of transition, the speed of forcing, noise structure, sampling, stationarity assumptions, and the adequacy of the underlying model.

The term *critical transition* should also remain distinct from several neighboring uses of *criticality*. A bifurcation parameter can take a critical value in the technical sense of bifurcation theory. Critical phenomena in statistical physics concern another body of theory involving collective behavior, scaling, and phase transitions. Self-organized criticality refers to still another family of models. Later complexity theory can draw relations among these traditions where justified, but shared vocabulary alone does not establish a common mechanism.

For economic and social analysis, bifurcation theory offers a disciplined alternative to purely linear extrapolation. An institution, ecological-economic system, credit network, technological regime, or pattern of collective behavior may respond differently as underlying conditions move across parameter ranges. The relevant parameter may itself summarize a complex set of relations, so empirical application requires caution. A diagram that contains a bifurcation proves a property of the model. Establishing that a historical economy approaches a corresponding transition requires measurement, parameter identification, mechanism evidence, and comparison against alternative explanations.

Bifurcations also sharpen the meaning of resilience. Within a given dynamical model, resilience can concern the rate of return after perturbation, the size or geometry of a basin, the distance to a basin boundary, or the persistence of a regime under parameter change. These quantities need not move together. A system can recover quickly from small disturbances while remaining close to a parameter threshold; another can recover slowly yet possess a large basin. Treating resilience as a single scalar property can therefore conceal several dynamical questions.

The later GR and GRE inheritance is again selective. Bifurcation theory provides a formal language for qualitative transformation, threshold effects, multistability, and changes in stability structure. It makes possible an analysis in which transformation concerns the organization of possible trajectories rather than only the magnitude of a variable. GR adds a historically broader question concerning the generation of the parameters, relations, and state variables through which the bifurcation description is constructed. In social settings, actors can respond to perceived thresholds, institutions can redefine the relevant variables, and governance can alter the mechanisms whose stability is being analyzed. These reflexive processes require further theoretical work beyond classical bifurcation analysis.

2.31.5 Time-Dependent and Changing Dynamics

Classical introductions often begin with autonomous systems, in which the evolution rule has no explicit dependence on clock time. Many empirical processes instead face seasonal forcing, technological change, environmental drift, policy intervention, demographic transition, or other conditions that vary through time. Nonautonomous dynamical-systems theory formalizes this situation by allowing the evolution law itself to depend explicitly on time. Equation 2.2 gives the basic continuous-time form.

$$\dot{x}(t) = f(t, x(t)). \quad (2.2)$$

The explicit time dependence in Equation 2.2 changes several familiar concepts. Time translation no longer leaves the dynamics unchanged in the same way as in an autonomous system. Long-run behavior can depend on when a trajectory is initialized, and the appropriate concept of attraction can require attention to both observation time and initialization time. The modern theory of nonautonomous dynamical systems therefore develops formulations in terms of processes and skew-product flows as well as concepts such as pullback attractors, nonautonomous bifurcations, and time-dependent invariant structures (Kloeden and Rasmussen 2011).

This extension is important because many apparently stable regimes exist under continually changing external conditions. A seasonal ecological cycle, a periodically

forced engineering system, or an economy under changing policy and technology can display regularity without being generated by a time-independent rule. The state observed at time t is then shaped by both the system's current configuration and the temporal conditions represented in $f(t, x)$. An attractor defined for an autonomous system may no longer capture the relevant organization of motion.

Time dependence can enter in several ways. A parameter can drift slowly. External forcing can be periodic, irregular, or episodic. Switching rules can move the system among different vector fields. Coupled subsystems can make a quantity that appears externally imposed in one reduced model into a state variable of a larger model. In some cases, enlarging the state space can convert an explicitly time-dependent formulation into an autonomous one by representing the forcing process as part of the state. This mathematical technique is powerful, but it relies on a specified higher-level evolution law. It does not remove the substantive task of determining what generates the forcing and whether the enlarged state description remains adequate.

The distinction between a changing state and changing dynamics is especially consequential for later GR. In Equation 2.1, the state changes while the rule f is fixed. In Equation 2.2, the effective rule varies with time according to a specified dependence. A still stronger problem arises when the mechanisms, variables, interaction structures, or rules through which future changes are produced become transformed through the history of the system itself. Some such processes can be represented within adaptive, switching, stochastic, or higher-dimensional dynamical models. Others require the modeler to revise the state space or model class because the relevant entities and relations have changed.

This stronger possibility should be stated without turning it into a claim that classical dynamical-systems theory is inadequate in general. Mathematics can represent changing laws at multiple levels whenever the relevant meta-dynamics can be specified. The epistemic difficulty is that a social analyst may not know in advance the complete space of future variables, institutions, technologies, interpretations, or relations. A fixed higher-dimensional representation can then function as a useful modeling hypothesis rather than a guarantee that historical novelty has already been contained within the formalism.

For GRE, the importance of time-dependent dynamics is therefore twofold. First, it prevents equilibrium or stability analysis from silently assuming a stationary environment. Economic trajectories can unfold while ecological constraints, technologies, institutions, preferences, classifications, and governance arrangements change. Second, it provides a disciplined precursor to the generative-relational idea that conditions of change can themselves become objects of change. The inheritance should remain carefully layered: autonomous dynamics studies motion under a fixed rule; nonautonomous dynamics studies motion under explicitly varying rules or forcing; generative-relational analysis asks when the relations that constitute states, rules, parameters, and relevant system boundaries are themselves historically produced and transformed.

The dynamical-systems lineage can now be located within the wider genealogy of Chapter 2. State spaces provide representations of possible configurations. Trajectories organize change through time. Attractors describe recurrent or asymptotically organizing structures and their basins. Bifurcations describe qualitative changes in the organization of dynamics, while critical-transition research develops domain-specific questions concerning abrupt shifts and possible warning signals. Nonautonomous

theory extends the framework to explicitly changing conditions. Together these concepts give GR and GRE a mature language for persistence, path, sensitivity, regime structure, and transformation without requiring a commitment that social reality is exhausted by a fixed dynamical model.

The remaining limitation also prepares the next lineage. Dynamical-systems theory can generate extraordinarily rich behavior from relatively compact evolution laws, yet many social, biological, technological, and economic systems involve heterogeneous populations, distributed adaptation, changing interaction networks, multiscale organization, and emergent collective patterns. Complexity and complex-adaptive-systems traditions place those features more directly at the center of analysis. Section 61 therefore turns from the geometry of trajectories and qualitative change to the distributed and multilevel organization of complex adaptive systems.

2.32 Complexity and Complex Adaptive Systems

Dynamical-systems theory provides a language for states, trajectories, stability, attractors, bifurcations, and changing evolution rules. Complexity research shifts the analytical emphasis toward systems in which many interacting components generate collective patterns while their own behavior may also change in response to those patterns. The role of this section is to reconstruct the principal intellectual resources associated with complexity and complex adaptive systems before they are translated into later GR and GRE questions. Its objective is to distinguish five recurring themes: emergence, nonlinearity, adaptation, multiscale organization, and coevolutionary dynamics. The section treats these themes as a family of partially overlapping research traditions rather than as a single unified theory. Its method is genealogical and analytical: it identifies characteristic problems, clarifies the distinctions among them, and limits later GR/GRE synthesis to a restrained account of what these traditions make conceptually available (Holland 2012; Levin 1998).

Complexity research inherits problems from statistical physics, biology, ecology, cybernetics, dynamical systems, computer science, and economics, while changing the balance among them. The characteristic object is frequently a population or ensemble of interacting components whose aggregate behavior is difficult to infer by examining a representative component in isolation. Local interactions can create regularities at larger scales; the larger-scale configuration can in turn alter the conditions under which local components act. Heterogeneity, feedback, adaptation, path dependence, and distributed organization consequently become central explanatory concerns. This orientation has encouraged analytical tools ranging from nonlinear dynamics and network analysis to agent-based modeling and evolutionary computation. The unity of the field lies more securely in a recurring problem-space than in a single formalism.

For economic inquiry, this problem-space is especially consequential. Firms, households, financial actors, regulators, infrastructures, technologies, and institutions interact under conditions in which expectations and strategies respond to outcomes generated by previous interaction. Aggregate economic patterns can thereby alter the environment faced by their own participants. Complexity economics has used this recursive structure to study processes of formation, adaptation, and novelty that receive less emphasis in equilibrium-centered representations

(Arthur 1999). The resulting vocabulary is highly relevant to GRE, while its concepts require local justification. Emergence, adaptation, hierarchy, and coevolution identify different analytical problems; their combination in a particular model should be demonstrated rather than presumed.

2.32.1 Emergence

Emergence concerns the appearance of organized properties, patterns, or regularities at one level of description through interactions occurring among components represented at another. The concept acquired different meanings across philosophy, physics, biology, and complexity science. Section 2.10 reconstructed earlier philosophical and social-theoretical lineages of emergence. Complexity research gives the concept a more explicitly constructive and model-oriented form: the analyst specifies local components and interaction rules and studies whether a collective pattern arises from their repeated interaction. The resulting macro-pattern can be causally or explanatorily significant even when it is generated from lower-level processes.

Anderson's argument that "more is different" became an influential statement of the methodological importance of higher-level organization. His claim concerns the autonomy of explanatory concepts across scales: knowledge of more fundamental laws does not automatically supply the concepts needed to explain organized behavior at higher levels (P. W. Anderson 1972). Complexity research develops a related insight through models in which collective organization arises from numerous interacting units. The relevant explanatory question becomes how local interactions generate a pattern, which properties of the pattern are robust across variations of the micro-description, and which macro-properties feed back into the behavior of components.

Emergence therefore differs from simple aggregation. If a population-level quantity is obtained by summing independent contributions, the aggregate may require little additional organizational explanation. Emergent patterns become analytically interesting when interactions among components alter the structure of the aggregate: clustering, synchronization, spatial patterning, institutional regularity, conventions, segregation, cascades, or market organization can depend on who interacts with whom, how interaction is sequenced, and how agents respond to previous outcomes. The system-level object can then carry information that is difficult to recover from a list of isolated component properties.

Agent-based modeling made this constructive orientation especially visible in the social sciences. Epstein and Axtell's *Growing Artificial Societies* develops bottom-up simulation as a method for examining how aggregate social patterns can arise from repeated interactions among heterogeneous agents (Epstein and Axtell 1996). In this approach, the model is generative in a methodological sense: a proposed micro-specification is used to generate an aggregate outcome computationally. The resulting correspondence between a simulated pattern and an empirical pattern can support an explanatory hypothesis, while additional work remains necessary to establish empirical adequacy, parameter plausibility, mechanism identification, and comparative performance against alternative models.

This distinction is important for later GR vocabulary. Computational generation within a model means that an aggregate pattern is produced by specified rules, initial conditions, interactions, and update procedures. GR's later concept of generativity

is broader and concerns the production and transformation of capacities, relations, subjects, structures, and future conditions. The two notions can intersect, but they occupy different theoretical levels. Chapter 2 therefore treats complexity-science emergence as an inherited analytical resource rather than as an already complete theory of generative relational reality.

Emergence also creates a problem of level selection. A pattern can appear stable at one scale while remaining highly variable at another. A city can display persistent spatial organization while households move; a market can preserve institutional routines while firms enter and exit; an ecosystem can maintain broad functional organization while species abundances fluctuate. The appropriate explanatory level depends on the question, time horizon, and observational resolution. Emergent description consequently introduces an epistemic task: the analyst must justify why a selected macro-pattern is meaningful and which lower-level variations can be treated as irrelevant for the purpose at hand.

The principal inheritance for GRE is therefore a disciplined distinction between local interaction and collective organization. Economic order can be studied as something produced through interaction rather than treated exclusively as an externally given constraint or a direct expression of representative-agent properties. The stronger question of how the categories used to identify agents, interactions, and aggregate patterns are themselves historically formed remains open for later GR development.

2.32.2 Nonlinearity

Nonlinearity supplies a second foundation of complexity analysis. Section 2.31 introduced nonlinearity through dynamical systems, where the effect of a change can depend on the current state and interactions among variables. Complexity research extends this concern to systems composed of many interacting elements. A local response can alter the environment encountered by other components; those responses can modify the aggregate pattern; and the changed aggregate can alter later local behavior. The resulting mapping from individual changes to collective outcomes can therefore depend strongly on configuration, sequence, interaction structure, and feedback.

Levin's treatment of ecosystems as complex adaptive systems emphasizes this connection among localized interactions, nonlinearity, historical dependence, multiple possible outcomes, self-organization, and dynamics operating at several levels (Levin 1998). The importance of nonlinearity here lies less in mathematical ornament than in a change of explanatory expectation. The aggregate effect of two interventions need not equal the sum of their separate effects. Similar disturbances can yield different consequences under different configurations. A component's effect can change as population composition, spatial structure, institutional environment, or interaction topology changes.

Several concepts that often travel together should remain distinct. Nonlinearity describes a property of a relation or evolution rule. Positive feedback describes a mechanism through which deviations can be amplified. Multiple equilibria or attractors describe possible system-level organizations under specified dynamics. Path dependence concerns the influence of historical sequence or earlier states on later possibilities. Chaos refers to a more specific class of deterministic dynamical behavior.

Complexity research may combine these phenomena, but one does not follow automatically from another. A nonlinear system can possess a single stable equilibrium; a path-dependent process can arise through institutional increasing returns without exhibiting deterministic chaos; an aggregate pattern can be complex because of heterogeneous interaction even when each component follows a simple rule.

Economics provides a clear illustration through increasing returns and adaptive response. Arthur's earlier work on competing technologies shows how increasing returns can make historical events consequential for later adoption and possible lock-in under specified mechanisms (Arthur 1989). His later complexity-economics formulation places this historical dependence within a broader picture in which economic agents continually adapt to a situation that their own actions jointly create (Arthur 1999). Prices, strategies, expectations, technological choices, and institutional arrangements can thereby participate in recursively changing environments.

This perspective changes the analytical status of averages. In linear or weakly interacting settings, average behavior may summarize a population effectively. In strongly interactive systems, an average agent can erase the variation that produces the aggregate phenomenon. Heterogeneous expectations can create trading dynamics absent from a representative expectation; heterogeneous balance sheets can generate networked financial vulnerability; heterogeneous technological positions can shape diffusion and competitive selection. Complexity methods therefore frequently preserve distributions, local interaction structures, or agent-level rules when those features are part of the mechanism being studied.

Nonlinearity also complicates intervention. A policy applied in one regime can have effects that change as the system reorganizes. Responses may saturate, reverse, or trigger indirect pathways through other actors. This does not imply that prediction or policy analysis becomes impossible. It changes the evidential burden. Analysts need to specify the relevant regime, interaction mechanisms, uncertainty, and plausible feedbacks, and they may need to compare outcomes across ensembles of scenarios rather than rely on a single local extrapolation.

For GRE, the inherited lesson is that relational effects can be configuration-dependent. The economic significance of a relation can depend on surrounding relations, institutional conditions, and temporal position. Later GRE can extend this insight toward value conversion, capability formation, power, and governance. The complexity lineage itself supplies the methodological reason to expect interaction effects and recursive feedback, while the substantive interpretation of those effects remains domain-specific.

2.32.3 Adaptation

Complex adaptive systems add adaptation to interaction. Components change behavior, internal rules, strategies, or organization in response to experience and to the environments created through ongoing interaction. Holland's work made this adaptive orientation central to complexity research, first through genetic algorithms and adaptive systems and later through a more general framework of signals, boundaries, agents, and evolving organization (Holland 2012). Adaptation can occur through learning within an agent, selection among agents or strategies, recombination of rules, organizational revision, or population change. These mechanisms should be distinguished because they imply different units of persistence and

different causal pathways.

Adaptation is relational in a limited but important sense. The success of a strategy depends on the environment in which it operates, and that environment can include other adapting agents. A behavior that performs well under one population composition can perform poorly after other agents change. Fitness, payoff, or performance is therefore frequently context-dependent. The analytical object becomes a moving relation among agent, strategy, environment, and population rather than a fixed ranking of alternatives.

This feature separates adaptation from optimization under a fixed objective and fixed environment. Optimization can be part of an adaptive model when agents repeatedly solve defined problems, but complexity research often studies situations in which the relevant environment changes while agents adjust. Search may be local, information incomplete, and learning distributed. Strategies can be revised using heuristics, imitation, reinforcement, experimentation, or evolutionary selection. Different mechanisms can produce similar aggregate outcomes, so empirical work needs evidence concerning how adaptation actually occurs.

Adaptation also differs from improvement. A system can become better fitted to a local environment while producing fragility at another scale or time horizon. A firm can adapt successfully to an institutional regime that is ecologically damaging; a pathogen can adapt in ways harmful to human welfare; a financial strategy can remain individually profitable while increasing systemic vulnerability. The criterion of adaptation belongs to the modeled relation between performance and environment. Normative assessment requires additional criteria concerning welfare, justice, sustainability, rights, or other values.

The role of internal representation varies across complex adaptive systems. Biological evolution can generate adaptation without reflective anticipation by individual organisms. Human and organizational agents can model possible futures, interpret signals, form expectations, and deliberately alter strategies. Arthur emphasizes this additional complication in economic systems: economic agents respond strategically to patterns they help create (Arthur 1999). Expectations about others' expectations can make the adaptive environment partly representational. Beliefs, narratives, classifications, and models can then participate in the process they attempt to describe.

This reflexive capacity makes economic adaptation distinct from a straightforward transfer of biological selection language. Institutional rules can be contested and redesigned. Agents can coordinate to alter the environment against which performance is assessed. Governments can change market architecture, firms can create standards, communities can establish governance rules, and technologies can create new categories of action. Adaptive economic analysis therefore benefits from evolutionary analogies while retaining attention to interpretation, deliberate intervention, authority, and institutional construction.

Agent-based models provide one way to study such adaptation explicitly. Heterogeneous agents can be given learning or updating rules, allowed to interact, and observed as aggregate patterns develop. The method permits mechanisms that are difficult to solve analytically, but computational richness also enlarges the space of modeling choices. A simulated adaptive outcome is evidence about the specified model. Empirical application requires sensitivity analysis, calibration or estimation where appropriate, validation against relevant observations, transparency concerning update rules, and comparison with plausible alternatives.

GRE inherits from this tradition a view of economic actors and institutions as potentially adaptive rather than behaviorally fixed. This inheritance supports later analysis of changing capabilities, strategies, norms, and organizational forms. GR asks a further question when adaptation alters the categories through which future adaptation occurs: actors can acquire new capacities, relations can create new constraints, and institutions can redefine what counts as a feasible action or relevant performance criterion. Complexity research supplies several formal routes for representing such changes; the adequacy of any route remains an empirical and theoretical question rather than a conclusion supplied by the label “adaptive.”

2.32.4 Multiscale Organization

Complex systems are frequently organized across multiple scales. Components form intermediate structures; intermediate structures participate in larger wholes; processes unfold at different temporal rates; and causal influence can travel across levels. Simon’s “architecture of complexity” provided an early and influential account of hierarchical and near-decomposable organization, emphasizing that complex systems can often be analyzed through nested subsystems whose internal interactions are stronger or more frequent than interactions across some subsystem boundaries (Simon 1962). The concept of hierarchy in this lineage concerns organized levels and subsystems in a broad analytical sense. It is wider than a hierarchy of command or authority.

Near-decomposability offers a practical reason why multiscale analysis is possible. If some interactions are relatively dense within subsystems and weaker across them, short-run dynamics can sometimes be studied locally while slower cross-system effects are represented at a higher level. This is a modeling advantage rather than a claim that natural or social systems possess perfectly separated layers. Boundaries can be porous, overlapping, and historically changeable. The usefulness of a scale depends on whether the processes relevant to the research question exhibit sufficient regularity at that resolution.

Anderson’s argument for explanatory autonomy at higher levels complements this architectural view (P. W. Anderson 1972). Higher-level concepts can become necessary because organization introduces regularities that are cumbersome or uninformative when expressed entirely in lower-level terms. Temperature, ecological community, organization, institution, and market are examples of concepts whose explanatory roles depend on aggregation and structure. In the social sciences, higher levels also involve meanings, rules, and legal or institutional categories that may be constituted through collective recognition rather than merely summarized from physical components.

Levin’s complex-adaptive-systems analysis places multiscale organization at the center of ecology. Local interactions and selection processes can generate larger-scale patterns, while ecological and evolutionary dynamics unfold at multiple levels and timescales (Levin 1998). This creates a recurring analytical problem: patterns that appear stable at one level can be produced by continuous turnover at another, and interventions aimed at one scale can generate effects elsewhere. Multiscale models therefore require explicit choices concerning aggregation, coupling, temporal resolution, and the variables preserved when moving between scales.

Economic systems display comparable organizational plurality. Transactions occur

among persons and firms; firms contain teams, departments, routines, and technical infrastructures; industries contain networks, standards, and competitive structures; states create legal and monetary institutions; global production and finance connect these organizations across jurisdictions. A relation can be local in one representation and part of a higher-order structure in another. The effect of a policy can depend on household practices, firm organization, sectoral networks, national institutions, and international constraints operating together.

Multiscale organization should remain distinct from a single upward chain of causation. Local interactions can produce aggregate structures, while established aggregate structures condition local possibilities. A monetary regime shapes firm and household action; accumulated transactions and political decisions can later transform the monetary regime. Organizational routines constrain members; member practices can gradually alter routines. Complexity research often represents such cross-level influence through coupled models, coarse-graining, network structure, nested agents, or adaptive rules. Each representation captures selected pathways while suppressing others.

This creates a scale-selection problem for explanation and governance. A pattern visible at one scale can disappear under aggregation or become noisy under disaggregation. Statistical relationships can reverse when populations are partitioned differently. A governance intervention can appear effective according to an aggregate indicator while distributing gains and losses unevenly among subgroups. Multiscale analysis therefore has an epistemic and normative dimension: the chosen resolution affects which relations, heterogeneities, and harms become visible.

GRE inherits from the complexity tradition the idea that economic organization may require several interacting levels of description. Later chapters can use this resource when examining persons, households, organizations, infrastructures, sectors, states, and transnational systems without assuming that one scale provides the complete explanatory unit. GR's stronger contribution concerns the historical production of scales themselves: organizations split or merge, jurisdictions are created, categories are redefined, and new infrastructures connect previously separated domains. Multiscale complexity makes cross-level organization analytically tractable; generative-relational inquiry adds the question of how the levels and boundaries used in that analysis come into being and change.

2.32.5 Coevolutionary Dynamics

Coevolutionary dynamics arise when changes in one population, subsystem, strategy set, or institutional domain alter the selective or adaptive environment of another, whose response in turn changes the conditions faced by the first. The concept emerged most prominently from evolutionary biology and ecology and later traveled into studies of technology, organizations, institutions, and economies. Within complexity research, coevolution extends adaptation from a system facing a largely fixed environment toward mutual adjustment among interacting systems or populations.

Holland's complex-adaptive-systems framework treats adaptive agents, signals, boundaries, recombination, and hierarchical organization as interacting components of evolving systems (Holland 2012). Levin similarly emphasizes the joint ecological and evolutionary development of complex systems, including the interaction between local processes and larger-scale system properties (Levin 1998). In economics,

Arthur's complexity perspective describes agents adapting to aggregate patterns that they collectively generate; the changed aggregate then becomes the environment for further adaptation (Arthur 1999). These formulations share a recursive structure even though their mechanisms and domains differ.

Coevolution is more specific than simultaneous change. Two variables can change during the same period because both respond to a third factor. Coevolutionary explanation requires some reciprocal dependence between their changes. The relevant coupling can be direct, as when two populations alter each other's selection environment, or mediated through a shared institutional or ecological structure. The strength, delay, and direction of coupling can vary over time. Empirical identification therefore requires evidence about interaction pathways rather than temporal correlation alone.

The concept also differs from generic feedback. Feedback can occur within a fixed architecture: an output affects a later input while the relevant actors, variables, and update rules remain stable. Coevolution often emphasizes that adaptive responses alter the configuration within which later feedback occurs. A technology changes user practices; user practices influence complementary technologies, standards, and regulation; these changes alter the later developmental environment of the original technology. Firms and institutions can likewise evolve together as organizational strategies affect regulation, labor markets, financial practices, and competitive norms that subsequently reshape firm behavior.

Path dependence becomes especially important in such settings. A coevolutionary process can generate opportunities that were unavailable earlier and close possibilities that once existed. Early events can alter the population of strategies, institutional infrastructure, or technical standards against which later adaptations occur. Arthur's increasing-returns analysis gives one bounded economic mechanism through which historical events can shape later technological selection (Arthur 1989). Complexity research generalizes the research orientation by asking how adaptive interaction continually modifies the landscape of subsequent adaptation.

The metaphor of an adaptive landscape is useful but requires care. In simple evolutionary models, a landscape can represent a relatively fixed mapping from configurations to fitness. Under coevolution, the performance landscape faced by one actor changes as other actors change. The landscape itself therefore becomes time-dependent and relational. Economic analogues are especially reflexive because agents can deliberately modify standards, property rights, organizations, market rules, or technologies. The object of analysis can shift from movement across a given landscape toward processes that reshape the landscape.

This point approaches, while remaining distinct from, later GR concerns. Complexity and coevolutionary theories already provide substantial resources for studying changing interactions, adaptive environments, emergent structures, and recursive adjustment. GR should therefore avoid presenting relational change or coevolution as absent from predecessor theories. Its additional question concerns cases in which interaction generates new actors, new relation types, new capacities, new evaluative criteria, or new rules for producing subsequent transformations. Some complexity models can represent these processes through changing networks, evolving grammars, endogenous rule sets, or open-ended evolutionary mechanisms. The theoretical issue is to specify which form of novelty is represented and which remains outside the model.

For GRE, coevolution offers a particularly important bridge among technology, institutions, capabilities, values, and economic organization. Technologies can alter feasible practices and skill demands; institutions can shape technological incentives; changing capabilities can alter demand and political participation; valuation practices can influence investment and organizational priorities. These relationships can form mutually transforming histories. The complexity lineage encourages their study as coupled processes rather than as isolated comparative statics.

The broader contribution of complexity and complex-adaptive-systems research can now be stated with appropriate restraint. Emergence directs attention to collective patterns generated through interaction. Nonlinearity makes effects conditional on configuration and feedback. Adaptation introduces learning, selection, and strategic adjustment. Multiscale organization locates dynamics across nested or overlapping levels. Coevolution studies reciprocal change among adapting populations, structures, and environments. Together these traditions provide GR and GRE with a mature vocabulary for distributed organization and historically contingent system formation.

Their inheritance also clarifies the next analytical requirement. Complexity models often depend on explicit representations of who interacts with whom, which connections carry influence, how local neighborhoods are formed, and whether several kinds of relations coexist. Those questions move the genealogy from general complexity toward the formal representation of relational architecture. Section 62 therefore turns to networks, hypergraphs, and multilayer approaches, where ties, higher-order interactions, and multiple relation types become explicit objects of mathematical analysis.

2.33 Network, Hypergraph, and Multilayer Approaches

Complexity research places interaction structure near the center of explanation. Network theory makes that structure an explicit object of representation by distinguishing the units under study from the relations that connect them. The role of this section is to reconstruct the principal formal lineages through which relational structure has been represented beyond collections of isolated variables. Its objective is to distinguish five increasingly expressive analytical forms: ordinary network representation, dynamic or temporal networks, higher-order interaction and hypergraphs, multilayer relational structures, and evolving relational topologies. The method is formal and genealogical. Each representation is introduced through the problem it solves, the distinctions it makes available, and the assumptions it retains. The resulting concepts provide important resources for later GR and GRE, while a mathematical relation in a model remains an analytical representation rather than an automatic claim about the ontology of social or economic reality (Newman 2003; Battiston et al. 2020).

Network approaches alter the explanatory unit in a way that is especially important for relational inquiry. A conventional variable-centered model can describe attributes of firms, households, persons, institutions, or technologies while leaving their pattern of connection implicit. A network representation places that pattern alongside the attributes themselves. Degree, clustering, centrality, component structure, assortativity, path length, community structure, and related quantities can then de-

scribe how relational position differs across nodes and how local connections compose into larger structures (Newman 2003). This does not make network analysis intrinsically more relational than every alternative method. It does, however, force the modeler to state which units are connected, what counts as a relation, whether the relation is directed or undirected, whether its strength or sign matters, and which observed interactions are treated as belonging to the same relational structure.

For economics, this representational move has obvious relevance. Production, finance, trade, employment, ownership, information exchange, technological dependence, and organizational collaboration can all involve structured relations whose consequences depend on position and connectivity. Yet the same pair of firms can be connected through supply, credit, ownership, litigation, technological licensing, and personnel mobility at once. A relation can also exist only during particular intervals or arise through group interaction that cannot be reduced without loss to independent dyads. The development from simple graphs toward temporal, higher-order, and multilayer formalisms responds to these limitations. The genealogy is therefore best understood as an expansion of what counts as representable relational structure rather than as a sequence in which newer formalisms render ordinary networks obsolete.

2.33.1 Network Representation

The basic network representation consists of a set of nodes and a set of relations among them. In graph-theoretic language, a graph can be written as $G = (V, E)$, where V is a set of vertices and E is a set of edges connecting selected pairs of vertices. The formal simplicity of this representation is one of its strengths. A large variety of empirical systems can be translated into a common relational language, after which structural properties can be compared and processes on those structures can be studied. Modern network science expanded this program across social, biological, technological, and information systems and developed a shared vocabulary for degree distributions, clustering, correlations, random graph models, growth mechanisms, and dynamical processes on networks (Newman 2003).

The simplicity of $G = (V, E)$ also conceals a substantial act of model construction. Nodes do not identify themselves. A researcher decides whether a node represents an individual, firm, household, country, legal entity, technological component, document, account, or other unit. Edges likewise depend on an operational definition: communication, exchange, ownership, co-presence, contractual dependence, citation, kinship, similarity, or another relation. Different choices can produce different networks from the same empirical domain. Network analysis therefore begins with an ontology of representation even when it suspends stronger claims about the ontology of the represented world.

Several distinctions enrich the basic graph. Edges can be directed when the relation has an ordered source and target, as with lending, citation, or command. They can be weighted when intensity, frequency, quantity, or capacity matters. Signed networks distinguish relations with different valences, such as support and opposition or credit and liability under an appropriate model. Self-loops may be meaningful in some domains and excluded in others. Node and edge attributes add information without changing the basic pairwise architecture. Each extension answers a distinct empirical question; combining them should follow the structure of the problem rather than

a preference for formal richness.

An adjacency representation makes pairwise structure computationally explicit. For a simple network with nodes indexed by i and j , an adjacency matrix can record whether the modeled relation is present between each pair. Weighted and directed variants replace the binary entry with the relevant magnitude and orientation. Such matrices support linear-algebraic analysis of paths, connectivity, spectral structure, diffusion, and centrality, but the matrix remains a representation of a chosen relation. A zero can mean that no relation exists, that no relation was observed, that the relation falls below a threshold, or that the data-generating system does not record it. Measurement and missingness therefore remain part of network epistemology.

Network measures also require interpretive discipline. High degree can indicate many direct connections, yet the substantive meaning of those connections depends on the relation being measured. Betweenness can identify nodes that lie on many shortest paths, but shortest paths may or may not approximate the routes through which information, goods, authority, or contagion actually move. Eigenvector-based measures privilege connection to structurally prominent neighbors under specific recursive assumptions. Community-detection procedures can reveal densely connected regions, while different algorithms and resolution choices can produce different partitions. Formal centrality and substantive power are consequently related only through an additional theory of how network position becomes consequential.

This distinction is particularly important for GRE. Economic power can be mediated by network position, but centrality is not itself a complete theory of power. A supplier with few connections can hold substantial bargaining power when its product is difficult to substitute; a highly connected worker can remain institutionally vulnerable; a peripheral legal actor can possess decisive formal authority. Network analysis supplies relational observables and structural hypotheses. Institutions, rights, resources, capabilities, and normative rules determine how those structural positions are translated into effective possibilities.

Ordinary networks nevertheless provide a major conceptual inheritance. They make relational topology inspectable. They allow the same set of nodes to support different patterns of connection and thereby separate properties of units from properties of arrangement. They also demonstrate that aggregate outcomes can depend on who is connected to whom rather than solely on the distribution of individual attributes. This creates a bridge from the interaction-centered concerns of Section 61 to a more explicit formal treatment of relational structure.

2.33.2 Dynamic Networks

A static network represents relations as though they were simultaneously available during the observational window. Many empirical relations are instead intermittent, ordered, and historically changing. Communication occurs at particular times; transactions open and close; employment and ownership ties begin and end; transport links operate according to schedules; alliances and contractual relations change. Temporal-network analysis makes the timing of edges part of the representation rather than collapsing all observed contacts into a single aggregate graph (Holme and Saramäki 2012).

This extension produces an important distinction between *dynamics on a network* and *dynamics of the network*. In the first case, a process such as diffusion, contagion,

learning, synchronization, or exchange evolves while the network is treated as fixed. In the second, the pattern of nodes and edges itself changes. Empirical systems can contain both at once. A financial shock can propagate over a credit network while lenders simultaneously terminate, create, or redirect credit relations; information can spread through a communication network while the communication pattern responds to the information being spread. Treating these two dynamics separately can be a useful approximation, but their coupling is a substantive assumption rather than a general property.

Temporal ordering can alter reachability even when the time-aggregated network is unchanged. If an edge from A to B is active only after an edge from B to C has disappeared, the aggregated graph may display a path $A-B-C$ even though no time-respecting sequence permits a process to travel from A to C during the relevant interval. Temporal-network theory therefore distinguishes structural connectivity from temporally feasible connectivity. Durations, waiting times, burstiness, recurrence, and ordering can affect diffusion and coordination in ways that disappear when contacts are aggregated (Holme and Saramäki 2012).

The choice of temporal resolution is itself consequential. Relations recorded by the second can appear highly intermittent; the same data aggregated by day can appear dense and stable. Long observational windows can combine relations that never coexisted, while very short windows can hide durable organization behind sparse instantaneous observations. A temporal network is thus not simply a static network with more data. It requires a model of which temporal distinctions matter for the process being studied.

Dynamic-network representations also clarify several meanings of persistence. A tie can persist continuously, recur intermittently, or disappear while being replaced by functionally similar ties. A network can preserve a stable degree distribution even while individual edges turn over rapidly. Community structure can remain recognizable although membership changes. Conversely, stable node identities can coexist with a major reorganization of connectivity. These are different forms of continuity and should not be compressed into a single claim that a relational structure is stable.

For economic analysis, the distinction matters whenever timing changes feasible action. Liquidity depends on when obligations mature, supply chains depend on sequencing and delivery windows, labor relations have contractual durations, and information advantages can depend on the order in which knowledge travels. A static graph can remain useful for long-run structural questions, while a temporal representation becomes necessary when ordering, duration, or turnover changes the mechanism of interest. The appropriate choice is therefore governed by the explanatory problem rather than by an assumption that temporal detail is always superior.

Dynamic networks provide GRE with a formal language for histories of connection. They make it possible to study not only whether relations exist but when they become available, how long they remain, and how sequences of relations constrain later possibilities. Yet most temporal-network models still prespecify what counts as a node and which type of contact is being recorded. The history of connectivity can be endogenous while the categories through which connectivity is recognized remain fixed. Later GR analysis can retain the temporal insight while asking how those categories themselves arise and change.

2.33.3 Higher-Order Interaction and Hypergraphs

Ordinary graphs encode interaction through pairs. This is appropriate when the modeled relation can be represented as a collection of dyadic links or when pairwise approximation preserves the mechanism of interest. Many processes, however, involve groups whose joint interaction is not equivalent to the sum of independent pairwise relations. A committee decision, team production process, multi-party contract, chemical reaction, household allocation, coalition, or group conversation can depend on the simultaneous participation of several units. Higher-order network approaches develop representations for this class of problem (Battiston et al. 2020).

A hypergraph replaces the requirement that each edge join exactly two nodes. In a hypergraph $H = (V, \mathcal{E})$, a hyperedge $e \in \mathcal{E}$ can contain more than two vertices. The formal object therefore records a group relation directly. If persons A , B , and C jointly participate in a single institutional decision, the hyperedge $\{A, B, C\}$ retains that joint participation rather than automatically replacing it with the three pairwise links AB , AC , and BC . This distinction matters whenever the collective relation has effects that arise only in the group configuration.

Pairwise projection can lose several kinds of information. It can erase the size of the interacting group, confuse repeated dyadic interactions with one genuinely collective event, and introduce links between members who were jointly present but did not possess an independent pairwise relation. More importantly, higher-order dynamics can generate thresholds and collective effects that cannot be reconstructed from pairwise coupling alone. Reviews of higher-order networks emphasize that interactions among three or more units can alter spreading, synchronization, cooperation, and other dynamical phenomena relative to pairwise network models (Battiston et al. 2020).

Hypergraphs are not the only higher-order representation. Simplicial complexes also represent relations among sets of vertices, but they impose an additional closure structure: when a simplex is present, its faces belong to the complex as well. A filled triangle therefore carries different formal commitments from an arbitrary three-node hyperedge. This difference can be analytically meaningful. A joint three-party institution does not necessarily imply that every corresponding dyadic institution exists independently. Hypergraphs are more permissive in such cases, whereas simplicial representations are useful when inclusion relations among lower- and higher-dimensional interactions are part of the phenomenon.

The move to higher-order structure should not be interpreted as a claim that dyads are generally inadequate. Many economic relations are explicitly bilateral: a loan contract, purchase, bilateral treaty, or employment agreement can often be represented productively as an edge, possibly with rich attributes. Higher-order formalisms become useful when the mechanism itself depends on joint participation. Model complexity should therefore follow interaction complexity.

This distinction has particular relevance for theories of production and value. Team output can depend on complementarities among several participants; common-pool governance can involve rule systems sustained by groups rather than a collection of independent exchanges; platform interactions can create group effects through shared infrastructures; and coalition formation can change what any bilateral relation means. A pairwise projection can still provide a useful approximation, but it may move the generative mechanism out of the representation.

Higher-order approaches thus broaden the formal meaning of relation. A relation need not connect exactly two predefined units. It can bind a set, carry internal dimensional structure, and alter processes through genuinely collective participation. This becomes an important resource for GR and GRE because relational generation may occur through configurations rather than isolated ties. At the same time, a hyperedge remains a modeled interaction category. The formalism does not decide which empirical groupings count as one relation, how participants acquire their identities, or how the meaning of collective membership changes historically.

2.33.4 Multilayer Relational Structures

A second limitation of ordinary networks arises when the same units participate in several kinds of relation. Social, economic, technological, and biological systems frequently contain multiple channels of connectivity, and these channels can interact. Multilayer-network theory develops a family of formalisms for representing such systems without collapsing heterogeneous relations into one edge set. The literature uses several related constructions, including multiplex, interconnected, interdependent, and multilayer networks, with differences in how node sets and interlayer connections are specified (Kivelä et al. 2014).

A multiplex representation can place the same set of entities in several relation layers. Firms, for example, might be connected through ownership in one layer, supply dependence in another, credit in a third, and technological collaboration in a fourth. The resulting layers are analytically distinct even when they share nodes. A multilayer framework can also allow different node sets across layers and explicit connections between node-layer combinations. This makes it possible to represent systems in which infrastructures, organizations, persons, or institutions occupy different but coupled relational domains.

The multilayer perspective addresses a concrete information-loss problem. If several relation types are aggregated into one network, the resulting edge indicates that two units are connected but can erase the mechanism through which they are connected. Two firms with the same aggregate degree may occupy very different positions when one is central in credit relations and the other in technological collaboration. Cross-layer dependence can also create effects invisible within any single layer. A failure in an infrastructure layer can disable production links; ownership can condition bargaining within a supply network; legal jurisdiction can alter the consequences of financial connection. Multilayer formalisms make these distinctions representable (Kivelä et al. 2014).

Layers should not automatically be identified with ontological levels. A layer may represent a relation type, communication channel, spatial context, time interval, institutional domain, or measurement source. Multiscale organization, discussed in Section 61, concerns organization across scales or levels of description and can intersect with multilayer structure without being identical to it. A firm network and a national institutional system can differ in scale; ownership and credit networks among the same firms differ primarily in relation type. Keeping these distinctions separate prevents “layer” from becoming a generic synonym for any form of complexity.

Interlayer coupling introduces another analytical choice. Some layers can be treated as independent descriptions of the same nodes, while others contain causal or functional dependence. Movement between transportation layers, substitution

between communication channels, or dependency between financial and production networks can require explicit interlayer relations. The strength and form of these couplings influence system-level behavior. As with ordinary edges, however, an interlayer edge is a modeling claim that requires substantive interpretation.

Multilayer representation is especially useful for political-economic analysis because economic action is rarely contained within one relational domain. Ownership, contract, authority, information, law, infrastructure, kinship, and reputation can jointly condition what actors can do. A single aggregated network can conceal which relation enables or constrains an outcome. A multilayer model offers one way to preserve heterogeneity while still studying cross-domain structure.

The GRE inheritance is therefore more specific than the general statement that reality has many layers. Multilayer network theory shows how distinct relation types can be represented simultaneously, how within-layer and cross-layer structures can be distinguished, and how aggregation choices can alter inference. It offers a formal precursor to the GR concern with heterogeneous relations. Yet the formalism normally begins after the analyst has specified the relevant layers. GR later asks how a relation becomes recognizable as a distinct type, how institutional practice creates or dissolves layer boundaries, and how categories that organize heterogeneous relations are themselves generated.

2.33.5 Evolving Relational Topologies

The preceding approaches progressively enrich the representation of relational structure, but a further question concerns how topology changes in response to the processes occurring on it. Adaptive or coevolutionary network theory addresses systems in which node states affect connections and connections affect node states. The network is then neither a fixed background nor an independently varying environment. State dynamics and topology participate in a coupled process (Gross and Blasius 2008).

A schematic discrete-time representation makes the distinction visible. Let x_t denote the modeled states associated with the units and let G_t denote their relational topology at time t . Coupled evolution can be represented abstractly as

$$x_{t+1} = F(x_t, G_t), \quad G_{t+1} = H(G_t, x_t). \quad (2.3)$$

Equation 2.3 does not specify a substantive mechanism. Its role is to distinguish two directions of dependence. The first relation states that later node states depend partly on the current network; the second states that later network structure depends partly on current states. Adaptive-network research studies concrete versions of this coupled problem in domains ranging from epidemiology and ecology to opinion formation and game dynamics (Gross and Blasius 2008).

The distinction from an ordinary temporal network is important. A temporal network can change according to a schedule or externally specified process without responding to the states of the nodes. An adaptive network makes at least part of the topological change state-dependent. Individuals may avoid infected contacts; firms may reconfigure suppliers after disruptions; lenders may withdraw credit in response to perceived risk; collaborators may form ties after successful interaction. The changed network then modifies subsequent exposure, opportunity, and interaction. Feedback crosses the boundary between process and topology.

This creates a formal route for studying relational patterns that reinforce or undermine themselves. A pattern of interaction can change node states in ways that reproduce the same pattern of interaction. It can also generate states that destabilize the topology that produced them. Segregation, coordination, cooperation, polarization, financial concentration, and organizational clustering can therefore be studied through coupled state–topology dynamics when the empirical mechanism supports such a representation. Persistence need not reside exclusively in node attributes or in a fixed network; it can arise through their recurrent mutual adjustment.

Topology can also evolve without preserving the node set. Organizations enter and exit, firms merge, households split, jurisdictions are created, accounts are closed, and technical components are replaced. Many network models can accommodate node birth and death, but a deeper conceptual issue then appears: the unit whose connections are being tracked can itself be historically transformed. If two organizations merge, the event changes more than an edge. It changes the set of represented entities. If a legal reform creates a new corporate form, the categories through which nodes are identified can change. These cases move toward the boundary between evolving topology and evolving ontology of representation.

This boundary is particularly significant for GR. Network science supplies powerful methods for making relations, timing, higher-order interaction, layer heterogeneity, and topological change explicit. Adaptive networks go further by allowing relations and states to coevolve. Yet most formal models still begin with a vocabulary that specifies what a node is, which relation types can occur, which attributes constitute a state, and where the modeled system ends. The topology can change dramatically while these meta-level specifications remain fixed.

The later generative-relational problem is therefore not solved merely by replacing a static graph with a dynamic one. GR asks when the production of nodes, relation types, boundaries, observables, and transformation rules must itself enter the analysis. A firm can be created by law, a market can be constituted by standards and infrastructures, a social category can become institutionally consequential, and a relation can acquire a new meaning through historical transformation. Some of these processes can be represented by enlarging the network model; others may require moving between representational schemes. Network formalisms remain valuable precisely because they make clear which objects have been allowed to vary and which have been held fixed.

For GRE, this yields a layered inheritance. Ordinary networks make relational topology explicit. Temporal networks introduce the history and ordering of ties. Hypergraphs and related higher-order structures allow collective interactions that exceed dyadic representation. Multilayer approaches preserve heterogeneous relation types and their couplings. Adaptive networks allow topology and states to modify one another. Together they provide a substantial formal vocabulary for studying economic relations without reducing economic structure to isolated attributes.

Their shared limit also prepares the next theoretical lineage. Networks primarily encode relations among distinguishable units, even when those relations are weighted, temporal, higher-order, layered, and adaptive. Some problems instead concern influences distributed throughout a surrounding domain, background structures that condition local relations, or transformations whose description depends on invariances across different representations. Field-based, gauge-sensitive, and background-aware formalisms address parts of this problem-space through a differ-

ent mathematical vocabulary. Section 63 therefore turns from relational topology to fields, local dependence, invariance, and the role of background structure.

2.34 Field, Gauge, and Background-Sensitive Formalisms

Network approaches represent relations through connections among distinguishable units. Field-based formalisms begin from a different analytical problem: how to represent quantities, potentials, constraints, or conditions that are distributed across a domain and whose local values can vary continuously with position or configuration. Gauge theories add a further distinction between differences in representation and differences in the represented physical state, while background-sensitive and background-independent formulations ask which structures are fixed in advance and which participate in the dynamics. The role of this section is to reconstruct these formal lineages without converting their physical origin into a social ontology. Its objective is to distinguish five resources that later GR and GRE may use selectively: field-based representation, local and distributed dependence, symmetry and gauge equivalence, the status of background structures, and methodological criteria for transferring physical formalisms into social analysis. The method is formal and genealogical. Each concept is introduced through the problem it solves in mathematics or physics, followed by a restrained account of what the concept can and cannot contribute to later generative-relational inquiry (Evans 2010; Jackson 1999; Yang and Mills 1954; Rovelli 2004).

These traditions matter because relational structure need not always be represented most naturally by a list of pairwise connections. Temperature varies across a body, electromagnetic quantities vary across spacetime, and continuum models represent density, velocity, pressure, or displacement through quantities attached to locations in a domain. A field description therefore asks how a quantity is distributed and how values at nearby or distant locations are related through differential, integral, or constraint equations. Gauge theory then shows that a formal description may contain degrees of freedom associated with representation rather than independently observable structure. General relativity and related work further demonstrate that some structures that function as fixed backgrounds in one theory can become dynamical variables in another. For GRE, the importance of these examples lies in the structural questions they make available: which conditions are distributed, which relations are local, which differences are representational, and which parts of a model have been treated as fixed before analysis begins.

2.34.1 Field-Based Representation

A field assigns a value or mathematical object to each point of a domain. In its simplest form, a scalar field assigns one number to each point; vector, tensor, spinor, and other fields assign richer objects. The domain can be physical space, spacetime, a manifold, or another configuration space appropriate to the problem. Field theories therefore differ from models whose principal objects are a finite collection of variables attached to discrete units. Their basic representational move is to make distributed variation itself the object of analysis.

A schematic scalar field can be written as a mapping

$$\phi : M \longrightarrow V, \quad x \longmapsto \phi(x), \quad (2.4)$$

where M is the domain and V is the space in which the field value lies. Equation 2.4 is intentionally generic. It does not say whether M is geographical space, spacetime, a material configuration, or an abstract state domain, and it does not specify whether ϕ represents temperature, density, potential, stress, or another quantity. Its analytical purpose is to distinguish a distributed assignment from a single system-wide variable.

Partial differential equations provide one of the principal mathematical languages for field evolution. Spatial derivatives encode how a field varies across nearby points, while time derivatives describe temporal change. Boundary conditions, source terms, constitutive relations, and initial conditions specify additional structure needed to determine solutions. The theory of partial differential equations is broad enough to include diffusion, wave propagation, fluid motion, elasticity, reaction–diffusion processes, and many other forms of distributed dynamics (Evans 2010). The common formal feature is not one physical ontology but a mode of representation in which local field values participate in a structured domain of variation.

Classical electromagnetism supplies a canonical example. Electric and magnetic fields assign quantities throughout space and time, and Maxwell’s equations relate their local variation to sources and to one another. Potentials provide another level of representation through which the same electromagnetic structure can be described (Jackson 1999). The field concept here does more than attach attributes to particles. A particle can move through a region whose electromagnetic conditions vary from point to point, and the relevant field exists in the model independently of whether a particle occupies every location. This is one reason field language became attractive far beyond its original domains: it offers a way to represent structured conditions surrounding or permeating localized entities.

That attraction requires conceptual discipline. A field in physics has a mathematically defined domain, codomain, transformation behavior, equations of motion, dimensions, and empirical interpretation. A social phrase such as “field of power,” “institutional field,” or “normative field” can be theoretically meaningful without sharing those properties. Section 50 already reconstructed social-field traditions whose explanatory logic concerns positions, stakes, dispositions, and structured arenas. The present section concerns a different lineage: mathematical and physical fields. Similar vocabulary creates opportunities for comparison, but terminological overlap does not establish formal equivalence.

A field representation can nevertheless support several kinds of social and economic modeling when its assumptions are explicit. Spatial economics can represent prices, population density, accessibility, pollution, land values, or productivity over geographical domains. Continuum models can approximate very large populations by densities rather than tracking each individual unit. Potential-like functions can summarize gradients that influence movement or adjustment. Mean-field methods can replace a complex collection of interactions with an effective aggregate influence under specified approximation conditions. Each use depends on substantive assumptions concerning continuity, scale, aggregation, locality, and measurement. The field formalism contributes a representation; the empirical domain determines whether that representation is defensible.

For GR and GRE, the main inheritance from field representation is therefore structural rather than ontological. It becomes possible to represent a condition that is distributed across a domain, to ask how local values vary, and to study how a change in one region propagates through an organized environment. This can be useful for later work on institutions, information environments, infrastructures, ecological constraints, or capability conditions when these are modeled as distributed rather than purely actor-specific. Yet GR must still ask how the domain M , the field values V , and the meaning of location are constituted. In a social setting, a relevant “position” can be geographical, institutional, legal, informational, economic, or relational. The field formalism does not decide which space is the right one.

2.34.2 Local and Distributed Relational Conditions

Field theories sharpen a distinction between local dependence and distributed consequence. A local differential equation specifies how change at a point depends on quantities and derivatives evaluated at that point or in an infinitesimal neighborhood. Yet solutions of local equations can produce effects that extend across large regions because local interactions propagate through the domain. Locality therefore concerns the structure of the governing relation, while spatial extent concerns the behavior generated by repeated or continuous coupling.

This distinction is easy to blur in ordinary language. A process can be generated through local rules and still produce system-wide patterns. Diffusion offers a simple example: local gradients determine flux, but repeated local transport spreads a disturbance over a large region. Wave equations likewise describe propagation through local differential relations while permitting signals to travel substantial distances. Reaction–diffusion systems can combine local transformation with spatial coupling and thereby generate macroscopic pattern. The field perspective therefore provides a formal route from local relations to distributed organization without requiring a centralized coordinator.

Boundary conditions add another important layer. A field equation alone rarely determines a unique empirical configuration. Conditions at the edge of the modeled domain, interfaces between regions, source distributions, and initial states can materially affect the solution. Two systems governed by the same local differential operator can behave differently because their boundary conditions differ. This means that “local law” and “global organization” should not be identified. The local rule, domain geometry, boundary structure, source configuration, and initial condition jointly shape the realized field.

The distinction is relevant to economic and institutional inquiry because many processes combine local interaction with distributed constraint. A household can face locally observed prices whose formation depends on market-wide arrangements. A firm can respond to nearby suppliers while depending on infrastructures whose failure propagates across regions. Regulatory rules can apply at specific institutional interfaces while producing distributed effects through chains of compliance, finance, or information. Social norms can be encountered in local interaction yet reproduce broader patterned expectations. Field formalisms do not by themselves explain these processes, but they make a useful question explicit: is the relevant condition attached to an actor, to a dyadic relation, to a region of an underlying domain, or to a distributed structure extending across many locations?

Nonlocal models provide another caution. Not every distributed dependence is well represented by nearest-neighbor or infinitesimal coupling. Integral operators, long-range kernels, delayed interactions, and global constraints allow the state at one location to depend directly on conditions elsewhere. Effective theories can also contain apparently nonlocal relations after unobserved degrees of freedom have been integrated out. The choice between local and nonlocal representation is therefore a modeling decision requiring evidence and scale awareness rather than a metaphysical preference.

The notion of locality becomes still more delicate outside physical space. If the domain is a network, an institutional hierarchy, a semantic space, or a configuration manifold, “nearby” refers to the geometry or topology of that representation. Two firms can be geographically distant yet adjacent in a supply network. Two legal categories can be close within a classification system while applying to actors in different jurisdictions. A field defined on such a domain inherits its locality from the chosen structure of the domain. Later GR can use this idea productively, but only if it specifies what relation makes two positions local.

Distributed conditions can also modify the capacities of localized actors without reducing those capacities to internal attributes. Access to transport, legal protection, information, credit, public goods, ecological quality, or institutional recognition can vary across a structured environment. A field-like model can represent such variation where continuity or another distributed structure is appropriate. This creates a bridge to the capability and relational-value traditions discussed earlier in the chapter: opportunities can depend on surrounding conditions as well as possessed resources. The formal field concept adds a possible representational vocabulary for patterned environments; it does not replace the normative or institutional theories needed to interpret those conditions.

For GRE, the inheritance is again precise. Field theories show how locally specified relations can generate distributed patterns and how background geometry, boundaries, sources, and coupling structure condition those patterns. They encourage analysis of economic environments that are neither reducible to individual attributes nor exhausted by pairwise networks. GR can extend the question by asking how the domain of locality itself changes: infrastructures alter effective distance, law changes which actors can interact, technologies reorganize information neighborhoods, and institutional reforms redraw boundaries. The relation that defines “local” can therefore be historically generated.

2.34.3 Symmetry and Gauge Equivalence

Symmetry introduces a different analytical problem. A transformation is a symmetry when it preserves specified structure. In geometry, mechanics, and field theory, symmetries can organize conservation laws, classify states, constrain admissible equations, or identify different mathematical descriptions that preserve relevant physical content. Gauge theory develops a particularly important case in which certain transformations alter the mathematical variables used in a description while leaving the represented physical situation unchanged in the relevant sense.

Electromagnetism provides an accessible example. The electromagnetic field can be expressed through potentials, but the potentials are not uniquely fixed by the observable field strengths. A gauge transformation changes the potential while preserv-

ing the electromagnetic field tensor. Schematically,

$$A_\mu \mapsto A_\mu + \partial_\mu \chi, \quad F_{\mu\nu} \mapsto F_{\mu\nu}, \quad (2.5)$$

where A_μ is a potential, χ is an admissible scalar function, and $F_{\mu\nu}$ represents the gauge-invariant field strength. Equation 2.5 displays the essential distinction: a variable in the formal description changes while the gauge-invariant quantity remains the same. Gauge freedom is therefore not simply ordinary empirical variation. It reflects redundancy or equivalence in the representation of the physical state (Jackson 1999).

The twentieth-century development of gauge theory generalized this structure beyond electromagnetism. Yang and Mills formulated a theory invariant under local isotopic-spin rotations, introducing non-Abelian gauge fields whose dynamics are nonlinear (Yang and Mills 1954). Their construction became foundational for later particle physics. The historical importance for the present chapter lies less in the specific physical theory than in the conceptual architecture: demanding invariance under transformations that can vary from point to point changes the structure required of the theory and introduces connection-like objects that relate local descriptions.

Global and local symmetry should therefore be distinguished. A global transformation applies the same transformation throughout the domain. A local transformation permits the transformation to vary with position. Maintaining a suitable form of invariance under local transformations generally requires additional mathematical structure. Gauge fields and connections can be understood, at one level, as providing the machinery needed to compare or transport locally defined quantities consistently across neighboring points. The exact interpretation depends on the theory, but the broader lesson is that local representational freedom can constrain relational structure.

Gauge equivalence also clarifies a general epistemic distinction between observable difference and descriptive difference. Two formal configurations can look different because different gauges, coordinates, parameterizations, or conventions have been chosen while representing the same relevant physical state. The analyst must therefore identify which quantities are invariant under the transformations treated as representational redundancy. This is a more demanding task than merely noting that several descriptions exist. A gauge structure specifies the transformation group and the equivalence relation generated by it.

The concept is attractive for social analysis because social inquiry also encounters multiple descriptions, conventions, units, classifications, and coordinate systems. Yet the analogy can easily become too strong. Different monetary units can represent the same purchasing relation under a simple conversion, but changes in accounting categories, legal classifications, or social identities can also change behavior, rights, or institutional consequences. A transformation in description is socially gauge-like only if the transformation preserves the modeled substantive structure under explicitly stated conditions. The existence of several vocabularies does not itself create gauge equivalence.

This point is especially important for GR. Generative-relational inquiry is interested in equivalence, translation, representation, and the possibility that different descriptions preserve some relations while changing others. Gauge theory contributes a rigorous precedent for separating representational redundancy from substantive

variation. It also shows that equivalence is structured: one must specify the transformations under which invariance is claimed and the observables that remain unchanged. Later GR can generalize the question beyond physics by asking which institutional, economic, or epistemic transformations preserve a relational structure and which transformations generate a genuinely different one. The answer has to be established within each domain rather than imported from gauge theory.

Gauge ideas also caution against treating every formal variable as directly observable. Some variables are indispensable for calculation or local formulation while individual values depend on representational choice. In economics, latent variables, index constructions, numeraire choices, accounting conventions, and coordinate-dependent quantities can raise analogous questions, although the mathematical structure differs. A useful methodological inheritance is therefore to ask which conclusions are invariant under admissible changes of representation. Robustness across such transformations can reveal which results depend on arbitrary descriptive choices and which survive them.

The GRE bridge should remain modest. Gauge theory does not provide a ready-made model of institutions, value, or social identity. It provides an unusually developed example of how local representation, symmetry, equivalence classes, connections, and invariant quantities can be organized within one formal system. Those concepts can inspire rigorous questions about economic representation when an explicit transformation structure exists. Their value lies in analytical discrimination rather than metaphorical prestige.

2.34.4 Background Dependence and Background Independence

Every formal model presupposes some structure. Coordinates, domains, metrics, boundary conditions, causal ordering, topology, probability spaces, admissible transformations, and measurement conventions can enter at different levels. A useful distinction concerns whether a structure is fixed in advance or included among the variables whose configuration is determined dynamically. In this sense, a *background* is not simply contextual information. It is structure that the theory presupposes rather than explains within the modeled dynamics.

Classical field theories often define fields on a fixed spacetime geometry. The geometry provides distances, causal relations, volume elements, and other structures used to formulate the field equations. The matter or gauge fields evolve, while the background spacetime is treated as given for the purpose of the theory. General relativity changes this arrangement in a fundamental way: spacetime geometry is represented by the metric field and participates in the dynamics rather than remaining a fixed stage. This feature motivates the language of background independence in gravitational theory and in approaches to quantum gravity (Rovelli 2004).

The distinction should be used carefully. Background independence is not exhausted by coordinate invariance, and general covariance alone does not guarantee that a theory contains no fixed background structure. A theory can be written in a coordinate-independent form while still presupposing nondynamical geometric objects. Conversely, practical calculations can introduce reference structures, gauges, boundary conditions, or perturbative backgrounds without thereby changing the fundamental status of the underlying theory. The relevant question is which structures are fixed by the formulation and which are solved for, constrained, or transformed

within it.

Background dependence is not intrinsically a defect. Models deliberately hold some conditions fixed in order to isolate a problem. A local labor-market model may treat national law as given; a firm model may treat currency institutions as given; an urban model may hold national borders fixed; a short-run macroeconomic model may treat technologies or demographic composition as parameters. These choices can be appropriate to the scale and purpose of inquiry. The methodological issue appears when a structure that materially changes during the process of interest is silently retained as fixed.

Economic theory repeatedly confronts this problem because its backgrounds are often institutional and historical. Property forms, accounting units, contractual enforceability, market boundaries, organizational categories, infrastructures, technologies, and legal personhood can be treated as conditions within one model while becoming objects of explanation in another. The same analytical object can therefore move between foreground and background depending on research scale. A price model can reasonably assume a market institution that a historical-institutional analysis seeks to explain.

This movement between levels has an important consequence for GRE. A model may be internally dynamic while remaining externally background-dependent in the sense relevant to the research question. Prices, quantities, or strategies can evolve endogenously while the rules defining admissible transactions remain fixed. A network can rewire while node identities and legal categories remain fixed. A field can evolve while its domain and metric remain fixed. Calling a model “dynamic” therefore says little about which of its constitutive conditions are themselves allowed to change.

Background sensitivity offers a useful intermediate language. An analysis can explicitly study how conclusions depend on the background structures it assumes even when those structures are not themselves dynamical variables. Sensitivity analysis can compare legal regimes, network architectures, spatial geometries, institutional constraints, or measurement conventions. Comparative institutional analysis likewise varies conditions that a narrower model would hold constant. This approach does not require a universal theory in which every background becomes dynamical at once. It requires the analyst to identify backgrounds and test which conclusions depend on them.

The generative-relational inheritance is strongest at this methodological level. GR repeatedly asks how the conditions that make a relation possible are themselves produced, maintained, altered, or removed. Background-independent physics supplies one striking precedent in which a structure once treated as fixed becomes dynamical. It does not imply that social institutions are analogous to spacetime geometry. The transferable question is more abstract: which elements of an explanation have been placed outside the process being explained, and what changes when one of those elements is brought inside the domain of transformation?

This question also guards against an impossible demand. No finite model explains all of its own presuppositions simultaneously. Formal systems require languages, domains, inferential rules, data constructions, and boundary choices. GR should therefore not interpret generativity as a requirement for absolute backgroundlessness. A more defensible aim is reflexive background specification: identify which structures are fixed for a given inquiry, justify that choice, examine sensitivity where relevant, and permit previously fixed structures to become variables when historical evidence

or the research problem requires it.

2.34.5 Methodological Limits of Physical Formalisms in Social Analysis

Field, gauge, and background-sensitive formalisms offer powerful structural vocabularies, but their transfer into social and economic inquiry requires a stricter methodology than terminological analogy. The relevant question is not whether social reality can be described evocatively with words borrowed from physics. It is whether a formal construction specifies objects, relations, transformations, observables, and empirical conditions clearly enough to do explanatory or inferential work.

A first requirement concerns domain construction. A physical field is defined on a domain with specified mathematical structure. A social field model therefore needs an account of what counts as position and what geometry or topology relates positions. Geographic space may supply a direct answer in some applications. Institutional or relational spaces require a constructed metric, ordering, adjacency relation, or manifold-like representation. Without such structure, statements about gradients, locality, curvature, or propagation remain metaphorical.

A second requirement concerns measurement. Field values must correspond to estimable or operationally interpretable quantities if the formalism is intended for empirical analysis. A modeled “trust field,” “power field,” or “norm field” requires more than a suggestive name. The researcher must specify what is measured, how values are assigned, how uncertainty enters, and what observations would discriminate among competing field configurations. In theoretical work, unobserved fields can still be legitimate latent constructs, but their relation to observables must eventually be articulated if empirical claims are made.

A third requirement concerns dynamics and coupling. Borrowing a field variable without specifying an evolution equation, interaction rule, or constitutive relation often adds notation without adding explanation. If an actor state is said to couple to a surrounding field, the model should state how the field affects the actor and how, if at all, actors affect the field. Linear, nonlinear, local, nonlocal, delayed, and stochastic couplings have different consequences. The choice should reflect a substantive mechanism rather than aesthetic resemblance to a physical theory.

A fourth requirement concerns symmetry. Gauge language is justified only when a transformation class has been specified and when the relevant substantive quantities are invariant under that class. Changing a label, currency unit, coordinate chart, accounting convention, or normalization can sometimes function in this way. Other changes alter institutional meaning or causal consequences and therefore cannot be treated as mere gauge. The formal discipline of gauge theory is valuable precisely because it prevents equivalence from being asserted loosely.

A fifth requirement concerns background structure. Social models inevitably fix some institutions, categories, scales, and boundaries. The important methodological task is to identify them. A model becomes more reflexive when it states which conditions are exogenous for the present inquiry, which are dynamical, and which may need to change status at another scale or historical period. Background independence in physics should therefore be treated as a source of conceptual questions rather than a standard that every social model must imitate.

A sixth requirement concerns ontology. Successful mathematical representation does not by itself establish that the represented social object is literally a physical field, gauge connection, manifold, or spacetime. Several mathematically inequivalent models can fit the same observations, and one formalism can often approximate systems with very different underlying mechanisms. The book's standing commitment to ontological suspension is especially important here. Formal structures should be evaluated by explanatory clarity, empirical adequacy, inferential value, and compatibility with the domain rather than by the prestige of their physical origin.

These limits do not reduce the importance of the lineage. They clarify what can be inherited responsibly. Field theories contribute methods for representing distributed conditions and continuous variation. Locality distinguishes immediate coupling from system-wide consequence. Gauge theory supplies a rigorous language for representational equivalence, local symmetry, and invariant quantities. Background-sensitive reasoning distinguishes what a model allows to vary from what it presupposes. Together, these concepts expand the formal repertoire available to relational economic analysis beyond discrete topology alone.

They also illuminate several later GR questions. A relational configuration may depend on conditions distributed across an institutional or informational environment. The effective meaning of locality may be generated by infrastructure, law, or communication technology. Different descriptions may preserve some relational structure while changing representational coordinates. Conditions initially treated as background can become objects of historical transformation. GR can formulate these problems without claiming that social reality obeys the same equations as a gauge field theory or gravitational theory.

For GRE, the most useful inheritance is therefore methodological reflexivity about representation. A formal model should reveal what its entities are, where they live, which relations are local, which transformations preserve the modeled structure, which quantities are invariant, and which backgrounds have been held fixed. These questions help prevent relational language from becoming vague precisely because they force the analyst to declare the architecture of the representation.

This prepares the next lineage. Field and gauge formalisms clarify how structure can be distributed, locally related, representationally redundant, and background-sensitive. They do not by themselves answer how information is quantified, how computation constrains inference, how simulations generate knowledge, or how symbolic systems mediate formal representation. Section 64 therefore turns to information, computation, and formal representation, where the focus shifts from the geometry and invariance of modeled structure to the encoding, transformation, and epistemic limits of representations themselves.

2.35 Information, Computation, and Formal Representation

Field, gauge, and background-sensitive formalisms clarify how a model can represent distributed conditions, locality, invariance, equivalence, and dependence on fixed or dynamical backgrounds. Information theory and computation shift attention toward another layer of formal inquiry: how distinctions are encoded, transmitted, transformed, and operationalized within symbolic systems. The role of this section is to re-

construct the principal intellectual resources connecting information, computation, simulation, and scientific representation before Section 65, *Generative Relational Theory*, turns explicitly to generative relational theory. Its objective is to distinguish five analytical problems that are often compressed into a general vocabulary of “information” or “computation”: probabilistic information and entropy, effective computation and resource complexity, simulation as a mode of scientific inquiry, symbolic representation and model construction, and the relation between computational limits and broader epistemic limits. The method is formal and philosophy-of-science oriented. Mathematical concepts are introduced only where their technical content matters, and their transfer to social and economic inquiry remains subject to the book’s standing commitments to methodological pluralism and ontological suspension (Shannon 1948; Turing 1937; Winsberg 2010).

The resulting lineage is important because formal representation does more than provide notation for already given objects. A computational analysis requires choices about variables, data structures, categories, admissible operations, initial conditions, stopping rules, and criteria of comparison. Information theory measures selected statistical properties of messages without supplying their semantic or normative interpretation. Computability theory distinguishes procedures that can in principle be carried out mechanically from problems for which no such general procedure exists. Complexity theory adds the further question of how computational resources grow with problem size. Simulation makes formally specified systems experimentally manipulable within computational environments, while philosophy of modeling clarifies that a model represents selected aspects of a target for specific purposes rather than reproducing the target in full (Hartmanis and Stearns 1965; Giere 2004). These distinctions supply GRE with disciplined resources for computational inquiry while preserving a central epistemic caution: what can be encoded or computed is determined partly by the representation through which the inquiry has been constructed.

2.35.1 Information and Entropy

Modern information theory gives the term *information* a precise statistical meaning. Shannon’s communication theory was formulated around the transmission of messages generated by a source through a channel, including the effects of noise, redundancy, coding, and channel capacity (Shannon 1948). Its mathematical achievement depends on restricting the problem. The theory asks how uncertain a message source is, how efficiently messages can be encoded, and under what conditions signals can be transmitted reliably. The semantic significance of the message to a receiver is not part of the quantity measured by Shannon entropy. This restriction is foundational for later interdisciplinary use because it prevents statistical information from being treated automatically as knowledge, meaning, relevance, truth, or value.

For a discrete random variable X taking possible values x_i with probabilities p_i , Shannon entropy is stated in Equation 2.6.

$$H(X) = - \sum_i p_i \log p_i. \quad (2.6)$$

Equation 2.6 measures uncertainty associated with the probability distribution. When one outcome is nearly certain, entropy is low; when probability mass is distributed more evenly across several possible outcomes, entropy is higher. The numer-

ical unit depends on the logarithm's base. A base-two logarithm measures entropy in bits. The quantity therefore concerns the expected informational content associated with distinctions among possible messages under a specified probability model. It does not by itself measure the importance of a message, the credibility of a source, the truth of a proposition, or the social consequences of receiving it.

This distinction matters because ordinary language uses *information* across several layers. A statistical event can reduce uncertainty while conveying little practical importance. A highly consequential statement can be unsurprising and therefore have low surprisal under an appropriate probability distribution. A false message can possess Shannon information because its statistical rarity is independent of its truth. A coded signal can be transmitted with high fidelity while its receiver lacks the interpretive resources required to understand it. Information theory therefore establishes one rigorous concept of information while leaving semantic, epistemic, pragmatic, and normative dimensions to other theories.

Entropy should also be handled carefully when moved among domains. Shannon deliberately adopted a mathematical form related to entropy expressions already used in statistical physics, and later work has developed deep connections between information theory and statistical mechanics. Yet the existence of formal correspondence does not make thermodynamic entropy, communication entropy, institutional uncertainty, and social disorder interchangeable concepts. A valid transfer requires a specified probability space, random variable, coding problem, or other formal object to which the entropy measure applies. Describing a society as having "high entropy" without such a construction usually functions as analogy rather than measurement.

Related information-theoretic quantities extend the same statistical architecture. Conditional entropy represents remaining uncertainty about one variable when another is known. Mutual information measures statistical dependence by quantifying how much knowledge of one variable reduces uncertainty about another. Channel capacity concerns reliable communication under constraints and noise. These quantities can be useful in economics, networks, learning systems, and computational social science because they can summarize dependencies that need not be linear. Their interpretation nevertheless remains representation-dependent: the analyst has already decided what the variables are, which observations count as possible states, how probabilities are estimated, and which distinctions are retained or discarded.

This makes information theory especially relevant to relational inquiry without turning information into a universal social substance. A relation between measured variables can carry mutual information; a communication network can be analyzed in terms of signal transmission; an institution can constrain the range of possible messages or actions observed in a dataset. These are legitimate formal uses when the statistical objects are specified. A richer relational claim—for example, that an actor understands another, recognizes an obligation, acquires practical knowledge, or experiences a change in trust—requires additional semantic and social theory.

The distinction also clarifies a recurring issue in economic measurement. Prices, classifications, ratings, indicators, and records can function as information-bearing signals, but their informational role depends on institutional arrangements and interpretive conventions. A price may summarize dispersed conditions while also being generated by rules of exchange, market structure, strategic action, legal rights, and measurement practices. A credit score can reduce uncertainty for a lender while shaping the opportunities of the person classified. The amount of statistical informa-

tion conveyed by such objects is analytically separable from the justice, meaning, or performative consequence of the classification.

GRE can therefore inherit information theory at a precise level. It gains tools for studying uncertainty, coding, dependence, transmission, compression, and noise. These concepts become especially useful when later research examines knowledge infrastructures, AI systems, market signals, institutional records, or distributed coordination. The stronger GR question concerns how the variables and distinctions over which information is defined become historically constituted. A probability distribution presupposes a sample space; an information channel presupposes identifiable messages, encodings, senders, receivers, or state distinctions. Generative-relational inquiry can place the formation and revision of those distinctions within the object of study while retaining the technical contribution of information theory where its assumptions are satisfied.

2.35.2 Computation and Complexity

Computation adds a different formal question: which transformations can be carried out by an effective mechanical procedure? Turing's analysis of computable numbers supplied a mathematical model of such procedures through abstract machines operating on symbols according to finitely specified rules (Turing 1937). The importance of this lineage lies in the separation between intuitive calculability and formally characterized computation. Once a class of mechanical procedures is represented with sufficient precision, the theory can establish both positive results concerning what can be computed and negative results concerning problems for which no general effective procedure exists.

The universal-machine idea further changes the relation between machine and task. A single machine architecture can, given an appropriate symbolic description, simulate the behavior of other machines. Program and data thereby become representable within a common computational medium. This conceptual move became foundational for general-purpose digital computation. It also supplies a useful distinction for later formal modeling: the physical computing substrate, the encoded procedure, the input representation, and the target process being modeled occupy different analytical layers even when they interact in practice.

Computability should be distinguished from computational complexity. A problem can be computable in principle while requiring resources that grow so rapidly with input size that exact calculation becomes impractical. Hartmanis and Stearns helped establish computational complexity as a systematic study of the resources required to compute, explicitly distinguishing the existence of a procedure from the difficulty of carrying it out (Hartmanis and Stearns 1965). Time, memory, communication, parallel depth, approximation error, and other resource measures can define different notions of computational difficulty. The resulting classification concerns algorithms relative to formal input specifications and computational models.

This distinction is especially important in economic and social modeling. An equilibrium, optimum, matching, policy schedule, network statistic, or inference problem may be mathematically well-defined without being efficiently computable at the relevant scale. A theoretically specified decision rule can therefore impose computational demands that actual agents could not satisfy. Algorithmic institutions—auctions, platforms, recommendation systems, allocation mechanisms, risk engines, or automated

bureaucratic procedures—also face computational constraints of their own. The economics of information and decision-making can consequently depend on the cost of computing, storing, searching, communicating, and verifying representations rather than only on the logical existence of a solution.

Computational complexity is also distinct from complexity in the sense developed in Section 61. Complex-systems research concerns interacting components, emergence, adaptation, nonlinearity, multiscale organization, and coevolution. Computational complexity concerns resources required by algorithms or formal problems. A complex adaptive system can sometimes be simulated by a computationally inexpensive model, while a formally simple problem statement can induce severe computational demands. Shared terminology should therefore not collapse two different research traditions.

The formalization of computation introduces its own representational dependencies. An algorithm receives inputs in an encoded form and produces outputs according to specified operations. Changing the encoding can alter practical performance and sometimes the apparent size of the problem, although robust complexity theory seeks classifications that survive reasonable changes of representation. In empirical work, further choices arise before the algorithm begins: which observations become variables, how missingness is represented, which categories are distinguished, how continuous quantities are discretized, and which losses or constraints define successful output. Computational analysis inherits these choices rather than replacing them.

This point becomes particularly important for AI and computational economics. Increased computational capability can enlarge the class of models, searches, optimizations, or simulations that are practically accessible. It does not automatically improve the quality of the represented problem. A powerful optimizer can efficiently solve a misspecified objective. A classifier can consistently reproduce a historically generated labeling scheme. A large simulation can explore a formal state space that omits decisive institutional or normative distinctions. Computational power and epistemic adequacy therefore constitute different dimensions of inquiry.

At the same time, formal computation contributes a valuable discipline to theories of agency. Economic models often describe actors as choosing, learning, forecasting, or optimizing. Computational perspectives ask which procedures could realize those capacities, what information the procedures require, and how resource bounds alter behavior. Bounded rationality, heuristic search, algorithmic markets, and machine-mediated institutions all become easier to formulate once the cost and structure of computation are treated as substantive features rather than invisible background conditions.

For GRE, the inheritance is again layered. Computability theory establishes limits on general mechanical procedure; complexity theory characterizes resource demands among computable procedures; practical computing adds architecture, approximation, numerical stability, data access, and implementation constraints. These resources help distinguish a theoretical possibility from an executable institutional mechanism. Later GR can add another question: how do the computational tasks themselves arise, change, or disappear as institutions redefine objectives, categories, available data, and relations among actors? A change in the represented problem can matter as much as a change in the algorithm used to solve it.

2.35.3 Simulation and Computational Experiment

Computer simulation turns formal models into executable processes whose behavior can be explored through systematic variation. The analyst specifies a model, initializes it under selected conditions, executes its update procedures, records outputs, and compares outcomes across parameter settings, interventions, stochastic realizations, or alternative model structures. Simulation thereby creates a distinctive mode of scientific practice situated between mathematical deduction, numerical approximation, empirical observation, and experimental manipulation. Philosophy of simulation has emphasized that its evidential role depends on the relations among theory, model construction, numerical methods, code, validation, calibration, and target-world evidence (Winsberg 2010).

A computational experiment differs from a laboratory experiment because the immediate object being manipulated is a formal or computational system. Changing a simulated tax rule, network topology, climate forcing, disease parameter, or agent strategy changes the model run. Whether the resulting variation supports a claim about the target system depends on the empirical and theoretical warrant connecting model and target. This distinction preserves the scientific importance of simulation while avoiding the inference that a result generated by code has thereby been observed in the world.

Simulation is especially valuable when analytical solutions are unavailable or when interaction produces behavior that is difficult to derive from component rules by inspection. Agent-based modeling provides a clear social-scientific example. Epstein and Axtell construct artificial societies in which heterogeneous agents interact under explicit local rules so that aggregate patterns can be studied as computational outcomes (Epstein and Axtell 1996). Section 61 used this tradition to clarify a constructive meaning of emergence. The present section adds an epistemic distinction: computational generation can demonstrate that a specified mechanism is sufficient to produce a pattern within a model, while additional evidence is required to establish that the mechanism generated the corresponding historical pattern in the target world.

This difference between generative sufficiency and empirical identification is central. Several distinct models can produce qualitatively similar aggregate outcomes. Parameter combinations can compensate for one another. A simulated macro-pattern can remain robust while the micro-mechanisms generating it vary. Conversely, a model can fit historical data because parameters were calibrated closely to those observations while performing poorly outside the calibration domain. Simulation therefore creates evidence through a chain of warrants rather than through visual resemblance between output and observation alone.

Validation has several layers. Verification concerns whether the computational implementation correctly solves or executes the specified model. Validation in the stronger empirical sense concerns whether the model is adequate for the target and purpose. Sensitivity analysis studies how outputs depend on parameters, initial conditions, stochastic seeds, numerical approximations, or structural assumptions. Calibration links parameter choices to observations. Out-of-sample comparison, replication, alternative specifications, and mechanism-specific evidence can further strengthen or weaken the interpretation. These procedures do not reduce simulation to a single universal protocol; they identify distinct questions that must be answered for differ-

ent inferential purposes.

Simulation also changes what counts as accessible evidence. Some models contain quantities that are difficult or impossible to observe directly in empirical systems but are completely recorded inside the simulation. The analyst can inspect every agent state, counterfactual branch, network tie, or intermediate variable if the program has been constructed to expose them. This epistemic abundance can be useful while creating a potential asymmetry: the simulation is more observable than the target. Explanations derived from internal simulated variables therefore require a bridge back to measurable or otherwise warranted features of the real system.

Computational experimentation can serve purposes beyond prediction. It can test the internal consequences of assumptions, reveal unexpected interactions, compare mechanisms, explore possible regimes, identify sensitivity, generate hypotheses, study counterfactuals, and expose where a verbal theory remains underspecified. Winsberg's analysis of simulation emphasizes the distinctive epistemic practices through which computational models mediate theory and evidence rather than functioning as transparent deductions from first principles (Winsberg 2010). In social inquiry, this is especially important because the act of formalization often forces assumptions about timing, interaction, information, and institutional structure to become explicit.

The capacity to experiment computationally does not make the represented social world closed under the model's rule set. Real actors learn from representations, contest categories, reinterpret rules, create institutions, and change technologies. A simulation can represent such reflexivity when corresponding processes are included, but the model remains bounded by its implemented state variables and transition mechanisms. Open-ended novelty poses a particular challenge because a finite computational model usually defines in advance at least the language through which novelty can appear, even when the realized sequence of events is unpredictable.

GRE can inherit simulation as an important methodological instrument without treating simulation as its privileged method. Historical archives, ethnography, legal interpretation, surveys, experiments, econometrics, network analysis, formal proof, and computational models answer different questions. Simulation becomes especially useful when GRE wants to examine how specified relational mechanisms generate trajectories, how interventions interact with network or institutional structure, or how heterogeneous agents and fields coevolve under explicit rules. The evidential status of the resulting outputs depends on the purpose of the model and on the quality of the bridge between formal construction and historical-economic target.

2.35.4 Symbolic Representation and Model Construction

Computation operates on representations. Variables, symbols, categories, data structures, equations, graphs, matrices, ontologies, program states, and model objects make selected distinctions available to formal manipulation. Section 37 reconstructed philosophical traditions in language, interpretation, and symbolic mediation. The present subsection focuses on the scientific and computational consequence of that inheritance: a model does not contain its target directly. It contains a structured representation through which particular aspects of a target can be described, transformed, compared, or simulated.

Cassirer's philosophy of symbolic forms provides an important philosophical pre-

cursor to this view by treating symbolic articulation as constitutive of intelligible experience rather than as a transparent duplication of a fully formed world (Cassirer 1955). Scientific modeling develops the issue in a more domain-specific way. Giere argues for a pragmatic relation in which scientists use models to represent selected aspects of the world for particular purposes, with the relevant representational relation depending on designated similarities and the aims of inquiry (Giere 2004). This formulation helps avoid two extremes: models are neither exact copies of reality nor arbitrary constructions unconstrained by evidence.

Selective representation is unavoidable. A macroeconomic model may retain output, inflation, employment, and interest rates while suppressing household identities and legal details. A network model may retain nodes and ties while omitting the semantic content of interactions. An agent-based model may encode several heterogeneous traits while holding institutional categories fixed. A machine-learning system may transform persons, texts, images, or transactions into feature vectors. Each representation creates an analytical surface on which some distinctions become computable and others disappear.

Formalization therefore involves more than assigning symbols to pre-existing facts. The analyst defines equivalence classes, scales, categories, units, temporal resolution, missing-value rules, boundaries, and admissible transformations. Two historical events can become instances of one variable because the model treats certain differences as irrelevant. Several institutional arrangements can be grouped under one category. A continuous phenomenon can be discretized. A relation can be represented as binary, weighted, signed, directed, temporal, multilayer, or higher-order. These choices can be justified and empirically productive while remaining theoretically consequential.

This representational selectivity is closely related to the background problem introduced in Section 2.34. A model background specifies what remains fixed while other quantities vary. A symbolic representation goes one step earlier by determining what can appear as a quantity in the first place. Some features of a target are variables, others parameters, others boundary conditions, and still others remain absent. Computational execution cannot recover a distinction that the representation never encoded unless the system is supplied with additional data or a mechanism for constructing a new representational category.

Representation also has a syntactic dimension. Formal systems define permissible expressions and operations. A graph permits questions about adjacency and paths once objects have been encoded as nodes and relations as edges. A probability model permits questions about distributions and conditional dependence once outcomes and events are defined. A program permits state transformations expressible through its data types and operations. Syntax enables systematic transformation precisely because it constrains what counts as a well-formed object. The scientific question is whether these constraints preserve the distinctions relevant to the intended target and purpose.

Semantics enters when formal objects are interpreted. A variable named “trust” is mathematically just a variable until the model states what empirical, behavioral, survey, institutional, or theoretical content the quantity is meant to represent. A network edge named “influence” requires a criterion for identifying influence. A latent factor receives substantive meaning through a relation among measurement model, evidence, and theory. Symbolic labels can therefore create an illusion of semantic

completeness when the interpretive bridge has not actually been established.

Pragmatics adds a third layer. The adequacy of a representation depends partly on what the model is being used to do. A coarse model can be adequate for estimating aggregate energy demand and inadequate for evaluating distributive justice. A binary network can be sufficient for identifying disconnected components and insufficient for analyzing the intensity or legal character of relationships. Giere's purposive account of representation is useful here because representational adequacy is assessed relative to selected aspects and scientific purposes rather than through an impossible requirement of total resemblance (Giere 2004; Giere 2006).

These choices acquire additional significance in social and economic systems because classifications can become causally active. A category used for taxation, credit, welfare eligibility, employment status, migration, or risk assessment can alter the opportunities and behavior of the persons classified. The representation then participates in the target system rather than remaining an external description. A computational classification system can change incentives and institutional practice; those responses can modify the data from which later models are trained or evaluated. Representation can therefore enter feedback with the reality it represents.

This possibility does not eliminate the distinction between model and world. It makes the relation historically dynamic. A classification may begin as an administrative representation and later become a strategic object around which actors organize. A metric can become a target. A platform's internal data model can reshape how transactions are offered or recorded. A legal category can create a new capacity or restriction. These processes are especially important for GRE because economic infrastructures increasingly embed formal representations directly into decision systems.

The GR inheritance from symbolic representation is consequently deeper than a claim that reality is constructed by language. Formal and symbolic systems create selective interfaces through which phenomena become recordable, comparable, computable, and governable. Their categories can remain purely analytical in one context and acquire institutional force in another. Later generative-relational analysis can therefore study both directions of mediation: relations and practices produce representations, while stabilized representations can reorganize later relations and practices. The conceptual contribution of the representation lineage is to keep the model, the target, the interpretive mapping, and the use of the model analytically distinct even when they become causally coupled.

2.35.5 Computational Limits and Epistemic Limits

The formal limits of computation provide powerful results, but they define only one part of the wider limits of knowledge. Turing's work establishes that a sufficiently general theory of effective computation encounters problems for which no universal mechanical decision procedure exists (Turing 1937). Complexity theory adds cases in which a procedure exists while required resources become prohibitive as problem size grows (Hartmanis and Stearns 1965). Numerical analysis, finite precision, stochastic approximation, and hardware constraints add further practical limitations. These are computational limits in different senses and should be distinguished from empirical underdetermination, measurement error, semantic ambiguity, model mis-specification, historical novelty, or normative disagreement.

A first distinction separates undecidability from intractability. An undecidable problem lacks a general algorithmic solution within the relevant formal framework. An intractable problem can be computable while exact solution demands excessive time, memory, or other resources for instances of practical interest. Approximation, heuristics, decomposition, randomized methods, or problem-specific structure can make difficult computations usable without changing the underlying theoretical classification. Statements about “impossibility” should therefore identify which type of limit is meant.

A second distinction separates computational difficulty from data limitation. An algorithm can be efficient while the required input is unavailable, unreliable, biased, or conceptually ill-defined. Estimating a social parameter can be computationally easy and empirically weak because the construct is poorly measured. Conversely, rich and reliable data can be available for a task whose optimal solution is computationally difficult. Data abundance and computational tractability are independent dimensions.

A third distinction concerns identifiability and underdetermination. Several models can fit the same observations while implying different mechanisms or counterfactuals. Additional computation can explore these alternatives more thoroughly, but computational power alone does not create discriminating evidence. Section 32 treated underdetermination as an epistemic problem concerning the relation among evidence, representation, and competing explanations. Computation can help characterize the space of compatible models while leaving the evidential ambiguity intact.

A fourth distinction concerns representation. A computational system solves the problem encoded for it. If the representation omits a relevant relation, confounds distinct categories, assumes a fixed boundary that later changes, or operationalizes a normative concept inadequately, exact computation can produce a precisely calculated answer to an ill-posed question. The epistemic limit then arises before computation, in the construction of the formal object. This is one reason symbolic representation belongs in the same lineage as computation rather than being treated as a cosmetic preprocessing step.

A fifth distinction concerns semantic and interpretive limits. Information-processing systems can manipulate symbols or statistical patterns without sharing the human practices through which those symbols acquire institutional, historical, ethical, or experiential meaning. Some computational approaches can model semantics, infer latent structure, or learn representation from data, but the evidential status of the resulting representation still depends on how it is connected to a domain of interpretation. Successful prediction can establish a useful regularity without resolving every question about meaning or causal mechanism.

A sixth distinction concerns reflexivity. Social actors can learn about a model, respond strategically to a metric, redesign institutions, change classifications, or alter behavior because a prediction has been published. The target can therefore change partly because it has been represented. Computational models can include reflexive responses when they are specified, but the possibility complicates any assumption that the data-generating process remains fixed across observation and intervention. This is a historical and institutional problem in addition to a computational one.

These distinctions qualify several common inferences. More computational power does not imply proportionately more knowledge. A formally undecidable question does not imply that every practically relevant question in the domain is unknowable. Computational intractability does not establish normative indeterminacy. Predictive

accuracy does not by itself establish causal explanation or justice. A transparent symbolic model can be epistemically weak if its assumptions are false, while a computationally opaque model can still provide useful evidence under appropriately tested conditions. Evaluation requires attention to the local epistemic task.

The converse is equally important. Formal limits can reveal genuine constraints that philosophical reflection alone might overlook. A policy design that presupposes an exact solution to an intractable optimization problem may be institutionally unrealistic. A decentralized mechanism can distribute computation differently from a centralized one. Approximation quality can affect distributive outcomes. Communication constraints can limit coordination even when actors share objectives. Verification costs can shape which claims or transactions are institutionally acceptable. Computational architecture can therefore become part of political-economic structure.

GRE can use these insights to analyze economies increasingly mediated by algorithms, databases, platforms, automated decision systems, and AI. Computational capacity is itself distributed unevenly across actors. Some organizations can collect more data, train larger models, simulate more alternatives, or execute decisions at greater speed than others. Those asymmetries can become sources of economic capability and power. Yet the analysis must distinguish the possession of computation from the possession of justified knowledge. An actor can compute at scale while operating with biased categories, incomplete observations, unstable objectives, or strategically produced data.

The generative-relational implication concerns the coevolution of representation, computation, and target. A model is built from distinctions generated within a historical setting; computational use can stabilize or amplify those distinctions; institutional responses can alter the environment; later data then reflect both the original world and the consequences of earlier representations. This recursive structure does not eliminate formal analysis. It identifies an expanded object of analysis in which formal systems participate in the relations they measure and govern.

Section 64 therefore completes the scientific and formal lineage developed across Sections 59–64. Systems and cybernetics contributed feedback, regulation, self-organization, and adaptation. Dynamical systems supplied state spaces, trajectories, attractors, bifurcations, and time-dependent change. Complexity research added emergence, multiscale organization, adaptation, and coevolution. Network and higher-order formalisms represented structured interaction and changing topology. Field and gauge approaches clarified distributed conditions, invariance, equivalence, and background sensitivity. Information and computation add encoding, uncertainty, effective procedure, resource limits, simulation, and the epistemology of formal representation. These traditions do not converge automatically into one theory. They provide a repertoire of partially compatible analytical resources whose assumptions and domains must remain visible.

The next step can therefore be stated with greater precision. Generative relational theory does not begin from an absence of predecessors. It emerges within a dense field of philosophical, social-theoretical, economic, dynamical, computational, and representational lineages. Section 65 turns to GR itself by clarifying ontological suspension, the relation between relational and representational layers, the meaning of generative relational systems, the use of fields and trajectories in generative space-time, and the possibility that the rules and relations producing later transformation can themselves become objects of transformation.

2.36 Generative Relational Theory

The preceding sections reconstructed philosophical, social-theoretical, economic, normative, dynamical, network, field-theoretic, informational, and computational resources that make a generative relational research programme intellectually available. The role of the present section is different. It turns explicitly to Generative Relational Theory (GR) and states the minimum conceptual architecture required for the later construction of Generative Relational Economics (GRE). The objective is to identify a provisional synthesis whose components remain open to revision as they are tested across domains, while keeping inherited concepts distinguishable from GR's own programmatic claims. The discussion proceeds through five elements: ontological suspension; the distinction and interaction between relational and representational layers; the concept of a generative relational system; fields, trajectories, and generative spacetime; and historical transformation of the rules through which later states and relations are generated. The method is synthetic and programmatic. Concepts inherited from earlier traditions retain their local meanings and limitations, while GR specifies how selected resources can be organized into a common research architecture without treating theoretical translation as identity.

GR begins from a methodological priority rather than a universal metaphysical proposition. Many phenomena of interest to economics and the social sciences are constituted, sustained, modified, or rendered effective through relations among heterogeneous participants, institutions, material conditions, symbolic systems, and historical processes. Relational analysis therefore asks how apparently stable entities acquire and maintain their properties within configurations of dependence, recognition, constraint, exchange, interpretation, and interaction. Generative analysis adds a second question: how do those configurations produce later entities, relations, capacities, constraints, meanings, values, and possibilities, including changes in the mechanisms of generation themselves? The combined programme treats relations as historically consequential and generation as recursively relational.

The word *generative* carries a specific burden in this framework. It does not refer simply to production, creativity, novelty, or causal influence. A process is generative in the stronger GR sense when its operation participates in producing the conditions, structures, distinctions, capacities, or relational configurations through which subsequent processes become possible. Generation can stabilize existing forms, open new possibilities, close existing possibilities, redistribute capacities, or alter the criteria through which later events are interpreted. The concept is therefore temporally extended and historically situated. What a relation generates can appear at another scale, after a delay, through mediation, or through cumulative reinforcement rather than as an immediate output.

The resulting theory is deliberately incomplete at this point in the book. Chapter 4 develops its ontological position in detail; Chapters 6–9 translate the framework into research praxis and methodology; Chapters 12–15 reconstruct specifically economic architectures, value processes, and generative spacetime. Section 2.36 therefore supplies a constitutional bridge within the intellectual genealogy: it states enough of GR to show what GRE inherits, while reserving stronger ontological, epistemic, methodological, and domain-specific claims for the chapters where they can be developed and evaluated directly.

2.36.1 Ontological Suspension

Ontological suspension is the first discipline of GR because relational inquiry frequently encounters heterogeneous kinds of entities whose ultimate ontological status is disputed or irrelevant to the local research question. Persons, organizations, states, legal persons, markets, algorithms, currencies, classifications, institutions, ecosystems, and mathematical representations do not obviously share one mode of being. A framework that required prior resolution of their ultimate metaphysical status would often make substantive inquiry depend on controversies that the inquiry itself is not equipped to settle. GR therefore suspends stronger ontological commitment where such commitment is unnecessary to the analytical task.

Suspension has a positive methodological meaning. It permits the researcher to ask whether a configuration is relationally produced, sufficiently persistent, causally or institutionally effective, recognizable within a domain, and capable of participating in subsequent relations without first identifying its ultimate metaphysical substance. This stance extends the minimal relational criterion introduced earlier in Section 2.11: a social or economic configuration can possess analytical reality through stable participation in consequential relations even when its deeper ontological interpretation remains contested. Chapter 4 later distinguishes ontological, relational, and manifestational registers more fully.

Ontological suspension differs from ontological denial. GR does not claim that metaphysical questions are meaningless, that ultimate ontology is inaccessible in principle, or that every ontological account is equally adequate. It makes a narrower commitment concerning research order. Where several ontologies are compatible with the observed relational structure and where the substantive argument does not require a choice among them, the choice can remain open. Where an empirical or normative claim does depend on ontology—for example, claims concerning consciousness, moral patienthood, biological individuality, or legal responsibility—suspension cannot substitute for domain-specific argument.

The same discipline applies to formal representation. Section 2.34 showed that field, gauge, and background-sensitive formalisms can organize distributed conditions, equivalence classes, and dependence on representational backgrounds. Section 2.31 showed that state spaces, trajectories, attractors, and bifurcations can organize temporal change. GR may use these resources without inferring that the social world is literally a physical field, a manifold, or a dynamical system of a single predetermined type. Formal success supports a representation relative to a research problem; it does not by itself settle the ontology of the represented domain.

Ontological suspension also supports interdisciplinary comparison. Economics may represent an organization as a producer, law as a juridical person, sociology as a structured collectivity, organizational theory as a decision system, and political theory as a locus of authority. These descriptions can overlap without becoming mutually reducible. GR asks which relations, capacities, constraints, and effects each representation makes visible, and where translation across representations succeeds or fails. The framework thereby preserves pluralism while permitting comparison at the level of relational organization.

A second consequence concerns historical variation. Ontological categories used in social inquiry can themselves be institutionally stabilized. The legal corporation, the modern household, the citizen, the employee, the platform account, and the algorithm-

mic agent acquire practical boundaries and capacities through historically specific arrangements. Ontological suspension prevents analytical categories from being naturalized prematurely. It keeps open the possibility that a category appearing entity-like at one historical moment is sustained through relations whose reorganization can transform the category itself.

For GRE, this methodological restraint is especially important because economic inquiry routinely crosses material, institutional, symbolic, computational, and normative domains. Money can be represented as a unit of account, a legal relation, a medium of exchange, a balance-sheet position, or an institutionalized claim. Value can appear through prices while exceeding price. Productive capacity can depend on human skill, technical infrastructure, legal permission, ecological conditions, and computational access. Ontological suspension allows these heterogeneous components to enter one relational analysis without assuming that they share a common metaphysical substance.

The practical limit of suspension should remain explicit. A theory cannot suspend every commitment simultaneously. Any analysis selects entities, distinctions, temporal boundaries, evidence, and relations. GR therefore treats ontological suspension as disciplined minimization of unnecessary commitment rather than absence of commitment. The next problem is consequently representational: once the researcher adopts a provisional relational description, how should the relation between the represented processes and the representation itself be understood?

2.36.2 Relational and Representational Layers

GR distinguishes relationally effective processes from the representations through which researchers, institutions, and participants describe them. The distinction is analytical rather than absolute. A representation can remain external to the processes it records, or it can enter the domain as a classification, metric, rule, prediction, legal category, price, score, or model that later affects conduct. The framework therefore requires both separation and possible recursion between relational and representational layers.

The *relational layer* contains the configurations being analyzed at the level relevant to the research question: participants, relations, structures, constraints, capacities, resources, institutions, material conditions, and processes of change. This language does not imply that each component is ontologically primitive. A participant can itself be relationally constituted, a constraint can be institutionally generated, and a boundary can be maintained through recurrent practices. The layer is defined by analytical role: its components participate in producing the phenomena under investigation.

The *representational layer* contains the observational, classificatory, symbolic, statistical, computational, legal, linguistic, or formal objects through which some features of relational processes become available for interpretation or intervention. Data sets, variables, categories, diagrams, equations, narratives, accounting identities, administrative classifications, and machine-learned representations all belong here when they function as representations. Section 2.35 established why representation cannot be reduced to neutral transcription. Representations select some distinctions and suppress others, and the adequacy of those selections depends on the purpose and evidential conditions of inquiry.

GR adds a historical relation between the two layers. Representations are gener-

ated within relational settings. Statistical categories depend on institutions of measurement; legal classifications depend on juridical practices; economic indicators depend on accounting conventions and data infrastructures; scientific models depend on research communities, instruments, and interpretive standards. Representation is therefore itself a relational achievement. Its categories can stabilize because organizations reproduce them, because infrastructures encode them, or because participants coordinate around them.

The reverse relation is equally important. A stabilized representation can return to the relational layer and modify later interaction. Credit scores affect access to credit. Performance indicators alter organizational incentives. legal classifications confer or withdraw capacities. Market forecasts influence expectations. Platform metrics reorganize visibility. Scientific categories can structure research and policy. In such cases, representation becomes one component of the relations whose later state it helps to generate. The distinction between layers remains conceptually useful precisely because causal coupling does not erase difference of function.

This recursive possibility provides one bridge between epistemology and political economy. A representation can distribute advantages and constraints when institutions act through it. The question is then wider than whether the representation is descriptively accurate. Researchers can ask who produces the category, whose characteristics become visible, what forms of uncertainty disappear from the representation, which actors can contest it, and how its institutional use changes subsequent relations. Representational power arises when the capacity to define or operationalize a category participates in structuring the domain represented.

GR also distinguishes manifestation from representation, although the full distinction belongs to Chapter 4. A phenomenon can manifest through observable effects without yet being symbolically represented; representation can then organize those manifestations into named or formalized objects. Several relational structures can produce similar manifestations, while one relational structure can manifest differently across contexts. Reverse inference from representation to underlying relation is consequently limited. The framework treats non-invertibility as a recurring epistemic problem rather than assuming transparent access from observable form to generative structure.

The layered view also prevents a recurrent confusion in formal modeling. A graph used to represent a social network is not identical to the social relations represented by its edges; a state vector is not identical to the historical system summarized by its coordinates; an estimated field is not identical to the institutional or material conditions it encodes. These distinctions remain important even when the formal model predicts successfully. The representation is evaluated through its mapping to evidence, its inferential purpose, its robustness, and its consequences of use.

At the same time, GR resists placing the representational layer wholly outside the system. Researchers, models, classifications, and measurements can themselves be participants in the history they study. The scope of the system therefore depends on the research question. A macroeconomic model may initially treat its publication as external to the modeled economy; a study of expectation formation may need to include publication and reception within the relational process. A legal model can treat a category as given for one task and study the historical production of the same category for another.

This variable boundary is central to GR's methodological flexibility. Layers are re-

search distinctions whose adequacy must be justified locally. They organize inquiry without imposing a universal two-level ontology. What matters is that the analyst can state which processes are being represented, what the representation selects, how the mapping is justified, and whether representational artifacts participate in subsequent relations. Once this distinction is established, the framework can define more precisely what makes a system *generative relational*.

2.36.3 Generative Relational Systems

Relational theories already challenge explanations that isolate entities from the relations through which their properties and capacities are constituted. GR extends this orientation by placing the generation of later relational conditions at the center of analysis. A generative relational system is therefore characterized less by a fixed inventory of elements than by the patterned processes through which entities, relations, capacities, constraints, structures, and possibilities are produced, maintained, transformed, or dissolved over time.

Definition 2.1 (Generative relational system). A *generative relational system* is an analytically bounded configuration in which relations among participants, structures, constraints, capacities, material conditions, and symbolic or institutional forms contribute to producing the conditions of subsequent states and relations. The definition permits the identities of participants, the topology and kinds of relation, relevant constraints, system boundaries, and the effective rules of transformation to change historically when the domain provides evidence for such change.

Definition 2.1 contains two commitments that distinguish GR from a merely relational description. The first is temporal: relations are studied through what they make possible later, not only through the properties they exhibit at one moment. The second is reflexive at the level of structure: some outcomes of a relational process can become inputs or conditions for later relational processes. An institution generated through earlier interaction can constrain later interaction; a trust relation can change the probability and cost of subsequent cooperation; a classification can become embedded in infrastructure; accumulated capital can reshape bargaining power; a technological standard can reorganize the space of feasible designs.

Generation should be distinguished from simple succession. The fact that one state follows another does not establish a generative relation. GR requires an account of the mechanisms, pathways, constraints, or enabling conditions through which an earlier configuration contributes to a later one. Depending on the domain, evidence can be historical, comparative, experimental, statistical, interpretive, computational, or formal. Methodological pluralism is essential because generative relations can operate through meanings and institutions as well as material transfers and measurable interactions.

Generation should also be distinguished from immediate causation. A relational configuration can generate a capacity without determining when that capacity will be exercised. It can generate a constraint whose effects appear only under later conditions. It can alter a probability distribution, a feasible set, a network topology, a legal status, or an interpretive repertoire rather than directly producing one observed event. Delayed, latent, cumulative, and cross-scale effects therefore belong within the generative vocabulary when the mediating relations are specified.

The concept permits stabilizing and destabilizing generation. A system can repro-

duce a recognizable structure through recurrent interaction, as in institutional routines, market conventions, or organizational roles. It can also produce transformations that weaken the relations responsible for earlier reproduction. Generativity therefore carries no presumption of growth, improvement, creativity, or desirability. Exploitation, exclusion, ecological degradation, institutional lock-in, and the destruction of future capacities can be generative processes in the technical GR sense because they alter the conditions of later possibility.

This neutrality is important for normative analysis. GRE later evaluates how generative processes distribute capacities, risks, value, participation, and future options, but the descriptive concept of generation precedes the judgment. A self-reinforcing hierarchy can be strongly generative while normatively objectionable. A just institutional arrangement can be normatively attractive while dynamically fragile. Keeping these dimensions distinct allows later justice analysis to ask which generative structures ought to be sustained, transformed, constrained, or dismantled.

GR also treats system boundaries as analytical and potentially historical. Classical systems analysis often gains explanatory power by specifying a system and environment. GR preserves that discipline while allowing the boundary itself to become an object of inquiry. A firm can internalize a function previously performed by a market; a platform can redefine which participants count as users or workers; a state can extend or retract legal jurisdiction; a supply chain can reorganize across national borders. Boundary transformation changes which relations are treated as internal, external, or constitutive.

The participants in a generative relational system need not remain fixed either. New organizational forms can emerge, legal statuses can be created, technical agents can enter an economic process, and previously separate collectivities can become institutionally integrated. The framework therefore distinguishes an entity's persistence from the persistence of the relations that constitute its effective identity. Stable subjecthood can itself be a generated achievement, as Sections 2.13 and 2.11 prepared through relational theories of subject formation and social reality.

A further distinction concerns scales. Generative effects can move upward, downward, and laterally across analytical levels. Repeated local interaction can stabilize an institution; institutional constraints can reorganize individual incentives and capacities; transnational infrastructures can alter local opportunity structures; local innovation can propagate through networked adoption. GR does not assume that macrostructure is reducible to microinteraction or that macrostructure acts independently of the relations that reproduce it. The analytical task is to identify the mechanisms connecting scales and the temporal conditions under which those connections persist.

The notion of a generative relational system is therefore intentionally broader than a specific mathematical model. Network models can represent topology, dynamical systems can represent trajectories, field models can represent distributed conditions, agent-based models can represent heterogeneous interaction, and institutional analysis can reconstruct rules and meanings. Different representations may be appropriate to different parts of the same generative process. GR supplies a common problem structure—relation, generation, historical transformation, scale, and representation—rather than prescribing one universal formalism.

2.36.4 Fields, Trajectories, and Generative Spacetime

GR requires concepts that can represent distributed conditions and temporally extended transformation without reducing historical processes to isolated events. Fields, trajectories, and generative spacetime provide three complementary resources for this purpose. Each is inherited from a different formal or scientific lineage, and each is used under ontological suspension. Their value lies in the analytical distinctions they make possible rather than in a claim that social reality literally possesses the structure of a physical field or relativistic spacetime.

A *field* in GR is a representation of conditions that vary across a specified relational, spatial, institutional, or otherwise structured domain. The field can encode opportunity, constraint, salience, risk, accessibility, institutional pressure, resource availability, or another quantity for which a distributed representation is analytically warranted. Section 2.34 established the methodological burden: the domain, field variable, notion of locality, coupling, and evidential interpretation must be specified. Field language is useful when the condition facing an actor depends on position within a structured environment rather than solely on pairwise relations.

The field perspective also supports interaction between actors and environment. Participants can respond to distributed conditions while their actions alter those conditions. Infrastructure can change accessibility; investment can alter productive capacity; collective exit can weaken an institution; public communication can change a field of salience; law can modify the constraints distributed across a jurisdiction. A field can therefore be both a condition of action and an outcome of accumulated action. The representation becomes generative when present field conditions participate in producing later relational configurations and when those configurations can in turn transform the field.

A *trajectory* represents the ordered history of a relational configuration through a chosen analytical space. Section 2.31 supplied the dynamical distinction between a state and a path through states. GR broadens the research use of this distinction by allowing trajectories of relations, institutions, capacities, classifications, resources, and values in addition to trajectories of conventional state variables. Historical sequence matters because the same observable condition can be reached through different paths whose accumulated commitments, latent capacities, or institutional memories differ.

Trajectory analysis also creates a natural place for irreversibility and hysteresis. A relation dissolved at one time need not be reconstructable at the same cost later. A capability lost through prolonged disinvestment may require years to rebuild. Institutional trust can decay rapidly and recover slowly. Ecological thresholds can foreclose prior production possibilities. Historical events can therefore alter the future option space even when a later observable variable returns to an earlier numerical level. GR treats these path-dependent differences as substantive objects rather than residual complications around a static equilibrium.

The term *generative spacetime* combines these temporal and relational concerns into a broader analytical representation. It is designed for domains in which what can affect what, when, through which pathways, and across which distances cannot be captured adequately by chronological time and geographic space alone.

Definition 2.2 (Generative spacetime). A *generative spacetime* is a research representation of events and processes in which temporal order, historical depth, relational

distance, spatial organization, causal or generative accessibility, and changing constraints are analyzed together in order to study how present configurations open, transmit, delay, amplify, redirect, or foreclose later possibilities.

Definition 2.2 is intentionally plural in its dimensions. Geographic distance can matter for transport, ecological exposure, or jurisdiction. Network distance can matter for information diffusion. Institutional distance can matter for access to authority. Epistemic distance can matter for translation across communities. Legal time, technological time, organizational time, and generational time can move at different rates. Generative spacetime is therefore not a single metric space given in advance. Its structure must be constructed for the research problem and justified by the mechanisms under investigation.

The concept also permits heterogeneous presents. Two actors occupying the same chronological moment can inhabit very different effective temporal positions because their infrastructures, institutions, technologies, legal statuses, accumulated resources, or historical exposures differ. A new technical capability can be immediately accessible to one organization and practically unreachable to another. A legal reform can take effect formally at one date while institutional implementation unfolds unevenly across regions or populations. Generative analysis therefore studies synchrony and misalignment rather than presuming a homogeneous present.

Causal and generative accessibility is another central dimension. Some potential relations are technically possible yet institutionally blocked. Others are legally permitted but economically inaccessible. Some effects require long chains of mediation and arrive only after substantial delay. A change can be locally strong while unable to propagate across a boundary. Generative spacetime provides a vocabulary for studying reachability, delay, blockage, amplification, and path dependence together, while leaving the specific formalization to the domain and evidence.

This representation is especially important for economic analysis because production, value, capability, and power unfold across different scales and times. Capital investment can reorganize future production long after the transaction. Educational capacity develops over years. Infrastructure fixes spatial possibilities for decades. Financial decisions propagate rapidly through networks. Ecological degradation can accumulate slowly and become difficult to reverse. Later GRE chapters use generative spacetime to place these heterogeneous temporalities and relational distances within one analytical programme without reducing them to a single clock or metric.

Fields, trajectories, and generative spacetime therefore supply a language for conditions, histories, and accessibility. Their shared limitation is equally important: each representation can still presuppose a rule for how change occurs. GR's strongest generative question arises when the effective rule itself becomes historically variable.

2.36.5 Historical Transformation of Generative Rules

The transformation of generative rules is the point at which GR moves beyond analysis of changing states under a stable mechanism. Section 2.31 distinguished autonomous dynamics, time-dependent dynamics, and changes in the conditions governing trajectories. Sections 2.32 and 2.33 added adaptation, coevolution, and changing interaction topology. GR generalizes the research question: under what conditions do the mechanisms that generate later relations, categories, constraints, and possibilities themselves become products of historical processes?

A useful analytical sequence distinguishes several levels of change. A *state change* modifies the values of variables while preserving the represented relations and rule. A *relational change* adds, removes, or changes relations among participants. A *parameter change* alters coefficients or conditions within a specified rule. A *structural change* modifies topology, constraints, boundaries, or available degrees of freedom. A *rule change* modifies the mapping through which current configurations generate later ones. These categories can overlap empirically, but separating them reduces the risk of describing an observed transformation prematurely as a change in the generative rule.

The distinction can be represented schematically while leaving open whether a particular empirical GR problem admits this formalization. Let $\mathcal{G}_t$ denote the relational configuration represented at time t , let Γ_t denote the effective generative rule used by the model, and let η_t collect contextual conditions not represented inside $\mathcal{G}_t$. A coupled representation of configuration change and rule change is stated in Equation 2.7.

$$\begin{aligned}\mathcal{G}_{t+\Delta t} &= \Gamma_t(\mathcal{G}_t, \eta_t), \\ \Gamma_{t+\Delta t} &= \Psi_t(\Gamma_t, \mathcal{G}_t, \eta_t).\end{aligned}\tag{2.7}$$

Equation 2.7 performs a limited analytical task. Its first line represents change generated under the effective rule at time t . Its second line allows the rule used for later generation to change through a process represented by Ψ_t . The equation does not establish that a social system literally contains an explicit meta-rule Ψ_t , nor does it guarantee that the analyst knows the space of possible future rules. It identifies a modeling distinction between evolution under a rule and evolution of the effective rule.

Historical social systems provide several mechanisms through which such rule transformation can occur. Institutions can revise the procedures that govern participation. Legal reforms can create new rights, liabilities, organizational forms, or transaction possibilities. Technologies can introduce actions that did not previously exist within the relevant option space. Collective learning can change norms of interpretation and coordination. Infrastructure can alter which relations are feasible. Political struggle can change who possesses authority to define the rules. Environmental change can render an earlier production rule materially impossible. The generative mechanism is therefore often distributed across institutional, material, symbolic, and strategic relations.

Rule transformation can also arise from outcomes generated by the earlier rule. A market structure can produce concentrations of capital that enable firms to alter regulation or platform architecture. A classification system can generate populations organized around the classification, creating pressure for revision. A technological standard can produce complementary investments that make later standards difficult to adopt. An educational system can generate expertise that changes the system's own curriculum and research capacities. In each case, earlier relational outputs become conditions of later rule formation.

Reflexivity makes the problem more demanding. Participants can form representations of the system, anticipate rules, and act in ways that preserve or transform them. A legal rule can be strategically tested. A metric can be gamed. A forecast can change behavior. A movement can deliberately attempt institutional transformation.

Generative rules in social inquiry therefore differ from immutable natural laws when the rule refers to institutions, conventions, classifications, or strategic arrangements that participants can contest. GR treats this distinction as a domain property to be investigated rather than a reason to abandon formal analysis.

Evidence for rule transformation requires caution. An observed break in a time series can reflect a shock, parameter change, measurement revision, unobserved heterogeneity, or model misspecification rather than a transformed generative mechanism. Historical documentation can reveal explicit institutional redesign, while comparative evidence can show that similar states generate different outcomes under different regimes. Structural estimation, change-point methods, network analysis, qualitative process tracing, archival work, and computational modeling can contribute different forms of evidence. The evidential adequacy of these methods remains domain-dependent, and claims of rule transformation require triangulation appropriate to the case.

The possibility of rule transformation also places a limit on prediction from historical regularity. A model estimated under one regime can remain locally useful while becoming unreliable after the relations generating the data have changed. The problem is stronger than ordinary parameter drift when the relevant variables, categories, or action possibilities are themselves reconstituted. GR therefore treats model validity as historically situated. A representation adequate to one generative regime can require revision when the regime transforms.

This point does not imply that historical systems lack durable regularities. Stable institutions, material constraints, path dependence, and self-reinforcing relations can make some generative mechanisms persistent over long periods. Indeed, identifying the conditions of persistence is one purpose of GR. The framework adds the complementary question of what would have to change for the mechanism itself to change, and which relations make that transformation more or less accessible.

For governance, the distinction is consequential. Intervention can target an immediate state, a relation, a parameter, a constraint, a capacity, an institutional boundary, or the generative rule through which later outcomes are produced. These targets differ in reversibility, delay, evidential burden, distributional consequence, and risk. Later chapters develop this distinction within application-dominant praxis. At the present genealogical stage, the important point is conceptual: generative relational analysis gives rule transformation an explicit place among the possible objects of inquiry.

Section 2.36 can now be summarized without treating GR as the inevitable convergence of the traditions reviewed earlier. Ontological suspension supplies methodological restraint. Relational and representational layers distinguish effective processes from the forms through which they are observed and governed while permitting recursive feedback between them. Generative relational systems make the production of later relational conditions central. Fields and trajectories provide representations of distributed conditions and historical paths, while generative spacetime integrates temporal order, relational distance, and accessibility. Historical transformation of generative rules extends analysis from change within a structure to change in the mechanisms that produce later structure.

These components form the minimum GR architecture required for GRE, but they leave substantial theoretical problems unresolved. Relation can be interpreted differently across philosophical and social traditions. Emergence, reproduction, adap-

tation, and generation do not share one established definition. Value and justice introduce normative dimensions that dynamical and informational formalisms do not supply. Formal equivalence can coexist with substantive disagreement about ontology or meaning. The next section therefore turns from synthesis to the limits of synthesis, identifying recurrent convergences while preserving unresolved differences among the intellectual lineages from which GR and GRE draw.

2.37 Convergences and Unresolved Theoretical Problems

The intellectual genealogy reconstructed across this chapter contains several recurrent problem forms, yet recurrence does not establish theoretical identity. Philosophies of relation, social theories of embedded action, process traditions, evolutionary economics, regenerative thought, theories of value and justice, and scientific formalisms often approach overlapping questions from different ontological, explanatory, normative, and methodological positions. The role of this section is to identify those partial convergences while preserving the disagreements that remain consequential for Generative Relational Theory (GR) and Generative Relational Economics (GRE). Its objective is therefore diagnostic rather than unificatory. The discussion compares four recurrent problem families—relation, generation, value, and formal representation—and then identifies the unresolved work required to connect them without converting translation into equivalence.

The method follows the discipline established at the beginning of the chapter. A convergence is treated as a shared analytical problem, a partially compatible distinction, or a mutually informative research orientation. It is not treated as evidence that the contributing traditions share one ontology or explanatory mechanism. Similar vocabulary can conceal different theoretical commitments, while different vocabulary can sometimes organize closely related problems. The task is consequently to compare the work performed by concepts within their home traditions and to identify which parts remain transportable into a generative relational programme.

This distinction is particularly important because GR sits close to several already mature intellectual traditions. Its relational orientation overlaps with philosophical accounts of internal and constitutive relation, relational sociology, field theory, institutional analysis, and network science. Its temporal orientation overlaps with process philosophy, historical materialism, evolutionary economics, path-dependence research, complexity science, and dynamical systems. Its concern with value and justice overlaps with political economy, capability approaches, relational-value scholarship, feminist economics, and normative theory. Its formal interests overlap with systems, networks, fields, dynamical models, information theory, and computational simulation. These overlaps provide resources and impose constraints. GR gains conceptual depth from them only when inherited differences remain visible.

The resulting picture is one of structured incompleteness. Relation does not by itself explain generation. Generation does not determine what has value. Value does not supply a dynamical mechanism. Formal representation does not establish the ontology or normativity of the represented domain. GR therefore requires coordination among several analytical registers whose integration remains a research programme rather than a completed theorem. Section 2.37 makes that incompleteness explicit

before the final section of the chapter states the more specific theoretical position of GRE.

2.37.1 Relation across Philosophical and Social Traditions

Relation is the most persistent convergence across the traditions reviewed in this chapter, but it is also among the most internally differentiated. Philosophical treatments ask whether relations are external to independently constituted terms, internal to what the terms are, structurally prior to some properties, or themselves dependent on relata that must be characterized independently. Cassirer's movement from substance concepts toward functional concepts and Whitehead's process-relational metaphysics represent strong attempts to relocate explanatory priority away from self-sufficient substances, while analytic debates over internal and external relations retain a more differentiated field of possibilities (Cassirer 1923; Whitehead 1929). Section 2.9 therefore resisted a universal relation-first ontology and treated relation as a family of philosophical problems concerning constitution, dependence, structure, and higher-order organization.

Social theory approaches relation through another route. Relational sociology criticizes explanations that attribute social action and identity exclusively to pre-given substantial actors, emphasizing transactions, positions, networks, fields, and patterned interdependence instead (Emirbayer 1997). Bourdieu's field-oriented sociology similarly analyzes practices through relations among positions, distributions of capital, and historically constituted fields rather than through isolated individual attributes (Bourdieu and Wacquant 1992). Institutional economics and economic sociology add rules, conventions, embeddedness, trust, authority, and organizational structure. Recognition theory, theories of subject formation, and legal-institutional analysis further show that some socially effective identities and capacities depend on relations of recognition, classification, authorization, and participation.

These approaches converge on a modest but consequential claim: many properties relevant to social and economic explanation become intelligible only when the relations through which they are constituted or exercised are included in the analysis. Bargaining power depends on alternatives and institutional positions. Creditworthiness depends partly on classificatory and informational arrangements. Organizational authority depends on recognized roles and procedures. Productive capacity depends on access to infrastructures, skills, technologies, and complementary participants. The explanatory unit therefore often extends beyond an isolated bearer of a property.

The convergence weakens when stronger ontological claims are introduced. A philosophical thesis that relations are metaphysically fundamental differs from an empirical claim that relational variables improve explanation in a specified social domain. A network representation that places edges between nodes can remain compatible with substantial assumptions about node identity. A field theory can make positions relational without claiming that persons possess no properties outside the field being studied. A legal analysis can show that corporate personality is institutionally constituted while leaving biological personhood outside its scope. GR inherits the analytical priority of relation under these differentiated conditions rather than treating them as one doctrine.

A second unresolved issue concerns the individuation of relata. Relational anal-

ysis commonly begins with participants whose identity is sufficiently stable for the research task. Generative relational analysis asks when that identity itself becomes historically produced. The difference matters because a relation among already specified firms is analytically different from a process through which mergers, law, technology, or classification produce new kinds of economic actor. Similarly, a relation among occupational categories differs from a historical process that changes the categories themselves. GR therefore needs criteria for deciding when entity identity can be treated as given and when it must become part of the generative explanation.

A third issue concerns the scale and type of relation. Dyadic interaction, network adjacency, institutional dependence, symbolic classification, material coupling, legal obligation, shared infrastructure, field position, and interpretive relation can all be important, yet they are not interchangeable. Their causal pathways, evidence, temporal durability, and normative significance differ. Higher-order relations add another layer: relations can depend on other relations, and configurations can acquire properties that are not attributable to one tie in isolation. The network and hypergraph traditions reviewed in Section 2.33 offer formal resources for some of these structures, while interpretive and institutional relations often require additional qualitative or historical reconstruction.

A fourth issue concerns relational persistence. A relation can be episodic, repeated, institutionally stabilized, technologically embedded, legally codified, or reproduced through expectation. These modes of stabilization generate different kinds of durability. Treating them under a common relational vocabulary remains useful only if the mechanisms of persistence stay visible. The same caution applies to dissolution: relations can weaken through non-use, strategic exit, institutional reform, infrastructural change, conflict, reinterpretation, or the disappearance of one participant. A general relational theory therefore needs a differentiated account of how relations begin, persist, transform, and end.

GR's convergence with relational traditions is consequently strongest at the level of research orientation. Entities, properties, and actions can require relational reconstruction; relations themselves can possess history; and the configuration of relations can alter what later relations become possible. The unresolved problem is to develop a sufficiently rich taxonomy of relational kinds and mechanisms without turning "relation" into an explanatory placeholder. GRE later inherits this problem in concrete form because economic relations include exchange, ownership, labor, credit, care, governance, dependence, cooperation, competition, ecological interdependence, and symbolic valuation, each of which requires domain-specific specification.

2.37.2 Generation across Process, Evolutionary, and Regenerative Traditions

Generation forms a second convergence across traditions concerned with process, emergence, reproduction, evolution, adaptation, and regeneration. Process philosophy emphasizes becoming and event over an exclusively static ontology, while theories of emergence analyze the appearance of organized properties that require explanation at a level or configuration different from the components considered independently. Evolutionary economics studies variation, selection, retention, innovation, routines, and coevolution as mechanisms through which economic structures change historically (Nelson and Winter 1982; Nelson 1994). Path-dependence research shows

how sequences of earlier events can alter later costs and possibilities. Regenerative thought asks how productive and ecological practices can participate in renewing capacities and conditions rather than merely extracting or recirculating existing stocks (Reed 2007).

The common orientation is temporal and productive in a broad sense. Present configurations participate in producing later configurations, and historical sequences matter because the conditions of later action are partly inherited from earlier processes. This convergence supports the GR emphasis on temporally extended consequence. A relation can matter because it changes a capacity, creates an institution, stabilizes a convention, modifies an ecology, redistributes resources, or reorganizes the feasible space in which later actors operate. The object of explanation is therefore often a transformation in conditions rather than an immediate output alone.

Important distinctions remain. Process describes becoming without necessarily specifying a mechanism of selection or retention. Emergence concerns the appearance or organization of properties and does not by itself establish a generative pathway. Evolutionary models require particular accounts of variation, selection, inheritance, learning, routines, or coevolution and should not be generalized into a synonym for historical change. Reproduction concerns the maintenance or renewal of conditions across time and can preserve structures that are unequal or destructive. Regeneration frequently carries a substantive orientation toward renewed ecological or social capacity, whereas GR uses generation descriptively before normative evaluation. These traditions therefore contribute different temporal grammars.

The distinction between generation and improvement is especially important. Evolutionary persistence can result from selection under historically specific conditions without implying normative superiority. Self-reinforcing mechanisms can stabilize exploitation, exclusion, ecological damage, or concentrated power. Regenerative design explicitly introduces evaluative criteria concerning the restoration or enhancement of capacities, while GR's more general category of generativity includes processes that create, reproduce, diminish, or destroy later possibilities. This descriptive neutrality is required if GRE is to study both generative benefit and generative harm.

Generation also differs from reproduction. Reproduction can maintain a recognizable organization through recurrent processes. Generation can produce continuity, but it can also produce qualitative novelty, new participants, new relations, or new rules. A labor regime may reproduce class relations while also generating new technical capacities. An educational system may reproduce inequality while generating knowledge. A platform may reproduce market dominance while generating new categories of work and new data infrastructures. These mixed effects make it difficult to assign one generative character to a whole system without specifying the object, scale, time horizon, and affected population.

A further unresolved problem concerns novelty. A process can generate a state that is new relative to the immediately preceding state without generating a new category of entity or relation. Stronger novelty arises when available action types, institutional categories, interaction topologies, or interpretive schemes change. Section 2.36 treated rule transformation as the strongest version relevant to the present framework, while also warning that observed discontinuity does not automatically establish transformation of the generative rule. GR therefore needs operational distinctions among ordinary state change, relational change, structural change, and transformation in the mechanisms that produce later states.

Temporality introduces another difficulty. Generative effects can occur at different delays and scales. A transaction may produce an immediate allocation and a delayed change in bargaining position. Infrastructure can generate capacities over decades. Ecological degradation can accumulate gradually before becoming visible as constraint. Institutional trust can emerge from repeated interaction and then alter the cost of future coordination. A generative explanation must therefore specify the temporal window within which effects are attributed and the mechanisms that connect events across that window. Otherwise, distant consequences can be attached to an earlier relation without sufficient evidential discipline.

The process, evolutionary, and regenerative traditions converge most strongly around the refusal to treat current structure as historically self-explanatory. Their unresolved integration concerns the mechanisms and criteria through which one kind of historical production can be distinguished from another. GR responds by reserving “generative” for processes that help produce later conditions of possibility, while leaving the specific mechanism to empirical and domain-specific analysis. GRE will need this distinction because economic production, reproduction, innovation, capability formation, accumulation, ecological renewal, and institutional transformation can intersect while remaining analytically different processes.

2.37.3 Value across Economic and Normative Traditions

Value creates a third zone of convergence and tension. Economic traditions have treated value through labor, utility, scarcity, exchange, price, production, and social form. Philosophical and pragmatist traditions distinguish forms such as intrinsic, instrumental, final, and relational value and examine valuation as a practice through which objects, actions, and states become appraised (Dewey 1939; E. Anderson 1993). Capability approaches shift attention from resources alone toward substantive opportunities and functionings, thereby connecting economic arrangements to what persons are effectively able to do and be (Sen 1999). Relational-value and relational-goods traditions identify goods or values that arise through forms of association rather than through isolated possession. Justice theory adds questions concerning distribution, procedure, recognition, equality, domination, and the institutional conditions of social relations (Rawls 1999; E. S. Anderson 1999).

The convergence lies in the inadequacy of treating all economically relevant value as a single homogeneous magnitude. Price provides indispensable information within market settings, yet price and value remain analytically distinguishable. Care, trust, ecological capacity, institutional legitimacy, knowledge, cultural meaning, social recognition, and future opportunity can participate in economic life without being adequately represented by one price measure. Conversely, assigning a non-market value to something does not imply that the value can be compared cardinally with other valued objects on a common scale. GRE therefore inherits value pluralism together with the burden of specifying which value concept is operative in a particular analysis.

Several levels should remain distinct. Valuation is a process through which value is attributed or recognized. Economic price is an institutional outcome generated through particular market arrangements. Normative value concerns what has worth under an ethical or evaluative account. Relational value concerns worth that depends constitutively on a relation or form of association. Capability concerns substantive op-

portunity rather than the valuation of an object alone. Justice evaluates distributions, procedures, relations, and institutional conditions under normative criteria. These concepts can interact without collapsing into a common metric.

The unresolved problem of commensurability follows directly. Economic decision often requires comparison among alternatives, while plural values may resist full reduction to one scale. Cost–benefit analysis, price signals, multicriteria methods, democratic deliberation, rights constraints, and institutional rules provide different mechanisms for making decisions under heterogeneous values. None of these mechanisms automatically settles the philosophical question of whether the underlying values are commensurable. GRE will therefore need to distinguish practical decision procedures from claims of value equivalence.

Power enters valuation because institutions shape which values become visible, measurable, exchangeable, compensable, or authoritative. Unpaid care can be socially necessary while weakly represented in market accounts. Ecological loss can remain external to transaction prices. Cultural and relational goods can be damaged by institutional changes that increase measured output. Conversely, symbolic or reputational value can be monetized through new infrastructures. A generative relational theory of value must therefore study the relations through which valuation criteria are formed and the consequences of those criteria for subsequent allocation and recognition.

Temporal extension makes the problem still harder. A process can create present value while degrading future capacity; another can impose present cost while expanding later capability. Intergenerational relations, infrastructure, education, ecological regeneration, and knowledge production all require value judgments across time. Discounting, rights, capability preservation, sustainability constraints, and regenerative criteria offer different approaches, yet they encode different normative commitments. A generative perspective adds the question of how present arrangements reshape the future space within which value can later be produced, perceived, and realized.

The notion of generative justice reviewed in Section 2.29 contributes an especially relevant bridge because it directs attention toward circulation, participation, return, and the capacity of communities to generate value rather than treating justice solely as the distribution of completed outputs (Eglash 2016). GR broadens the generative question beyond one established normative framework, while GRE can retain the insight that justice may concern access to value-generating relations and infrastructures as well as shares of existing goods. The normative criteria for evaluating those relations, however, still require argument from justice theory rather than derivation from generativity itself.

The central unresolved integration is therefore triangular. Economic analysis identifies processes through which resources, goods, prices, and productive capacities are organized. Normative theory evaluates institutions and relations under criteria of justice and worth. Generative analysis traces how present arrangements produce later capacities, constraints, values, and opportunities. These three tasks can inform each other, but none can substitute for the others. GRE requires a vocabulary capable of linking them while preserving their different evidential and justificatory burdens.

2.37.4 Formal Representation across Scientific Traditions

The scientific and formal traditions reviewed in Sections 2.30–2.35 provide a fourth field of convergence. Systems and cybernetics contribute feedback, regulation, openness, and adaptation. Dynamical systems contribute state spaces, trajectories, stability, attractors, and bifurcations (Strogatz 2024). Complexity science contributes emergence, heterogeneous interaction, multiscale organization, and adaptive dynamics (Holland 2012). Network and multilayer approaches represent relational topology and changing patterns of connection (Newman 2003; Kivelä et al. 2014). Field formalisms represent distributed conditions and local variation. Information theory and computation contribute precise measures and limits for coding, transformation, algorithmic procedure, and simulation (Shannon 1948; Turing 1937). Philosophy of modeling and simulation clarifies the mediated relation between formal representation and target system (Giere 2004; Winsberg 2010).

These traditions converge in their capacity to represent organized dependence. They permit analysis to move beyond isolated variables toward patterns of interaction, temporal evolution, distributed conditions, multiscale effects, and computational constraints. They also make distinctions that ordinary prose can obscure. A node is distinguishable from an edge; a state from a trajectory; a parameter change from a bifurcation; a local field value from a global configuration; a Shannon measure from semantic content; a computable procedure from a tractable one. GR benefits from these distinctions because relational and generative claims otherwise risk becoming too elastic to test.

Formal convergence, however, remains representational rather than ontological. The same empirical system can often be represented through more than one formalism. A supply network can be studied as a graph, a dynamical system on a graph, a multilayer network, an agent-based model, or a system of coupled flows. Different representations foreground different features. The existence of multiple useful models therefore supports methodological pluralism and model comparison more readily than it supports a unique formal ontology.

A related issue concerns equivalence. Two mathematical representations can be equivalent under a transformation while carrying different empirical interpretations. Conversely, two empirically similar phenomena can require formally different models because their mechanisms differ. Gauge equivalence supplies one technically precise example of representational redundancy, but its social-scientific analogues require independent justification. GR should therefore treat “same structure” as a claim whose criterion must be stated: isomorphism, homomorphism, simulation relation, observational equivalence, statistical similarity, or qualitative analogy each establishes a different kind of sameness.

The specification of state space is another unresolved problem. Many formal models assume that relevant variables, entities, and action types are defined before the modeled dynamics begin. Sections 2.33 and 2.36 relaxed this assumption by allowing changing topology, participant composition, and generative rules. Yet a formal model still requires some representational domain in which such changes are expressible. Historical novelty can exceed a model’s vocabulary when new institutions, categories, technologies, or practices emerge. The resulting limitation is epistemic as much as mathematical: the analyst may not know in advance which dimensions will become relevant.

Measurement connects this problem to evidence. A formal variable becomes empirically meaningful through operationalization, data generation, classification, and interpretation. Social categories can change while the numerical variable retains the same label. Data-producing institutions can alter definitions and coverage. Strategic actors can respond to metrics. Computational systems can make classifications causally effective by embedding them in allocation procedures. A generative relational methodology therefore has to study the production of data and representations when those representations participate materially in the system being represented.

Formal pluralism also creates a problem of interoperability. Different models can illuminate different scales or mechanisms, yet connecting them requires mappings that may lose information. A network model may represent who is connected while omitting meanings of connection. A dynamical model may represent aggregate state variables while suppressing institutional heterogeneity. An agent-based model may represent heterogeneous behavior while relying on simplified rules. A field representation may capture distributed constraints while abstracting from discrete organizational boundaries. Multimodel analysis can improve explanation when these losses are explicit, but combining models mechanically can multiply incompatible assumptions.

The unresolved task for GR is consequently to build a disciplined relation between formal objects and empirical-relational claims. Formalization should state what is represented, which distinctions are preserved, which are suppressed, what empirical evidence supports the mapping, and how the representation may fail under historical transformation. This requirement leaves room for mathematical ambition while preserving ontological suspension. GRE will need such discipline particularly when formal results are used to guide intervention, because errors in representation can become consequential when they are translated into policy, organizational design, or automated allocation.

2.37.5 Unresolved Integration of Relation, Value, and Generativity

The four convergences above reveal a common architecture without yielding a completed synthesis. Relation concerns constitution, dependence, and structured connection. Generation concerns the production of later conditions. Value concerns appraisal, worth, opportunity, and normative evaluation. Formal representation concerns the disciplined construction of models through which these phenomena can be described, compared, and sometimes predicted. GR brings these registers into one research programme, but several integration problems remain open and should remain visible as the theory develops.

The first concerns relational individuation. A generative account needs some way to identify participants and relations while also allowing those identities and relations to change. Excessively fixed individuation hides constitutive change; excessively fluid individuation makes comparison across time difficult. The relevant solution is likely domain-sensitive rather than universal. A legal entity may have a clear institutional boundary for one research problem while requiring relational reconstruction for another. The theory therefore needs explicit criteria for when identity is treated as stable, when it becomes a dependent variable, and how continuity is established across transformation.

The second concerns generative attribution. Historical systems contain many simultaneous processes, delayed effects, feedbacks, and cross-scale interactions. Showing that a later condition follows an earlier relation is insufficient to establish that the relation generated the condition. GR requires evidence concerning mechanisms, mediation, counterfactual relevance, process sequence, comparative variation, or other forms of warranted attribution appropriate to the domain. This problem connects the theory directly to the methodological chapters that follow later in the book. Generativity becomes analytically useful only when claims about generation can be made more discriminating than broad narratives of influence.

The third concerns normative orientation. Generativity is descriptively neutral enough to include the production of capability and the production of vulnerability, the reproduction of trust and the reproduction of domination, or the expansion and contraction of future possibility. Normative evaluation therefore enters through additional criteria. GRE must ask which capacities matter, whose possibilities are expanded, whose are constrained, how burdens and benefits are distributed, and which relations deserve preservation or transformation. Justice cannot be read directly from dynamical persistence or productive fecundity.

The fourth concerns value conversion and non-equivalence. Economic systems continuously convert among heterogeneous forms: labor into income, knowledge into intellectual property, trust into reduced transaction cost, land into collateral, attention into advertising revenue, ecological capacity into production, and symbolic distinction into economic advantage. These conversions can be institutionally real without implying that the underlying values are equivalent. GRE therefore needs to study conversion mechanisms, exchange ratios, institutional permissions, losses, residuals, and asymmetries while preserving the possibility of incommensurability. The difference between conversion and equivalence will become important in later analyses of circulation, return, and justice.

The fifth concerns scale and historical time. A relation can be beneficial at one scale and damaging at another; a process can be productive in the short run and capacity-destroying over a longer horizon. Microlevel adaptation can generate macrolevel lock-in, while macro institutions can reshape micro capacities. GR's multiscale orientation provides a language for these interactions, but it does not predetermine which scale should govern evaluation. Empirical analysis must identify the relevant temporal and relational ranges, and normative analysis must justify how conflicts across scales and generations are handled.

The sixth concerns reflexivity. Social participants can interpret theories, respond to classifications, alter their behavior under measurement, contest rules, and deliberately redesign institutions. Researchers and computational systems can also enter the generative process through forecasts, rankings, standards, and automated decisions. This reflexivity complicates the separation between model and target without eliminating it. GR therefore needs a method for expanding the analytical boundary when representations become causally active, while retaining a practical boundary for research. Chapter 5 will develop the epistemic implications of this problem more fully.

The seventh concerns formal openness. A theory capable of using networks, dynamical systems, fields, agent-based simulation, statistical models, historical narrative, and interpretive reconstruction gains flexibility at the cost of a simple common formal language. A premature universal formalism could suppress important do-

main differences, while unstructured pluralism could make theoretical claims difficult to compare. The present programme therefore favors a modular architecture: common conceptual questions concerning relation, generation, value, scale, representation, and historical transformation can be paired with formalisms chosen for specific mechanisms and evidential contexts. Stronger mathematical integration can be developed where mappings among models are explicit and justified.

An eighth problem concerns the transformation of evaluative and epistemic criteria themselves. Historical processes can alter what counts as economically valuable, scientifically credible, legally recognizable, aesthetically significant, or politically legitimate. This possibility creates a second-order challenge. A generative analysis may need to study the formation of the criteria by which its objects are later evaluated while still retaining enough normative and epistemic distance to assess those criteria critically. Historical situatedness therefore cannot become simple relativism. Revisability requires standards of argument, evidence, and justification even when those standards possess histories.

These unresolved problems clarify the status of GR at this stage. It is best understood as a structured research architecture that coordinates questions across relational, temporal, normative, and representational registers. Its coherence comes from recurrent problem forms and explicit distinctions rather than from reduction to one ontology, one value theory, or one mathematical language. Such an architecture can still generate strong claims locally, provided that each claim states the relevant entities, relations, time horizon, scale, value criterion, evidence, and model assumptions.

The implications for GRE are now sufficiently clear to complete the chapter. GRE does not emerge because the preceding traditions secretly converge on one final theory. It emerges because contemporary economic problems repeatedly require concepts that existing traditions have developed in partial and complementary ways: historically constituted relations, changing productive and institutional conditions, plural forms of value, normative evaluation, multiscale dynamics, and disciplined formal representation. The remaining task is to state how GRE inherits these resources selectively and what kind of economic research programme follows from that inheritance. The final section therefore closes the chapter by locating GRE within the historical-material, philosophical-relational, economic-normative, and scientific-formal lineages reconstructed here.

2.38 The Theoretical Position of Generative Relational Economics

The preceding genealogy has reconstructed the intellectual resources through which Generative Relational Economics (GRE) becomes conceptually available. The role of this final section is to state GRE's theoretical position within that landscape without converting a heterogeneous genealogy into a claim of theoretical unification. Its objective is to identify what GRE inherits, what it modifies, and what it leaves to neighboring traditions and later chapters. The discussion proceeds through four inheritances—historical-material, philosophical-relational, economic-normative, and scientific-formal—before characterizing GRE as an integrative economic research programme. The method is positional and synthetic. Inheritance denotes a

selective use of concepts, problem forms, and methods whose original differences remain visible; it does not imply that the reviewed traditions anticipated GRE or that GRE supersedes them.

GRE occupies a specific level of analysis. Generative Relational Theory (GR) supplies a broader meta-framework for studying historically consequential relations, recursive generation, changing conditions of possibility, and transformation of generative rules. GRE develops that orientation within economic inquiry. Its principal objects include production, allocation, circulation, reproduction, valuation, ownership, labor, care, credit, institutional capacity, technological infrastructure, ecological dependence, power, and the distribution of future economic possibilities. GRE therefore remains answerable to economic evidence and economic problems even when its conceptual resources originate in philosophy, sociology, political economy, systems science, or other domains.

The theoretical position is consequently plural but bounded. GRE accepts that a conventional allocation model can be the most adequate representation for one problem, that institutional economics may explain another more directly, that Marxian political economy may provide the strongest account of historically specific relations of production, and that capability, feminist, commons, ecological, or justice traditions may illuminate dimensions that an explicitly generative-relational model does not capture well. GRE's contribution lies less in replacing these approaches than in organizing a class of questions that repeatedly crosses their boundaries: how economic relations become constituted; how they generate later capacities and constraints; how heterogeneous forms of value move through conversion and circulation; how productive, institutional, epistemic, ecological, and normative conditions interact across scales; and how the rules governing those processes can themselves change.

This position also limits the claims made at the end of Chapter 2. GRE has acquired an intellectual genealogy and a preliminary theoretical location; it has not yet received its full disciplinary constitution. Chapter 3 will specify the programme's objects, boundaries, research questions, explanatory ambitions, and relation to economics more directly. Chapters 4 and 5 will develop the ontological and epistemological commitments that remain provisional here. The present section therefore closes the foundational genealogy by identifying the inherited commitments that make those later constructions possible.

2.38.1 Historical-Material Inheritance

GRE inherits from historical-material and political-economic traditions a commitment to treating economic categories as historically constituted. Production, labor, capital, property, money, markets, firms, households, and states can acquire relatively stable institutional forms without thereby becoming timeless units of analysis. Classical political economy already connected wealth, production, distribution, accumulation, and social order; Marxian traditions made historically specific relations of production, class, accumulation, circulation, and reproduction central analytical objects; institutional and historical approaches further showed how rules, organizations, technologies, conventions, and path-dependent processes structure economic possibility (Smith 1776; Marx 1867; Polanyi 1944; North 1990). GRE takes this historicity as a starting discipline.

The inheritance has two consequences. First, GRE treats economic entities and

variables as potentially dependent on the institutional and relational environments in which they operate. A firm is a legally and organizationally constituted actor whose boundaries can change through ownership structures, contracting practices, regulation, platform architectures, and technological integration. Labor is performed through historically specific arrangements of employment, care, coercion, autonomy, skill, and recognition. Property denotes institutionally organized bundles of rights and powers whose practical content varies across legal and political orders. Money, credit, and financial claims depend on systems of authorization, accounting, enforceability, expectation, and trust. The empirical usefulness of stable categories remains compatible with an inquiry into their historical production.

Second, GRE gives temporal priority to the reproduction and transformation of conditions. Historical-material analysis directs attention beyond isolated transactions toward the arrangements that make transactions recurrently possible: productive capacities, infrastructures, labor-power, institutional authority, ecological resources, technical standards, organizational routines, and social reproduction. Marxian theories of circulation and reproduction, feminist theories of social reproduction, and institutional approaches differ substantially in their explanatory commitments, yet each demonstrates that an economy persists through processes that renew or reorganize enabling conditions rather than through isolated acts alone (Fraser 2014; North 1990). GRE generalizes this question cautiously by asking which relations reproduce, expand, degrade, or transform the capacities from which later economic activity proceeds.

Historical dependence also enters GRE through sequencing and path formation. Institutional choices can modify later feasible alternatives; accumulated infrastructures can create complementarities and switching costs; classifications and legal forms can stabilize expectations; technological systems can reorganize the distribution of skills and bargaining positions. Path-dependence research provides concepts for increasing returns, lock-in, and temporally structured choice without implying that historical outcomes are predetermined (Pierson 2000). GRE adds a generative emphasis by examining how a path can alter the actors, relations, and evaluative criteria through which later choices are made.

This temporal orientation makes historical time analytically heterogeneous. Economic processes unfold through multiple durations: a payment may settle in seconds, organizational routines persist for years, infrastructures endure for decades, demographic or ecological effects can span generations, and institutional categories can accumulate meanings over centuries. A relation that expands production in one interval may erode ecological or social capacities over another. GRE therefore treats time horizon as part of the specification of an economic claim. Generativity cannot be evaluated from an arbitrarily short temporal slice when the process under study redistributes future capacities or burdens.

The historical-material inheritance also restrains universalization. GRE does not presume that one observed economic configuration represents a natural endpoint or universal equilibrium form. Markets, firms, welfare institutions, intellectual-property regimes, household structures, development paths, and technological infrastructures are historically variable arrangements whose comparative analysis can reveal multiple viable or contested forms. This openness is compatible with identifying recurrent mechanisms. A mechanism such as cumulative advantage, institutional exclusion, network externality, or debt compounding can recur across

contexts while taking different institutional forms.

GRE's distinctive extension concerns the historical production of generative conditions. A relation matters economically not only because it transfers an existing resource or changes a current payoff, but also because it can modify what participants will later be able to do, become, recognize, produce, exchange, or contest. Education can change future capability; infrastructure can open or close productive possibilities; debt can finance capacity while also restructuring future claims; platform rules can generate markets while reorganizing dependence; ecological extraction can create present output while narrowing later material possibility. These are heterogeneous mechanisms, and GRE does not reduce them to one causal form. The shared analytical question concerns their consequences for subsequent economic possibility.

Historical-material inheritance therefore gives GRE its temporal and institutional seriousness. Economic relations occur within histories, reproduce conditions, and can transform the categories through which later economic activity becomes intelligible. GRE preserves that insight while broadening the object from material production alone to heterogeneous generative conditions that include institutional, epistemic, technological, ecological, symbolic, and normative capacities where they have economic consequence.

2.38.2 Philosophical and Relational Inheritance

GRE's philosophical inheritance supplies conceptual discipline for speaking about entities, relations, processes, appearances, interpretation, and value without allowing one convenient representation to determine ontology silently. Philosophies of relation and process, phenomenology, hermeneutics, pragmatism, and social theories of relational constitution contribute different resources to this task. Cassirer's functional orientation, Whitehead's process metaphysics, and later relational sociology each challenge forms of explanation that treat properties as fully intelligible apart from structured dependence, although they do so from different philosophical positions (Cassirer 1923; Whitehead 1929; Emirbayer 1997). GRE inherits the problem of relational constitution rather than a single metaphysical answer.

The first consequence is ontological restraint. Section 2.36 introduced ontological suspension as a GR discipline: an inquiry can study the relational constitution, persistence, and effects of an economic object without settling every question about its ultimate metaphysical status. GRE requires this restraint because its objects cross several ontological registers. A corporation is simultaneously a legal person, an organization, a contractual structure, an accounting entity, a productive arrangement, and a participant in networks of power and exchange. Money can be represented through legal claims, accounting positions, media of payment, or institutional relations. An algorithm can be a technical artifact, organizational procedure, decision rule, property asset, or participant in a mediated economic relation. The relevant representation depends on the question under investigation.

Ontological suspension does not make representation arbitrary. GRE asks whether a representation preserves the distinctions required for the explanatory or evaluative task. An analysis of firm productivity may legitimately treat the firm as a bounded unit; an analysis of subcontracting, ownership, or platform dependence may require the firm's boundary itself to become an object of inquiry. A household can be an observational unit in one statistical model while requiring internal relational analysis

when care, bargaining, gendered labor, or intrahousehold distribution becomes relevant. Relational analysis therefore changes resolution according to the mechanism under study.

The second inheritance concerns constitution through relation. Some economically significant properties are relational by their structure. Debt positions require creditor-debtor relations; ownership requires recognized institutional relations concerning control and exclusion; bargaining power depends on alternatives, dependencies, and enforceable rights; reputation depends on histories of recognition and communication; market access depends on institutional and infrastructural connections. Other properties, including biological or technical capacities, can remain meaningful outside a specific social relation while still being economically effective only within relational configurations. GRE consequently avoids converting relational dependence into a universal claim that every property is wholly relational.

The third inheritance concerns interpretation and symbolic mediation. Economic actors respond to prices, classifications, expectations, narratives, rankings, contracts, forecasts, and institutional meanings. Hermeneutic and linguistic traditions show that interpretation occurs through historically available languages and practices rather than through direct access to self-interpreting facts. GRE incorporates this insight when representations themselves enter economic processes. A credit score, risk category, performance metric, accounting standard, or policy model can begin as a representation and later influence the relations it describes. The representational layer can therefore become generative when participants orient conduct toward it.

This reflexive possibility connects philosophy of interpretation with social ontology. Categories can organize recognition and action; repeated classification can stabilize an institutional reality; contested interpretation can transform what a category permits or excludes. GRE will later examine such processes empirically rather than treating symbolic mediation as sufficient explanation. The relevant question is how meanings are stabilized, by whom, through which institutions, with what material consequences, and under what conditions they change.

The fourth inheritance concerns process and emergence. Process traditions prevent GRE from treating a stable economic configuration as explanatory merely because it persists. Persistence itself can require recurrent work, resources, recognition, enforcement, maintenance, or feedback. Emergence likewise directs attention to properties that arise at a level of organization without being simply attributable to one component. The language remains demanding: a claim of emergence should identify the level, mechanism, and explanatory remainder involved rather than functioning as a synonym for complexity or surprise.

The philosophical-relational inheritance therefore gives GRE a vocabulary for asking how economic objects are constituted, represented, interpreted, stabilized, and transformed. It also establishes boundaries. GRE does not require acceptance of a universal relation-first metaphysics; it does not reduce persons to social positions; and it does not treat interpretive construction as evidence that material constraints are merely discursive. The programme instead holds relational, material, institutional, symbolic, and experiential dimensions together where the economic problem requires them.

This plural ontology of inquiry is one reason GRE remains a domain-specific programme rather than a total social theory. Relations studied in economics intersect with law, politics, ecology, education, technology, family life, and culture. GRE can

trace those interfaces when they affect economic generation, valuation, allocation, or reproduction, while leaving the fuller analysis of neighboring domains to the relevant disciplines and broader GR research programmes.

2.38.3 Economic and Normative Inheritance

GRE remains an economic programme because it inherits central economic problems rather than substituting a general relational vocabulary for them. Scarcity, choice, allocation, production, exchange, distribution, incentives, information, coordination, welfare, growth, accumulation, and institutional design remain legitimate and often indispensable objects of analysis. Marginalist and neoclassical traditions provide precise tools for understanding trade-offs, equilibrium, efficiency, and decentralized allocation; mechanism and information approaches sharpen questions of incentives and knowledge; institutional and political-economic traditions place those mechanisms within systems of rules, ownership, authority, and historical power (Arrow and Debreu 1954; Debreu 1959; North 1990). GRE incorporates these achievements selectively rather than defining itself through opposition to mainstream economics.

The generative-relational extension begins when the objects ordinarily treated as inputs to an economic problem become consequences of earlier economic relations. Preferences can be shaped through education, advertising, habit, and institutional context. Feasible sets can change through infrastructure, law, technology, health, ecological degradation, or accumulated wealth. Agents can acquire or lose capabilities through relations of work, care, exclusion, training, credit, and political recognition. Markets themselves require institutional and informational conditions. A final allocation can therefore affect the conditions under which later allocations occur. GRE makes such recursive effects explicit where they are empirically consequential.

Capability approaches provide one major bridge between present distribution and future possibility. Sen's distinction among resources, functionings, capabilities, and conversion factors prevents evaluation from identifying possession automatically with effective freedom (Sen 1985; Sen 1992; Sen 1999). GRE inherits this sensitivity to conversion conditions and extends it toward the generation of capabilities over time. An educational resource, for example, matters through the capabilities it helps develop under specific social and institutional conditions. A loss of health, mobility, legal status, or access can reduce the value realizable from nominally equal resources. Generative analysis asks how those conversion conditions themselves are produced and distributed.

Care and social-reproduction traditions deepen the same problem from another direction. Economic production depends on forms of maintenance, caregiving, household labor, emotional support, education, and social reproduction that can remain weakly represented in market measures while being indispensable to later productive and social capacity (Fraser 2014; Tronto 1993). GRE therefore treats maintenance and reproduction as possible generative processes rather than relegating them conceptually beneath visible production. This does not imply that every act of care should be monetized or reduced to economic output. It means that economic analysis must be able to represent dependence on capacities generated outside conventional market exchange.

Commons and cooperative traditions contribute another set of institutional possibilities. Ostrom's work demonstrates that collective-resource governance cannot be

adequately represented by a simple dichotomy between privatization and centralized state control; durable institutional arrangements can arise through diverse combinations of rules, monitoring, participation, graduated sanctions, nested organization, and local knowledge (Ostrom 1990; Ostrom 2005). GRE inherits the comparative institutional lesson and adds questions concerning what governance arrangements generate over time: trust, monitoring capacity, exclusion, knowledge, ecological resilience, organizational competence, or dependence.

Value theory introduces a further layer. Section 2.14 distinguished value, valuation, and price, while Sections 2.28 and 2.29 reconstructed relational value, relational goods, and generative justice. GRE treats market price as one consequential form of valuation and coordination without assuming that it exhausts the values relevant to economic life. Productive, ecological, cultural, epistemic, relational, and capability values can enter economic processes through different institutions and conversion mechanisms. Their coexistence raises problems of comparability and commensurability that cannot always be resolved through a common metric.

This is where Eglash's generative-justice tradition becomes particularly important. Generative justice directs attention to value-producing processes in which participants retain or recover control over generative conditions and in which value can circulate back toward the communities and capacities from which it emerged (Eglash 2016; Eglash, Robinson, et al. 2024). GRE inherits this concern while extending the research space toward heterogeneous forms of value, conversion interfaces, capture, dissipation, regeneration, and generative foreclosure. Such extensions should remain explicitly distinguished from the established generative-justice literature rather than being attributed retrospectively to it.

Normative evaluation therefore enters GRE at more than one point. Distribution asks who receives resources, income, risk, or opportunity. Procedure asks how decisions are made and contested. Relational justice asks how institutions structure status, domination, recognition, and standing. Generative justice asks who participates in and controls the processes through which future value and capability are produced. These dimensions can support one another and can also conflict. A highly productive arrangement may generate severe dependence; an equal present allocation may leave unequal capacity to convert resources into future opportunity; a procedurally inclusive institution may reproduce ecological costs across generations.

GRE accordingly separates descriptive generativity from normative desirability. A process can be powerfully generative while producing domination, vulnerability, exclusion, ecological destruction, or epistemic concentration. The fact that a relation reproduces itself does not justify its continuation. The fact that a system expands aggregate productive capacity does not settle the distribution or justice of that capacity. Normative claims require explicit criteria and arguments rather than being inferred from persistence, growth, complexity, or generativity itself.

Power enters this architecture through control over relations and conversion conditions. Economic actors differ in their capacity to set terms of exchange, define classifications, control infrastructures, determine access, appropriate returns, impose externalities, or shape the future rules under which others act. GRE will later analyze these mechanisms in greater detail. At the foundational level, the important point is that power can operate through the generation of future constraints and capacities as well as through immediate command or unequal possession.

The economic-normative inheritance thus locates GRE within economics while

widening the temporal object of evaluation. Economic analysis concerns present allocation and exchange, and it can also concern the production of future capabilities, dependencies, institutions, values, and ecological conditions. GRE's distinctive object is the relation between these present economic processes and the conditions they generate for later economic and social possibility.

2.38.4 Scientific and Formal Inheritance

GRE's scientific and formal inheritance provides languages for representing change without dictating one universal mathematical form. Systems theory and cybernetics contribute feedback, regulation, recursive organization, and adaptive response. Dynamical-systems theory contributes state spaces, trajectories, stability, attractors, bifurcations, and time-dependent dynamics. Complexity science contributes emergence, heterogeneity, multiscale organization, adaptation, and coevolution. Network, hypergraph, and multilayer approaches contribute relational topology and higher-order interaction. Field and gauge formalisms contribute distributed conditions, locality, representational equivalence, and sensitivity to backgrounds. Information theory, computation, and simulation contribute precise questions concerning representation, uncertainty, computability, complexity, and model-mediated experimentation (Strogatz 2024; Kivelä et al. 2014; Shannon 1948; Turing 1937; Winsberg 2010).

GRE inherits these resources through methodological pluralism. A dynamical model is useful when the relevant state variables and evolution rules can be specified with sufficient stability. A network model is useful when topology and interaction structure are central. An agent-based simulation can represent heterogeneous local rules and emergent aggregate behavior. A statistical model can estimate associations, distributions, or causal effects under explicit assumptions. Historical reconstruction can recover institutional sequences and transformations that a fixed-variable model obscures. Interpretive methods can examine classifications, meanings, and normative reasoning. The method follows the problem rather than the programme prescribing one privileged representation.

This pluralism is compatible with formal rigor. Each formalization should identify its state variables or objects, relations, parameters, temporal scale, boundary conditions, empirical mapping, and domain of validity. A model can be highly informative while idealized. The requirement is to make the idealization visible and to distinguish what follows mathematically from what is supported empirically. Section 2.35 emphasized the same distinction for computation and simulation: an output is evidence about the behavior of a specified model, while its relevance to an economic target depends on the warranted relation between model and target.

Dynamical concepts have particular importance for generative analysis. Attractors can represent recurrent organization, but attraction is neither a goal nor a normative good. Bifurcations can model qualitative changes in regimes, but an abrupt historical event does not establish a mathematical bifurcation without a justified mapping. Criticality can describe specific formal phenomena and should not become a generic term for social instability. GRE uses these concepts where they clarify mechanisms and retains ordinary historical or institutional language where formalization would add little.

Network and higher-order models contribute an analogous discipline. Economic relations rarely form one homogeneous graph. Ownership, credit, employment, in-

formation, supply, kinship, care, legal authority, and technological dependence can occupy different layers and interact across them. Hypergraphs or higher-order structures can represent processes involving more than pairwise ties. Adaptive-network models can allow the network itself to change with node states. Yet even these rich formalisms usually require prior specification of node identities, relation types, and admissible transformations. GRE's generative question begins where those categories themselves acquire histories.

Field language supplies another representational option for distributed conditions. Prices, legal constraints, infrastructure, norms, ecological exposure, information access, or institutional authority can sometimes be represented as spatially or relationally distributed conditions affecting local possibilities. The analogy must remain explicit. A useful social field representation does not establish that an economy is ontologically a physical field, and gauge-theoretic language does not transfer simply because two representations contain formal symmetry. Section 2.34 therefore treated these formalisms as resources for disciplined comparison under ontological suspension.

Information and computation sharpen the distinction between data and meaning. Shannon information quantifies uncertainty relative to a probability structure; it does not by itself measure semantic significance or knowledge (Shannon 1948). Computability and complexity place limits on classes of formal procedure, while social inquiry also encounters identification problems, incomplete observation, strategic behavior, historical novelty, interpretive disagreement, and normative uncertainty. GRE therefore avoids treating computational tractability as equivalent to epistemic adequacy.

The scientific inheritance becomes most distinctive when combined with historical transformation. A fixed formal model can represent states changing under stable rules. Nonautonomous and adaptive models can represent changing environments, parameters, or topologies. GR and GRE ask a further question when economic history transforms the categories, relations, or evaluative structures from which the model itself was constructed. Such transformation does not render formalization impossible. It requires explicit attention to model revision, regime-dependent variables, changing boundaries, and the possibility that a representation adequate to one historical interval loses adequacy in another.

Formal openness is therefore part of GRE's theoretical position. The programme seeks formal development where formalization performs analytical work, while leaving room for historical, interpretive, qualitative, and institutional inquiry that accesses different aspects of economic reality. A future GRE may develop stronger mappings among dynamical, network, field, and categorical representations. At the present stage, methodological discipline is more valuable than premature mathematical unification.

2.38.5 Generative Relational Economics as an Integrative Research Program

The four inheritances locate GRE as an integrative research programme within economics. Integration here has a specific meaning. GRE coordinates questions that existing traditions often distribute across separate analytical registers: historical constitution, relational dependence, generation of future conditions, heterogeneous

value, normative evaluation, multiscale dynamics, formal representation, and transformation of the rules through which later economic states become possible. The programme gains coherence from the relation among these questions rather than from a claim that they reduce to one explanatory principle.

The central analytical object can now be stated more precisely. GRE studies economic processes in which relations among heterogeneous participants and conditions contribute to the generation, reproduction, transformation, distribution, or foreclosure of later economic capacities and possibilities. Those participants can include persons, households, firms, states, communities, organizations, technical systems, ecological systems, legal institutions, and other domain-relevant entities. The relevant relations can include exchange, production, ownership, labor, care, credit, authority, cooperation, competition, recognition, information, infrastructural dependence, and ecological coupling. The analytical task is to specify which relations matter for a particular problem rather than to presume that every relation belongs in one model.

This object distinguishes generativity from immediate output. A productive process can generate commodities while degrading the skills, trust, ecological conditions, or institutional capacities required for future production. A transfer can increase present consumption while altering future dependence. A platform can generate new opportunities while centralizing access to data or market participation. A cooperative can distribute current surplus while also generating organizational competence and collective governance capacity. GRE asks about these temporally extended consequences while preserving conventional measures of output, income, cost, and efficiency where they remain relevant.

A second defining feature is heterogeneity of value. Economic processes can transform material resources, labor, knowledge, attention, ecological capacity, legal rights, symbolic recognition, and social relations through interfaces that permit some forms of conversion while blocking others. GRE treats the institutional architecture of conversion as an economic object. Who can convert which resource into which capability, under what conditions, at what loss, with what return, and with which external consequences can matter as much as the nominal quantity initially possessed. Conversion does not imply equivalence, and a common price does not dissolve differences among the values converted.

A third feature is recursive economic constitution. Economic relations can alter the actors and conditions that later participate in economic relations. Education changes capability; employment can develop or erode skill; organizational routines create competence; debt changes future claims; property regimes shape incentives and access; technological standards reorganize coordination; ecological extraction changes later resource conditions; institutions modify expectations and enforcement. GRE treats such recursion as a family of mechanisms requiring empirical differentiation. The concept of a generative relational system from Section 2.36 provides an abstract language for this recursion, while later chapters will develop economic-specific forms.

A fourth feature is multiscale analysis. Economic generation can move across individual, organizational, sectoral, institutional, ecological, national, and transnational scales. Local adaptation can create aggregate lock-in; national policies can reorganize household possibilities; global supply chains can transmit shocks and dependencies; organizational design can transform individual learning; ecological degradation can feed back into prices, health, migration, and fiscal capacity. GRE consequently treats

scale as an analytical choice requiring justification rather than as a fixed hierarchy. Cross-scale effects are especially important where benefits and burdens appear at different levels.

A fifth feature is explicit normative separability. GRE can describe the generative structure of a process without endorsing it. Normative assessment enters through articulated criteria concerning welfare, capability, justice, freedom, sustainability, recognition, democratic participation, or other justified values. The programme should therefore support both positive and normative research while marking the transition between them. This separation also permits disagreement: two researchers may accept the same generative account while defending different normative evaluations, or share a normative commitment while disagreeing about the mechanism that would realize it.

A sixth feature is reflexive openness. Economic representations can become components of the systems they describe. Forecasts alter expectations; classifications alter eligibility; metrics reshape organizational conduct; models inform policy; algorithms allocate opportunities; theories influence institutional design. GRE therefore treats model use as potentially generative when representations enter causal or institutional relations. This does not eliminate the distinction between model and target. It creates a research problem concerning when and how the representational layer becomes part of the target's subsequent history.

These features suggest a recognizable GRE research sequence without imposing a universal method. A study can begin by identifying an economic object and historical boundary; specifying relevant entities, relations, and representations; tracing how current configurations were produced; examining the mechanisms through which they generate or reproduce later capacities and constraints; identifying forms of value and their conversion interfaces; analyzing distribution, power, scale, and time horizon; evaluating the adequacy of available evidence and models; and, where normative questions arise, stating the criteria through which alternatives are assessed. Different studies can enter this sequence at different points and use different methods.

The programme's boundaries are equally important. GRE does not claim jurisdiction over every relational phenomenon. A purely legal question belongs primarily to legal analysis even when its consequences later affect economic relations. A theory of consciousness, aesthetic experience, or religious practice remains outside GRE unless an economic problem specifically requires an interface with those domains. Broader GR research can coordinate such cross-domain questions without making economics the organizing discipline. This boundary protects GRE from becoming a vocabulary that expands by relabeling neighboring scholarship.

GRE also remains corrigible by established economics. If a standard price-theoretic model explains an observed allocation with greater precision and fewer unsupported assumptions, GRE has no reason to replace it. If a causal inference design identifies a policy effect adequately, generative-relational vocabulary should not be added decoratively. GRE becomes useful where the research problem requires historically changing relations, recursive capacity formation, heterogeneous value conversion, multi-scale reproduction, reflexive representation, or transformation of economic conditions that narrower models legitimately hold fixed. Its contribution should be judged by explanatory, empirical, methodological, and normative gains in those domains.

The position established in Chapter 2 can therefore be summarized as disciplined

integration under retained plurality. Historical-material traditions provide the temporality and institutional specificity of economic categories. Philosophical and relational traditions provide conceptual resources for constitution, interpretation, process, and ontological restraint. Economic and normative traditions provide rigorous problems of allocation, production, welfare, capability, reproduction, value, justice, and institutional design. Scientific and formal traditions provide representational resources for dynamics, networks, fields, information, computation, and multiscale organization. GR supplies the immediate architecture through which relation and generation can be studied together. GRE develops that architecture as an economic research programme whose distinctive questions concern the production and distribution of future economic possibility.

The chapter therefore ends with a position rather than a completed system. GRE has an intellectual genealogy, a set of inherited distinctions, and a preliminary object of inquiry. Its concepts remain subject to specification, empirical testing, normative argument, and revision. Chapter 3 turns from genealogy to disciplinary constitution. It will state more directly what GRE studies, which questions define its research programme, how it relates to established economics and neighboring disciplines, and what standards should govern its future development. The foundations assembled in the present chapter provide the conceptual resources for that task while preserving the theoretical plurality from which the programme emerged.

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Chapter 3

Constitution and Research Programme of Generative Relational Economics

Chapter 3 completes the foundational movement of Part I by turning historical emergence and intellectual possibility into disciplinary constitution. Chapter 1 examined the historical conditions under which an economic framework centered on relations, generation, changing capacities, and future conditions of possibility becomes increasingly relevant. Chapter 2 reconstructed the philosophical, economic, social-theoretical, normative, scientific, and formal lineages from which such a framework can draw without treating their differences as reducible to a single doctrine. The present chapter asks a different question: what kind of research programme follows when those historical problems and theoretical resources are organized specifically around economic inquiry? Its task is therefore constitutive. It specifies the provisional identity, objects, scales, questions, epistemic commitments, modes of inquiry, normative interfaces, and boundaries of Generative Relational Economics (GRE).

The term *constitution* is used here in a methodological and disciplinary sense. GRE is still an emerging research programme, and its conceptual vocabulary remains open to revision through empirical inquiry, formal development, comparison with established economics, and criticism from neighboring disciplines. A preliminary constitution therefore does not fix an immutable doctrine. It makes explicit the commitments that currently organize the programme, the questions that distinguish it, the conditions under which a contribution can reasonably be described as GRE, and the domains in which theoretical disagreement remains legitimate. Such specification is necessary for cumulative research. An open programme becomes difficult to evaluate when its objects, boundaries, and standards remain entirely implicit; a rigid programme loses the capacity to learn when provisional commitments are transformed prematurely into protected axioms. Chapter 3 develops an intermediate institutional form: sufficiently explicit to support research coordination and sufficiently revisable to permit theoretical evolution.

The chapter begins from a domain distinction already established at the end of Chapter 2. Generative Relational Theory (GR) supplies a broader orientation toward

relations, recursive generation, historical transformation, changing conditions of possibility, and the possible transformation of effective rules of change. GRE develops that orientation within economics. Its primary concern is therefore economic life: production, allocation, circulation, reproduction, labor, care, ownership, credit, valuation, institutions, technological infrastructures, ecological dependencies, economic power, and the distribution of future capacities. The broader GR framework can interact with law, political theory, education, ecology, history, aesthetics, artificial intelligence, and other domains, while GRE remains responsible for showing why a particular problem is economically significant and how its claims relate to economic evidence and existing economic knowledge.

This disciplinary positioning gives the chapter two complementary functions. The first is selective. GRE requires boundaries because relation and generation are extremely broad concepts. A study does not become GRE merely because it describes a network, identifies an interaction, invokes emergence, or discusses long-run consequences. The programme is organized around more specific analytical questions: how economic relations constitute subjects and objects; how allocations are mediated through relational configurations; how present arrangements generate later capacities, constraints, values, dependencies, institutions, and possibilities; who can access, mobilize, and shape generative capacities and the conditions that sustain them; how those effects propagate across scales; how heterogeneous forms of value are converted, circulated, captured, dissipated, or returned; how economic power alters generative conditions; and how the conditions that govern future change can themselves be transformed. The second function is pluralistic. These questions can be investigated historically, interpretively, qualitatively, quantitatively, causally, formally, computationally, normatively, and through intervention-oriented inquiry. GRE does not require a single privileged method or mathematical representation.

The chapter consequently moves from disciplinary identity to problem structure and then from problem structure to research architecture. It first specifies the scope of the emerging programme and the economic problems that motivate it. It then develops a minimal primitive vocabulary for ontological emergence and identifies the heterogeneous objects and scales that GRE may investigate. Subsequent sections formulate characteristic GRE questions and clarify the distinctive analytical movement from allocation through relational mediation, generation, propagation, conversion, recirculation, extraction, and structural transformation. The chapter then addresses economic subjecthood, the orientation of generation, modes of inquiry, epistemic commitments, praxis, normative evaluation, power, heterogeneity, disciplinary boundaries, and criteria for research contribution. Its final movement treats GRE as a cumulative and internally plural programme, states major open problems, maps the architecture of the wider research agenda, and offers a preliminary constitution that can guide later chapters without foreclosing revision.

Several restraints govern this constitutional exercise. Ontological suspension remains the default: useful relational, dynamical, network, field, geometric, or computational representations do not by themselves establish the ultimate ontology of economic reality. Descriptive generativity remains distinct from normative desirability: a relation can generate durable capacities or self-reinforcing structures while also generating domination, ecological damage, exclusion, or vulnerability. Representation remains distinct from represented reality: measures, categories, graphs, models, and simulations are epistemic constructions whose adequacy depends on the local

question and evidence. Finally, disciplinary openness remains reciprocal. GRE can borrow from neighboring traditions, and those traditions can expose GRE's errors, omissions, and domain limits.

The result is intentionally preliminary. Chapter 3 provides enough constitution for the rest of the book to proceed with a stable research language, while leaving empirical, methodological, formal, and normative disagreements available for later development. The subsequent chapters can therefore deepen GRE's ontology, epistemology, methodology, praxis, substantive economics, theories of power and justice, epistemic economy, artificial intelligence, and domain applications without repeatedly renegotiating the programme's most basic disciplinary identity.

3.1 Disciplinary Identity of Generative Relational Economics

The role of this section is to establish the preliminary disciplinary identity of Generative Relational Economics (GRE) before the chapter specifies its problem-space, objects, methods, and standards of contribution. Its objective is to explain what kind of intellectual formation GRE currently is, the scope within which it makes economic claims, and the commitments that give coherence to otherwise heterogeneous research practices. The argument proceeds from the transition between theoretical proposal and research programme to the scope of the field, the priority of economics as its primary domain, the organizing commitments of relation and generativity, and the conditions under which the programme should remain open and revisable. The method is constitutive rather than taxonomic: the section proposes a working disciplinary identity capable of coordinating research without presenting that identity as historically settled.

GRE is best understood at this stage as an *emerging economic research programme*. The phrase marks both ambition and restraint. It indicates an effort to organize a cumulative body of questions, concepts, methods, models, empirical inquiries, and normative debates around a distinctive analytical orientation. It also recognizes that GRE has not acquired the institutional history, stabilized professional community, canonical methods, or settled boundaries associated with an established discipline or mature subfield. Its identity therefore rests primarily on a coherent problem-space and a set of research commitments rather than on institutional recognition.

This distinction matters because the vocabulary of GRE ranges across several domains. Relations are studied throughout sociology, economics, anthropology, network science, political theory, ecology, and philosophy. Generation appears in theories of production, reproduction, development, evolution, emergence, innovation, complexity, and social formation. Value is central to economics and also to ethics, aesthetics, ecology, and political theory. Fields, trajectories, networks, capabilities, institutions, subject positions, and historical transformations already possess rich literatures of their own. GRE gains disciplinary identity neither by collecting these vocabularies under a new label nor by claiming ownership over their objects. Its identity arises from the specific economic questions produced when relational constitution and downstream generation are treated together as sustained objects of inquiry.

A characteristic GRE inquiry therefore asks how an economic arrangement changes more than the variables administratively attached to its immediate recipi-

ent or transaction. An allocation of money, land, information, compute, credit, legal recognition, care, education, infrastructure, or technological capability enters an existing relational configuration. The allocation can alter capacities, dependencies, bargaining positions, recognition, expectations, institutional practices, ecological conditions, or access to later opportunities. These changes can propagate through further relations, be converted into other forms of value or constraint, become self-reinforcing, dissipate, or transform the conditions under which subsequent economic action occurs. GRE treats these downstream and relationally mediated effects as part of the economic object rather than as automatically external to it.

The programme remains compatible with narrower analyses when they are adequate to the question. A price model, accounting identity, causal estimate, institutional comparison, historical interpretation, network representation, ethnography, or simulation can each provide the most appropriate access to a local problem. GRE does not require every study to represent the full relational and generative field. Its disciplinary claim is instead that certain economically consequential phenomena become visible only when analysis can move between immediate allocation and the relations through which future capacities and constraints are produced. This claim defines a research orientation rather than a mandatory universal model.

3.1.1 Research-Programme Constitution of GRE

A theoretical proposal can be organized around a small number of concepts. A research programme requires a wider architecture. It must identify recurring problems, specify objects of inquiry, permit methods appropriate to different forms of evidence, distinguish stronger from weaker claims, accumulate comparative findings, expose itself to revision, and provide criteria through which researchers can disagree productively. GRE enters this second task in Chapter 3.

The transition is significant because relation and generativity can otherwise remain suggestive but underspecified. A relational statement may simply observe that economic actors are connected. A generative statement may merely report that one event has consequences for another. A research programme needs sharper questions. Which relations are constitutive of the economic situation? What entities and subject positions are stabilized through them? Which changes can reasonably be attributed to a relation or configuration rather than to coincident conditions? Through what mechanisms do effects propagate? Which forms of value are generated, converted, captured, returned, or destroyed? How do effects vary across scale and historical time? Under what conditions does a generative process reproduce itself? When does it alter its own conditions of continuation? What evidence would count against a proposed account?

These questions turn GRE from a vocabulary into a programme of inquiry. They also make possible disagreement internal to GRE. Researchers can disagree about whether a particular relation is constitutive or incidental, whether a claimed downstream effect is causal or interpretive, whether a state-space model preserves the relevant distinctions, whether a value conversion is commensurable, whether an intervention strengthens capability or dependence, or whether a historical transformation changes only outcomes or changes the effective rules through which outcomes are produced. Such disagreements are productive when the disputed objects, assumptions, scales, and evidential standards are made explicit.

A research programme also requires cumulative structure. One study may identify a recurring relational mechanism; another may test whether it travels across institutional contexts; a third may formalize the mechanism; a fourth may show where the formalization fails; a fifth may examine its normative consequences; and an intervention study may alter the relation and observe how the surrounding system responds. The contribution of GRE lies partly in making these inquiries legible to one another. Historical interpretation, qualitative evidence, quantitative estimation, formal modeling, and normative analysis can then address different aspects of a shared problem without being forced into a single epistemic hierarchy.

The programme should therefore distinguish several levels of theoretical commitment. Some propositions will function as organizing hypotheses: for example, that present economic relations can generate future capacities and constraints that are not well represented by immediate allocation alone. Others will be domain-specific empirical claims: a particular credit architecture may generate dependence under specified institutional conditions. Still others will be methodological proposals, formal representations, normative arguments, or exploratory analogies. Treating these levels as equivalent would weaken the programme. GRE becomes more rigorous when the standing of each claim is stated locally and can change through evidence or criticism.

The term *research programme* also protects GRE from premature closure. The field can contain competing accounts of generativity, alternative formal representations, and disagreements about value while retaining a recognizable common problem-space. A programme is strengthened when rival formulations expose assumptions that one formulation had made invisible. Internal plurality therefore becomes part of disciplinary development rather than evidence that the field lacks identity.

GRE's transition from proposal to programme can consequently be summarized through four requirements. It needs a stable enough vocabulary to support communication, a sufficiently explicit problem-space to distinguish relevant contributions, methodological openness appropriate to heterogeneous evidence, and institutionalized revisability through which its own categories can change. Later sections of this chapter elaborate each requirement. The disciplinary identity established here supplies their common orientation.

3.1.2 Scope of the Emerging Field

The scope of GRE is defined by an intersection rather than by a single class of objects. The first component is economic: the inquiry concerns production, allocation, exchange, circulation, reproduction, labor, care, ownership, credit, institutions, technology, ecological dependence, valuation, power, or other processes that materially organize economic life. The second component is relational: the analytical object includes relations or configurations through which subjects, capacities, constraints, values, and opportunities are constituted or mediated. The third component is generative: the inquiry examines how those relations contribute to later states, possibilities, structures, or rules of change.

This intersection permits a broad empirical range while limiting conceptual inflation. A study of a labor platform can belong to GRE when it investigates how contractual, algorithmic, reputational, and infrastructural relations shape workers' future bargaining capacity, subject positions, dependence, or access to opportunity. A study

of agricultural credit can enter GRE through the way financing relations reorganize production choices, ecological risk, household vulnerability, and later credit dependence. A study of education can become economically relevant to GRE when it examines the generation and distribution of capabilities, knowledge, credentials, networks, and future participation in production or exchange. A study of artificial intelligence can enter through changing productive capability, ownership of computational infrastructure, knowledge concentration, labor transformation, or new asymmetries in the capacity to generate economically consequential outputs.

The same objects can also be studied outside GRE, and that coexistence is expected. A legal analysis may focus on doctrinal validity, a sociological analysis on status relations, a psychological analysis on cognition, and a GRE analysis on the economic generation and distribution of capacities through the same institution. Domain boundaries therefore concern the primary research problem rather than exclusive ownership of empirical objects. Interdisciplinary work becomes especially important when the economic mechanism cannot be understood without juridical, cultural, ecological, technological, or political relations.

Scope also varies by temporal depth. GRE can examine immediate relational mediation, medium-term capability formation, long-run institutional reproduction, intergenerational effects, or transformations in the conditions that govern later change. The appropriate horizon depends on the generative claim. A microcredit intervention may require months or years to evaluate changes in debt dependence and productive capacity. An infrastructure investment may reorganize settlement, land value, ecological conditions, and institutional expectations over decades. Knowledge and educational processes can generate effects whose later manifestations are difficult to attribute to a single intervention. GRE therefore treats temporal horizon as part of research design rather than assuming that the period convenient for measurement is identical to the period relevant to generation.

The programme is similarly multiscalar. Generative effects can occur within persons, households, organizations, communities, markets, institutions, states, ecosystems, or transnational systems, and they can propagate across these levels. A policy that expands aggregate productivity can simultaneously weaken a local community's bargaining capacity; a household intervention can change community norms; an institutional classification can alter individual access to credit; a technological standard can reorganize international production networks. GRE does not presume that effects observed at one scale aggregate straightforwardly into effects at another.

A useful boundary follows from this scope. Relational complexity alone is insufficient to define a GRE contribution. Many systems contain numerous relations. GRE becomes relevant when the inquiry identifies an economically meaningful process through which relations contribute to generation, reproduction, transformation, distribution, or foreclosure. The analytical burden is therefore positive: the researcher should specify the relation, the generated object or capacity, the mechanism or interpretive pathway connecting them, the relevant scale and horizon, and the evidence appropriate to the claim.

This scope allows GRE to remain broad without becoming synonymous with social science. It welcomes interdisciplinary objects while retaining an economic center of gravity. It also leaves neighboring GR domains available for questions whose primary object lies elsewhere. The breadth of the programme is therefore an architecture of interfaces rather than a claim of disciplinary absorption.

3.1.3 Economics as the Primary Domain

GRE is constituted within economics because its motivating questions concern the organization of material and symbolic conditions through which economic life is produced and reproduced. Production, distribution, allocation, exchange, labor, care, investment, credit, ownership, technological capability, ecological dependence, institutions, and value formation remain central. The relational and generative vocabulary changes the analytical emphasis placed on these objects; it does not dissolve the obligation to engage economic mechanisms, evidence, and established economic explanations.

This primary-domain commitment has several consequences. First, GRE should be able to state what is economically at stake in an inquiry. A sophisticated relational description does not automatically become economic analysis. The researcher must connect the relational configuration to economically consequential capacities, constraints, valuations, flows, institutions, or distributions. Second, GRE remains answerable to existing economics. When a conventional model explains the relevant outcome more parsimoniously and with adequate empirical support, GRE has no disciplinary privilege that exempts it from that result. The programme earns analytical space by identifying dimensions that established representations omit or by connecting findings that remain separated across existing literatures.

Third, economics as the primary domain does not imply a narrow definition of economic value. Market prices, income, productivity, and output are indispensable in many inquiries, but economic life also depends on capabilities, care, ecological conditions, knowledge, institutional trust, infrastructure, social reproduction, and forms of relational value whose significance may be incompletely priced. GRE therefore studies how multiple forms of value enter economic processes, while preserving the distinction between economic relevance and universal commensurability.

Fourth, the economic domain contains both descriptive and normative questions. GRE can describe how a platform generates dependency or how an institution concentrates productive capacity without thereby deciding whether the arrangement is just. Normative inquiry enters when evaluative criteria are made explicit: distribution, capability, recognition, participation, ecological sustainability, generative justice, or other justified standards. Economics supplies part of the descriptive object; ethical and political reasoning remain necessary where evaluation exceeds positive explanation.

Fifth, the primary-domain commitment helps distinguish GRE from the wider GR framework. GR can investigate generative relations in history, law, education, epistemology, aesthetics, governance, or other domains without reducing those domains to economics. GRE concerns those interfaces when they materially affect economic processes or when economic arrangements shape the neighboring domain. A legal rule governing property, for example, is relevant to GRE because it constitutes ownership relations, allocative authority, collateral possibilities, and future investment conditions. The same rule can simultaneously require independent jurisprudential analysis concerning legal validity, interpretation, or rights. The interface is real while disciplinary identity remains differentiated.

This differentiation is important for the future development of the research programme. Without it, GRE could expand until every relational phenomenon becomes an economic phenomenon and the term loses discriminative value. With an explicit

economic center, interdisciplinary expansion becomes more rigorous: each borrowing must show what economic problem it helps explain and what aspects remain better handled by another domain.

Economics also offers GRE a demanding test environment because economic systems combine formal institutions, strategic behavior, material constraints, symbolic valuations, historical change, quantitative data, and normative controversy. A viable GRE research programme must therefore interact with several established modes of economic reasoning rather than relying on a single philosophical language. The field's disciplinary identity is strengthened when relational and generative claims produce better questions, better explanations, better empirical distinctions, or more adequate evaluations within this demanding domain.

3.1.4 Relation and Generativity as Organizing Commitments

Relation and generativity provide GRE with its two principal organizing commitments. Neither concept functions as a universal explanation. Relation directs attention to the possibility that economic entities, capacities, positions, and values are partly constituted through connections, dependencies, institutions, recognitions, and repeated interactions. Generativity directs attention to the possibility that present relations alter what becomes possible later. Their conjunction gives GRE its characteristic analytical movement.

The relational commitment begins from specification. A relation should be identified with enough precision to distinguish it from mere co-presence or statistical association. Depending on the inquiry, the relevant relation may involve ownership, exchange, debt, employment, care, authority, information, recognition, technological dependence, ecological dependence, legal standing, platform access, infrastructural connection, or another structured linkage. Relations can be direct or mediated, durable or episodic, formal or informal, symmetric or asymmetric, cooperative or exploitative, visible or weakly represented in available data. GRE does not require these differences to be collapsed into a common relational metric.

Relations can also be constitutive at different levels. A contractual relation may connect already recognized legal persons while simultaneously contributing to their later capacities. Other relations help constitute the relevant economic subject or object itself. Employment relations can stabilize occupational identities and access to social insurance; credit relations can create debtor positions and classifications; platform rules can constitute categories of worker or seller; property institutions can define the objects over which exchange rights are recognized. Relational analysis therefore includes both interaction among entities and the relational production of entityhood.

The generative commitment adds temporal and counterfactual depth. A relation matters not only through its current state but through the capacities, constraints, structures, values, and subsequent relations it helps produce. Generation can involve accumulation, learning, reproduction, institutionalization, path formation, trust, dependence, lock-in, ecological change, innovation, subject formation, or the creation of new option spaces. Some generative effects amplify later agency; others narrow the range of feasible action. Many do both for different actors or at different scales.

GRE consequently treats generativity as descriptive before it becomes evaluative. A relation can be highly generative because it reliably produces further structures or

capacities while remaining normatively objectionable. Monopoly power can generate entry barriers; surveillance infrastructures can generate behavioral control; debt can generate productive investment and also dependency; extractive institutions can reproduce themselves. The strength of a generative mechanism does not determine its justice. Normative orientation must be supplied through explicit evaluative argument.

The two commitments become especially distinctive when the generated effects alter the conditions of further generation. A subsidy can increase productive capacity; the expanded capacity can change market structure; the changed market structure can alter bargaining power and investment incentives; those changes can influence the design of subsequent policy. A technology can alter productivity while also reorganizing skills, ownership, infrastructure, and standards in ways that change which technologies can be developed later. At this point, economic analysis concerns more than a sequence of outcomes. It concerns transformations in the field of future possibility.

This recursive feature explains why GRE pays attention to what later chapters call generative conditions and effective rules of change. The language should remain modest. Many cases can be modeled adequately with fixed rules and changing state variables. Stronger claims about rule transformation require stronger evidence and clearer specification. GRE does not infer meta-level transformation merely because a system changes. It asks whether the mechanisms through which future states are produced have themselves been altered and what observations would support that inference.

Relation and generativity therefore organize research without dictating a single ontology or method. A historical study may reconstruct how property relations generated institutional persistence. A causal design may estimate how access to credit changes later productive capacity. A network model may represent diffusion through relational structure. An ethnography may identify meanings and recognition processes omitted by administrative data. A formal model may examine self-reinforcing dependence under specified assumptions. These inquiries share an orientation while preserving different evidential objects and standards.

The disciplinary identity of GRE resides in this organized plurality. Relation specifies the mediating architecture through which economic processes occur; generativity specifies the downstream production of capacities, constraints, values, structures, and possibilities. Their conjunction turns attention from isolated possession toward economically consequential histories of formation.

3.1.5 Openness, Revisability, and Disciplinary Development

An emerging research programme requires mechanisms for changing itself. GRE therefore treats openness and revisability as constitutive commitments rather than temporary concessions made during an early phase. Its concepts, categories, methods, and boundaries should remain corrigible through empirical failure, theoretical criticism, comparison with competing explanations, normative disagreement, and changes in the historical economy it attempts to understand.

Revisability begins with ontological suspension. GRE can use relational, processual, dynamical, network, field, geometric, or computational representations while leaving open the question of whether any one representation captures the ultimate ontology

of economic reality. This stance permits formal development without transforming modeling convenience into metaphysical certainty. A network can be an excellent representation for one mechanism and an inadequate representation for another. A field model can capture distributed conditions while obscuring actor interpretation. A qualitative reconstruction can identify constitutive meanings that are difficult to parameterize while remaining unable to estimate population-level magnitude. Openness protects the programme from identifying one mode of access with reality itself.

Revisability also concerns the programme's own categories. Economic subjects, institutions, technologies, forms of labor, ownership arrangements, and modes of value production change historically. A research language adequate to one economic formation can become less adequate as new infrastructures and relations emerge. Artificial intelligence offers an obvious contemporary example: rapid changes in productive capability, knowledge generation, labor substitution and complementarity, compute ownership, and human-machine interaction may require categories that were less salient in earlier economic analysis. GRE's emphasis on historical generation would be inconsistent if GRE treated its own conceptual vocabulary as historically exempt.

The programme should therefore preserve records of theoretical change. When a category is revised, the earlier formulation should remain intelligible enough for researchers to understand what changed and why. This matters for cumulative inquiry. A field that silently changes the meaning of its central terms can create an appearance of agreement while losing comparability across studies. Explicit versioning of definitions, assumptions, measures, and model classes can make theoretical evolution a source of knowledge rather than a source of confusion.

Openness further requires external correction. GRE should remain answerable to mainstream economics, heterodox economics, economic history, sociology, anthropology, political theory, law, ecology, philosophy, computer science, and other relevant fields. The appropriate correcting discipline depends on the claim. A causal claim can fail under econometric scrutiny; a historical claim can fail under archival evidence; a legal claim can misunderstand doctrine; an ecological model can omit biophysical constraints; a normative argument can rely on undefended values. Interdisciplinarity is therefore not only a source of concepts. It is a structure of accountability.

Internal pluralism performs a related function. Researchers working within GRE may prefer different ontologies, causal accounts, measures, formal systems, or normative theories. The field should permit such disagreement when the competing formulations remain explicit enough to compare. Productive pluralism differs from unrestricted eclecticism. Competing accounts should specify their domains, assumptions, explanatory targets, evidential support, and points of incompatibility. A programme grows when disagreement creates sharper tests and better distinctions.

Disciplinary development also depends on negative results and limits. A proposed generative mechanism may fail to replicate, operate only under narrow institutional conditions, or add little beyond an existing model. A relational representation may become computationally intractable without improving explanation. A broad concept of value may prove impossible to operationalize for a particular decision. Such findings belong inside GRE rather than outside it. A research programme that records only cases where its preferred vocabulary succeeds would gradually lose contact with the conditions under which that vocabulary is useful.

Finally, GRE should remain historically revisable in its normative orientation. The programme can state commitments to transparency, participation, non-domination, capability, ecological viability, generative justice, or other evaluative principles only by making their justification available for criticism. Historical change can reveal conflicts among values or forms of exclusion that an earlier framework failed to perceive. Normative learning therefore requires both continuity and openness: continuity sufficient to make commitments accountable, and openness sufficient to correct them.

The disciplinary identity proposed in this section is consequently provisional by design. GRE is an emerging economic research programme organized around relational constitution and generative consequence, committed to economics as its primary domain, open to methodological and formal plurality, and structured for revision through evidence and criticism. This identity is strong enough to distinguish a problem-space while remaining incomplete enough to learn from the research it enables. The next section can therefore move from the identity of the programme to the concrete classes of economic problems that give it substantive necessity.

3.2 The Problem-Space of Generative Relational Economics

The role of this section is to delimit the class of economic problems for which Generative Relational Economics (GRE) is intended to provide additional analytical leverage. Its objective is not to claim that these problems belong exclusively to GRE, but to identify the recurring situations in which analysis becomes incomplete when it stops at the immediate recipient, current output, present ownership, or a fixed description of economic actors. The section proceeds through nine problem families: relational effects of allocation, downstream generation, access to generative capacity and conditions, value beyond possession and exchange, persistent asymmetry and power, changing economic subjecthood, symbolic abundance and representational instability, heterogeneous subjects and value structures, and transformation of future generative possibilities. The method is constitutive and problem-oriented. Each subsection identifies an analytical difficulty that already appears within economic life and states the additional questions that a generative-relational perspective places around it.

The problem-space of GRE begins from a simple observation with wide consequences: an economic intervention rarely terminates at the point where it is administratively recorded. A payment reaches a recipient, a loan enters a balance sheet, an educational opportunity is allocated to a student, infrastructure is installed in a locality, compute is assigned to an organization, legal recognition is granted to a category of actor, or information becomes available to a community. Each event can be represented as an allocation. Yet its economically consequential effects depend on the relations through which the allocated object becomes usable, convertible, reproducible, contestable, shareable, or restrictive. The immediate transfer is therefore one moment within a potentially longer generative process.

This does not make conventional measures irrelevant. Recipient-level outcomes, prices, quantities, income, productivity, ownership, expenditure, and welfare indicators remain indispensable where they answer the question at hand. GRE instead focuses attention on cases in which these measures capture only one layer of the economic transformation. The programme asks what new capacities, dependencies, rela-

tions, subject positions, institutional routines, representations, and later possibilities are generated after the administratively visible event. It also asks which possibilities are weakened, foreclosed, extracted, or displaced. The resulting problem-space extends economic analysis temporally, relationally, and across scales without presuming that every problem requires maximal complexity.

The eight problem families below are connected but analytically distinct. An allocation can alter future capability without changing formal ownership. A productive process can generate symbolic standing without generating transferable wealth. A capability asymmetry can remain benign in one relational configuration and become power in another. An artificial system can become economically consequential before its legal or moral subjecthood is settled. Symbolic abundance can expand expressive possibility while making evidence, attribution, and scarcity harder to stabilize. Heterogeneous actors can participate in one economic process while valuing its outcomes through partially incommensurable standards. GRE treats these differences as reasons to preserve a plural problem-space rather than compress them into one master variable.

3.2.1 Allocation beyond the Administrative Recipient

Many economic interventions are administratively organized around identifiable recipients. A household receives a transfer, a firm receives credit, a student receives a scholarship, a municipality receives infrastructure funding, a laboratory receives equipment, or a community receives access to a service. Administrative legibility requires such attribution because institutions must identify who qualifies, who receives, how much is transferred, and whether the transfer conforms to a rule. This recipient-centered representation is operationally necessary, yet it can be analytically narrower than the economic effects that follow.

An allocation enters a pre-existing relational environment. A monetary transfer can alter bargaining positions within a household, reduce dependence on one employer, enable mobility, change creditworthiness, or increase the capacity to support others. A scholarship can generate knowledge, recognition, networks, migration opportunities, future income, or new asymmetries between the recipient and those who remain excluded. Infrastructure can alter land values, mobility, ecological pressure, political expectations, and patterns of settlement. Access to compute can enable research, automation, surveillance, artistic production, or organizational concentration depending on surrounding capabilities and institutions. The economically relevant object is therefore often larger than the administratively named recipient.

GRE treats the recipient as an important entry point rather than the presumed boundary of analysis. The analytical task is to identify which relations are activated, weakened, or reorganized by an allocation and which downstream effects are sufficiently connected to the intervention to warrant inclusion. This requires boundary discipline. Expanding the field indefinitely would make attribution impossible and turn relational analysis into a description of everything connected to everything else. A GRE inquiry therefore needs to justify why particular relational pathways are economically material to the problem under study.

The extension beyond the recipient also changes how incidence can be understood. Formal receipt and effective benefit can diverge. A subsidy assigned to one actor may partly accrue to landlords, intermediaries, suppliers, creditors, family members, or

platforms through price adjustment, contractual dependence, or relational obligation. Conversely, an allocation formally directed at one person can generate benefits for a wider group through care, knowledge sharing, network access, or local demand. Recipient-level accounting remains informative, while the relational incidence of an intervention can require a different map.

This problem becomes especially important where institutions evaluate success shortly after delivery. Immediate uptake can coexist with longer-term dependence, capability loss, market concentration, ecological degradation, or institutional displacement. The reverse is also possible: modest immediate output can generate durable capabilities whose value becomes visible only later. GRE therefore places the administrative recipient inside a wider temporal-relational field and asks how the intervention changes the conditions under which later economic action becomes possible.

The resulting problem is not simply one of externalities. Externality language often begins from a focal transaction and asks which effects fall outside the prices or decisions of the transacting parties. GRE can include such effects, but its concern is broader. Some downstream consequences are constitutive of the recipient's own future capability; others alter the identities and relations through which the original economic categories remain meaningful. The issue is therefore not only what spills outward from a transaction, but how an allocation participates in the production of a subsequent economic configuration.

3.2.2 Generation beyond Immediate Output

Economic analysis frequently evaluates a process through an observable output: units produced, income generated, services delivered, learning achieved, emissions reduced, jobs created, patents filed, or profits realized. Such outputs matter, yet a process can also alter the capacity to produce later outputs. GRE distinguishes these two analytical moments. Immediate output concerns what is produced within a defined interval or activity. Generative effect concerns how the process changes the capacities, relations, constraints, orientations, infrastructures, or rules through which subsequent outcomes may be produced.

The distinction is visible in ordinary economic life. Training can produce a credential while also changing confidence, professional networks, problem-solving capacity, and access to later institutions. A research grant can produce papers while also creating laboratories, datasets, collaborations, techniques, reputations, and future questions. A platform can produce convenience while also establishing standards, behavioral routines, data assets, dependency relations, and barriers to entry. Care can meet an immediate need while also maintaining the bodily, emotional, and social capacities through which later participation remains possible. A failed project can produce little immediate output while still generating knowledge about constraints, new alliances, or institutional learning.

These examples show why generativity cannot be inferred mechanically from output volume. High output can consume the capacities on which future production depends. A firm can raise short-run productivity by exhausting workers, degrading equipment, externalizing ecological costs, or eliminating slack needed for adaptation. An institution can increase publication counts while narrowing intellectual diversity. A resource boom can raise current income while weakening alternative productive

capacities. Conversely, a process can appear inefficient in a short horizon because it invests in capacities whose effects are delayed or uncertain.

GRE therefore treats the temporal relation between present production and future productive possibility as a central economic problem. This includes positive generation, maintenance, regeneration, reproduction, depletion, and foreclosure. The relevant question is not whether every activity has downstream consequences; that proposition would be trivial. The research problem is to identify which downstream changes are economically consequential, through what mechanisms they occur, how durable they are, who can access them, and whether they remain reversible.

Generation also differs from simple multiplication. A process is generative in the stronger GRE sense when it changes the conditions under which later states can be produced. Replicating an identical output can matter economically, but repetition alone does not establish transformation of generative capacity. A production system becomes analytically interesting to GRE when participation, accumulated resources, learned practices, institutional recognition, or altered relations change what can subsequently happen. The generated object may be material, organizational, epistemic, symbolic, ecological, juridical, or relational.

This distinction creates a problem of attribution. Later capacities usually have multiple antecedents. A newly capable organization may have received funding, benefited from favorable regulation, recruited skilled members, inherited prior infrastructure, and learned from failed experiments. GRE should therefore avoid attributing the whole later capacity to one relation merely because the relation preceded it. Generative claims require mechanism-sensitive reasoning and calibrated scope. The field's interest in downstream effects increases rather than relaxes the burden of specifying how generation is believed to occur.

3.2.3 Access to Generative Capacity and Conditions

A further GRE problem concerns the difference between receiving what has already been generated and gaining effective access to the capacities through which new outcomes can be generated. Conventional distributive questions remain indispensable: who receives income, goods, services, assets, welfare, or other outputs? GRE adds a second layer by asking who can mobilize human, organizational, technical, institutional, or artificial generative capacity. It adds a third by asking who participates in shaping the conditions under which such capacity can exist, be maintained, and develop.

These layers become especially visible in economies organized around infrastructures. A subject can possess equipment yet lack the knowledge, networks, institutional recognition, data access, legal permissions, energy, compute, or organizational support required to make that equipment economically effective. Conversely, access to a powerful generative system can transform what a subject is able to produce even when the subject acquires little conventional property. The economically relevant object is therefore sometimes not the distributed thing itself but effective access to a configuration capable of producing later possibilities.

Artificial intelligence sharpens the problem because it can weaken one form of productive dependence while intensifying another. If artificial systems perform tasks for which subjects previously depended on other people's labor, some forms of human-to-human instrumental dependence may decline. Yet access to the artificial capacity can

remain conditional on infrastructures, permissions, ownership, technical standards, energy, compute, or platform governance. A post-labor tendency would therefore not imply a post-political-economic condition. Dependence can migrate from labor-mediated access toward access to generative infrastructure.

GRE does not resolve these questions in advance by treating broad access, common ownership, decentralization, or generative autonomy as automatically desirable. Its constitutive task is narrower. It makes visible a problem that is easily obscured when analysis stops at current output: who can enter, mobilize, influence, maintain, and alter generative processes, and how are the conditions of such participation reproduced? Later chapters develop the associated theories of capital, power, exploitation, justice, and governance. Here the problem is included because it extends political economy from the distribution of generated value toward the organization of generative capacity and generative conditions without replacing the former question.

3.2.4 Value beyond Possession and Exchange

Possession and exchange provide powerful ways of organizing economic value. Ownership establishes claims over resources; exchange reveals willingness to trade under particular conditions; prices coordinate decisions and permit aggregation across many activities. GRE retains these objects while addressing situations in which economically significant value depends on participation, relation, access, recognition, continued circulation, ecological condition, or future capability rather than possession alone.

A resource can have little value to an actor who lacks the relations required to use it. Data require interpretive and computational capacity. Credit requires institutional access and future repayment possibilities. Land depends on legal recognition, infrastructure, ecology, community relations, and permitted uses. Knowledge can gain value through dissemination and recombination rather than exclusion. Membership in a trusted network can create opportunities that cannot be transferred as a discrete owned object. Public infrastructures and commons can generate value through reliable shared availability. Care, reputation, cultural meaning, and institutional legitimacy similarly resist complete description through possession.

Value can also change form as it moves through relations. Economic resources can become educational capability, political access, symbolic standing, health, time, security, knowledge, or ecological resilience. These conversions are neither automatic nor necessarily commensurable. The same monetary amount can generate very different capacities under different institutional, bodily, geographical, or relational conditions. Conversely, forms of value that appear qualitatively different can sometimes be converted into economic advantage through mechanisms such as credentialing, collateralization, monetization, platform visibility, or legal recognition.

GRE treats these conversions as part of the economic problem because they influence who can participate in subsequent generation. The possession of a resource at time one may matter less than whether it can be converted into durable capability at time two. A person may formally possess information without possessing the literacy or authority required to act on it. A community may possess land while lacking political protection against dispossession. A researcher may possess an idea while lacking access to laboratories, collaborators, or publication channels. An organization may own technology whose value depends on ecosystems maintained by others.

This perspective also creates a problem of value trajectories. Value can circulate, recirculate, dissipate, be extracted, be destroyed, or become embedded in relations that outlast the originating exchange. An intervention that appears beneficial at one point may produce a later value transfer away from the original participants through debt service, rent, licensing, platform fees, intellectual-property claims, or unequal bargaining. Conversely, a resource can generate distributed value through open standards, shared knowledge, community infrastructure, or repeated reciprocal use.

The purpose of GRE is not to replace price with a universal alternative measure. Doing so would reproduce the commensuration problem in another form. The programme instead asks which forms of value are relevant to the generative process, how they are recognized or obscured, which conversions occur, and what is lost when heterogeneous values are forced onto one scale. Some studies may use monetary valuation; others may require capabilities, ordinal comparison, qualitative description, multidimensional indicators, or explicit acknowledgement of incommensurability.

The problem-space therefore includes a distinction between current value realization and future value generation. An actor can possess valuable assets while occupying relations that reduce future autonomy or capability. Another actor can possess few assets while participating in institutions that generate durable access, learning, security, or collective capacity. GRE does not assume that future generativity should replace present welfare as the evaluative objective. It instead treats the relation between present value and future generative conditions as an economic question requiring explicit normative and empirical analysis.

3.2.5 Persistent Asymmetry and Economic Power

Economic relations routinely contain asymmetries. Actors differ in wealth, productive capability, knowledge, computational capacity, institutional access, bargaining position, vulnerability, mobility, legal recognition, and ability to exit a relation. Difference alone does not establish domination. A doctor and patient, teacher and student, infrastructure provider and user, or advanced technical system and ordinary user can possess highly unequal capabilities while participating in relations that remain mutually beneficial. The analytical problem is to understand when persistent asymmetry becomes economic power and how that power affects later generative possibilities.

GRE approaches power through the conversion of asymmetry into the capacity to shape another actor's options, dependencies, classifications, resources, risks, or future relations. Resource asymmetry can become power when one party controls access to necessities. Knowledge asymmetry can become power when one party can define the relevant evidence or obscure the consequences of a transaction. Institutional asymmetry can become power when one actor controls eligibility, procedure, or recognition. Exit asymmetry can stabilize dependence even where formal participation appears voluntary. Computational or informational asymmetry can allow one actor to predict, rank, personalize, or intervene in another's behavior at a scale the other cannot reciprocate.

This problem is generative because power can reproduce or deepen the conditions from which it arises. Control over capital can generate further capital; control over data can improve prediction and attract further users; institutional authority can shape the categories through which later authority is exercised; reputational advan-

tage can increase access to opportunities that generate additional reputation. Such processes are not inevitable. Competition, law, collective organization, technological change, public infrastructure, and countervailing institutions can interrupt them. GRE is interested in the mechanisms that determine whether an asymmetry decays, persists, becomes self-reinforcing, or changes form.

Persistent asymmetry also complicates simple strategies of equalization. Some differences in skill, knowledge, role, or capability are produced by specialization and may be beneficial. Other differences may be difficult to eliminate or may arise continually through innovation. The problem for GRE is therefore not reducible to making actors identical. It concerns the relational conditions under which unequal capabilities remain compatible with meaningful participation, non-domination, contestability, access to alternatives, and the preservation of future capacity.

This issue becomes especially important under radical capability asymmetry. An actor may rely on another whose productive, predictive, cognitive, financial, or infrastructural capacity is orders of magnitude larger. Traditional bargaining models can become insufficient when one party cannot meaningfully evaluate the other's capabilities, reproduce the service independently, or exit without severe loss. GRE treats such situations as economic problems of relational architecture. Governance may need to address access, reversibility, auditability, representation, fallback options, common infrastructure, or limits on conversion of capability into control.

The programme also distinguishes power from observable coercion. A relation can shape behavior through dependence, standards, defaults, classification, architecture, or anticipated exclusion without direct commands. Conversely, strong influence can sometimes arise from trust, expertise, or voluntarily delegated authority without amounting to domination. GRE therefore requires local analysis of mechanisms rather than treating every asymmetry as evidence of one universal power relation.

3.2.6 Subjecthood under Changing Productive Relations

Economic theories require some account of the actors who produce, exchange, consume, invest, work, own, decide, cooperate, and bear risk. These actors are often represented as given units for analytical purposes. That representation is frequently useful. Yet productive relations can also change the capacities, roles, identities, and recognition through which an actor counts as an economic subject. GRE treats this instability of subjecthood as part of its problem-space.

Industrialization transformed relations among workers, firms, households, professions, and states. Corporate forms created collective economic actors with legal capacities distinct from their members. Welfare institutions established categories of claimant, beneficiary, dependent, contributor, and protected person. Digital platforms reorganized relations among user, worker, producer, advertiser, seller, and data source. Contemporary artificial systems further complicate the picture by performing economically consequential tasks that were previously associated with human expertise, agency, authorship, coordination, or judgment.

The GRE problem is not to settle the metaphysical status of every possible subject before economic analysis can begin. It is to examine how economic systems assign, stabilize, contest, and transform subject positions. Legal status, contractual capacity, ownership, accountability, recognition, access to institutions, technological mediation, and productive participation can all affect who is treated as an actor and which

consequences attach to that treatment.

Changing productive relations can also alter human subjectivity without replacing human subjects. A worker who collaborates with automated systems may become responsible for supervision rather than direct production. A creator working through generative tools may occupy changing relations to skill, attribution, originality, and ownership. A consumer can simultaneously become a source of behavioral data, content, training material, reputation signals, and network effects. A household member can become an economically visible care provider when institutions change the classification of care. Subject positions are therefore partly produced through the categories and relations of economic organization.

This creates problems for models that assume stable preferences, capabilities, roles, or boundaries of agency across the period being analyzed. Participation in an economic relation can change what an actor knows, wants, can do, expects, or is permitted to become. These changes do not imply that subjecthood is infinitely fluid. Bodies, histories, institutions, legal status, material constraints, and persistent identities provide continuity. GRE's task is to identify which aspects of subjecthood are sufficiently transformed by economic relations to matter to explanation.

The problem also has distributive consequences. When productive systems redefine valued participation, some actors gain recognition while others lose it. Automation can reduce the market value of an existing skill while increasing the value of complementary judgment or coordination. Credential systems can open access while excluding actors whose competence is not institutionally legible. New categories can create rights and protections while also fixing identities in ways that become restrictive. GRE therefore studies subject formation together with the institutional conditions under which recognition generates capability or constraint.

3.2.7 Symbolic Abundance and Representational Instability

Contemporary economies increasingly operate through symbolic objects: data, classifications, scores, rankings, credentials, financial representations, software, models, digital identities, synthetic media, generated text, virtual assets, and machine-produced predictions. Symbolic production has become inexpensive in many domains, while attention, verification, trusted interpretation, and institutional recognition remain scarce. GRE treats this divergence between symbolic abundance and representational stability as a distinct economic problem.

A representation can influence economic reality even when it is incomplete. Credit scores affect access to lending; rankings affect applications and funding; metrics shape organizational behavior; maps and categories determine eligibility; recommendation systems alter visibility; forecasts influence investment; labels affect trust; and digital profiles mediate access to platforms or services. These representations do more than describe pre-existing actors. Once institutions act on them, they can change the relations and opportunities through which those actors subsequently develop.

Symbolic abundance intensifies this process because the cost of producing plausible representations can fall faster than the cost of verifying them. When text, images, claims, reports, credentials, signals, or forecasts can be generated at high volume, scarcity shifts toward provenance, attention, adjudication, trusted institutions, and the ability to distinguish meaningful variation from noise. Economic value can then

accumulate around infrastructures that organize visibility and credibility rather than around content production alone.

Representational instability also arises when the underlying object changes faster than the categories used to represent it. Occupational classifications can lag behind new forms of work. Legal categories can lag behind technological capability. Statistical indicators can retain the same name while their social meaning changes. A model trained on historical data can continue producing stable outputs after the relations that made the historical pattern informative have shifted. The representation may remain technically consistent while its relation to the target becomes weaker.

GRE is concerned with this problem because representations participate in generative processes. A classification used to allocate resources can alter behavior, incentives, identities, and institutional structure. A ranking can change the population it was designed to rank. A predictive system can influence the outcome it predicts by affecting who receives attention or opportunity. A narrative about economic risk can alter investment and thereby change the risk environment. Representation is therefore both epistemic and potentially causal.

This does not mean that symbols possess autonomous power outside institutions and practices. Their effects depend on recognition, enforcement, infrastructure, interpretation, and material consequence. A score ignored by all relevant actors remains economically weak; the same score embedded in lending, hiring, insurance, or governance can become highly consequential. GRE therefore studies the relation among symbolic objects, institutional uptake, material allocation, and downstream generation.

The contemporary problem of symbolic abundance also raises questions about knowledge capital. If the production of codified knowledge becomes much cheaper, advantage may shift toward actors who control data, evaluation systems, distribution channels, trusted identities, proprietary infrastructure, or the capacity to convert symbolic output into institutional action. The economic structure of knowledge can therefore change even when information becomes more abundant. GRE treats this as a problem of changing generative conditions rather than assuming that abundance automatically produces equal access or equal capability.

3.2.8 Heterogeneous Subjects and Value Structures

Many economic models gain tractability by representing actors through a common set of variables or a shared metric of preference and welfare. Such representations can be highly informative when the relevant differences are commensurable. GRE also addresses situations in which subjects differ more deeply: in embodiment, cognition, temporal horizon, vulnerability, institutional status, ecological dependence, forms of agency, or the values through which outcomes are interpreted. Heterogeneity then becomes a constitutive feature of the problem rather than a residual variation around one common type.

Heterogeneous subjects can still enter economic relations. A child and guardian, patient and care institution, local community and multinational firm, present generation and future generation, human user and artificial system, or human economy and ecological system may be connected through exchanges, dependencies, constraints, and value creation even where their capacities and evaluative structures differ sharply. The analytical challenge is to represent the relation without pretending

that the parties are equivalent or completely mutually intelligible.

Value heterogeneity intensifies this challenge. Economic decisions can involve income, autonomy, cultural continuity, ecological integrity, security, dignity, recognition, knowledge, aesthetic significance, collective identity, and future possibility. Some of these values can be monetized for particular purposes; others resist stable conversion or lose important meaning when reduced to price. Conflict can therefore arise not only over the distribution of one value but over which values should count, how they should be represented, and who has authority to decide.

GRE approaches heterogeneous value through explicit pluralism. A study may compare several value dimensions, trace conversions among them, identify institutional priorities, or describe conflicts that remain partially incommensurable. The aim is not to prohibit aggregation. Aggregation can be indispensable for decision and coordination. The requirement is to distinguish the practical need for a decision rule from a claim that the underlying values are intrinsically reducible to one scale.

Heterogeneity also affects generative relations because the same intervention can expand one subject's capabilities while narrowing another's. Infrastructure can increase mobility while degrading an ecosystem or displacing a community. Automation can reduce routine labor while expanding organizational capability and concentrating control. Open information can increase public access while exposing vulnerable individuals. A generative process therefore needs to be indexed to subjects, scales, and value dimensions rather than described as generative in an unqualified sense.

The GRE problem-space consequently includes coexistence under incomplete commensurability. Economic relations often need to continue even where actors do not share one ontology, one value function, one time horizon, or one conception of flourishing. Governance then concerns the design of relations that preserve participation, contestability, translation, and revisability under difference. This is an economic issue whenever resources, capabilities, risks, and future possibilities are allocated through those relations.

The problem should also be distinguished from simple diversity. Diversity describes variation among actors or values. Heterogeneity in the stronger GRE sense becomes analytically significant when the differences affect what can be compared, exchanged, represented, or jointly generated. A heterogeneous relation may require several descriptive languages at once. Economic analysis must then resist both premature unification and the opposite conclusion that comparison is impossible.

3.2.9 Transformation of Future Generative Possibilities

The deepest extension in the GRE problem-space concerns interventions that change not only current states or future outcomes, but the space of possibilities from which later economic processes can unfold. An intervention can create new capacities, remove constraints, alter institutions, establish standards, transform expectations, reorganize infrastructures, generate new subject positions, or change the relations through which subsequent innovation and coordination occur. GRE refers to this family of problems as the transformation of future generative possibilities.

The distinction can be illustrated through capability formation. Education does not merely raise an output variable at the moment instruction occurs. It can change which problems a person can recognize, which institutions can be entered, which collaborations become possible, and which future learning can be undertaken. Infrast-

structure does not merely deliver a service. It can alter settlement patterns, market access, technological adoption, and the feasibility of later investments. Legal reform can change not only current entitlements but the range of organizations, contracts, claims, and collective actors that can subsequently exist.

Technological platforms provide another example. A platform may begin as an intermediary and later become infrastructure on which other actors build businesses, identities, communities, data practices, and standards. At that point, changes to the platform's architecture affect a wide field of downstream possibilities. The economically relevant question extends beyond current user surplus or firm revenue toward the distribution of capacity to create, exit, interoperate, and develop alternatives.

Future possibility can also be narrowed. Debt can finance productive investment while creating obligations that restrict later choices. Monopoly can generate efficient infrastructure while reducing the space for alternative innovation. Environmental degradation can increase present output while eliminating future ecological options. Surveillance infrastructures can improve prediction while normalizing forms of control that become difficult to reverse. Educational standardization can improve comparability while reducing curricular diversity. These processes are generative in the sense that they shape future conditions, even where what they generate is constraint or foreclosure.

GRE therefore distinguishes generation from desirable expansion of possibility. More possibilities are not automatically better, and some constraints are constitutive of valuable order. Legal prohibitions can protect persons and ecosystems; technical standards can make cooperation possible; professional norms can sustain trust; ecological limits can preserve future viability. The analytical problem is to identify which possibilities are enabled or foreclosed, for whom, at what scale, through what mechanism, and according to which evaluative commitments.

Transformation of future possibilities also makes reversibility important. Two interventions with similar current benefits can differ greatly if one preserves exit and revision while the other creates lock-in. Reversible experimentation can support learning under uncertainty. Irreversible infrastructure, ecological change, institutional centralization, or path-dependent standards require stronger attention to long-horizon effects because later actors inherit conditions they did not choose. GRE therefore treats temporal asymmetry between present decision and future revisability as economically significant.

At the strongest level, an economic process can alter the effective rules through which later change occurs. A new legal form can change what organizations may be created. A communication infrastructure can transform how markets and communities coordinate. Artificial intelligence can alter the cost and distribution of cognitive tasks, thereby changing which activities are scarce and which forms of expertise remain economically valuable. Political-economic reforms can change not only allocations but the procedures through which future allocations are decided. The system's later transformations then occur under conditions partly generated by earlier transformations.

This does not imply that future possibility can be mapped exhaustively. Novelty, uncertainty, reflexivity, and incomplete knowledge place limits on prediction. GRE therefore treats generative possibility as an object of inquiry under uncertainty rather than as a fully enumerable state space. Researchers can identify enabling conditions, constraints, path dependencies, option structures, mechanisms of lock-in,

and observed capability formation without claiming complete knowledge of the futures that may emerge.

The nine problem families together delimit the initial problem-space of GRE. Allocation can propagate beyond its administrative recipient; production can transform future productive capacity; access to generative capacity and conditions can diverge from receipt of generated outputs; value can depend on relations and conversion rather than possession alone; asymmetry can become self-reinforcing power; productive relations can reshape economic subjecthood; symbolic abundance can destabilize representation and shift scarcity toward verification and institutional recognition; heterogeneous subjects can remain economically connected without complete commensurability; and interventions can reshape the future conditions under which generation itself occurs. These problems share no single mechanism and should not be collapsed into one model. Their common feature is that economically consequential change exceeds the immediate state that conventional accounting or transaction-level description may record.

The next step is therefore conceptual rather than empirical. If GRE is to investigate these problems without presupposing a fixed ontology of entities, agents, relations, or values, it requires a minimal vocabulary from which richer economic objects can later be constructed. The next section introduces that primitive structure through change, structure, constraint, and difference, while retaining ontological suspension regarding their ultimate metaphysical status.

3.3 Primitive Structure for Ontological Emergence

The problem-space specified in the preceding section requires GRE to speak about entities, subjects, relations, capacities, institutions, values, and fields. Treating those objects as unquestioned primitives would, however, reintroduce many of the assumptions that a generative-relational analysis is intended to examine. The role of this section is therefore to establish a weaker conceptual starting point from which richer economic objects can become analytically available. Its objective is to specify four primitive distinctions—change, structure, constraint, and difference—and to explain how their interaction can support the emergence and stabilization of more determinate configurations. The discussion proceeds from each primitive separately to their interaction, the emergence of relative stability, ontological suspension, and multiple realization. Its method is constitutive and minimal: the section states the weakest commitments currently required by GRE while leaving stronger metaphysical claims open.

The term *primitive* is used here in a methodological sense. A primitive is a distinction that the present analytical framework takes as available before introducing more articulated objects. It is not thereby asserted to be metaphysically fundamental, indivisible, timeless, or ontologically prior in every possible theory. Another formalism may decompose one of these primitives further, replace it with a different basis, or represent the same empirical problem through another ontology. GRE's purpose in selecting a primitive structure is practical and epistemic: to begin with concepts weak enough to avoid presupposing the entities and relations whose emergence the programme may later wish to explain.

This choice also prevents a common circularity. If an economic subject is defined

first and its relations are then studied, the analysis can miss processes through which subjecthood itself depends on recognition, law, infrastructure, classification, productive organization, or repeated participation. If a relation is defined first as a link between already constituted nodes, the analysis can miss cases in which the relation contributes to the differentiation or persistence of the nodes. If an institution is treated as a fixed background, the analysis can miss how repeated practices maintain or transform the institution. A minimal primitive structure postpones these commitments. It asks first what changes, what organization makes those changes intelligible, what conditions restrict or enable possible transformations, and what differences become consequential within the configuration.

The four primitives should not be imagined as four substances or four separable components of an economic system. They are analytical dimensions that become meaningful through one another. Change without structure is difficult to identify because change requires some organization within which a transformation can be distinguished. Structure without change becomes analytically inert because structure is known through persistence, variation, reproduction, or transformation. Constraint presupposes a space of possible differences or transitions whose accessibility is conditioned. Difference becomes economically consequential when a structure renders it perceptible, operative, classifiable, or capable of altering later possibilities. Their interaction supplies a minimal grammar for describing ontological emergence while leaving the ontology itself under suspension.

3.3.1 Change

Change is the first primitive because GRE studies economic processes in which later conditions differ from earlier ones. The minimal concept is deliberately broad: change designates a transformation that can be distinguished between configurations, positions, capacities, relations, classifications, rules, or other analytically relevant conditions. This formulation does not presuppose that the thing changing is already an entity with a fixed identity. It permits the identity, boundary, or kind of the relevant object to become part of the change being studied.

Several levels of change should therefore remain distinct. A variable can change while the relations among variables remain similar. A relation can form, intensify, weaken, reverse, or dissolve while the participating terms remain sufficiently stable for the relation to be tracked. A structure can change when patterns among multiple relations are reorganized. A constraint can change when possibilities previously unavailable become accessible, or when previously accessible transitions become costly, prohibited, or practically unreachable. A classificatory or representational regime can change when actors are newly recognized, grouped, valued, or rendered visible. At a still stronger level, the effective rule through which later transformations occur can itself be modified. GRE eventually requires all of these possibilities, yet the primitive concept of change remains weaker than any one of them.

Change is therefore not synonymous with movement along a pre-specified coordinate. Many economic models legitimately represent change in exactly that way: price changes, employment changes, output changes, wealth changes, or probabilities change within a stable variable system. GRE retains such representations wherever they answer the research question. Its additional interest appears when the variable system itself is historically unstable. A category such as employment may change in

prevalence while retaining a stable legal meaning, or the legal and organizational meaning of employment may itself be transformed by platform work, contracting arrangements, automation, or new institutional classifications. The first case can be represented as change within a category; the second includes change in the category's constitutive conditions.

This distinction also separates state change from generative change. A state can differ at two times without the transition altering the capacity to produce later states. By contrast, a generative change modifies some condition through which subsequent possibilities are produced, selected, stabilized, or foreclosed. Training that raises a measured skill level is a state change; when the training also alters future access to occupations, networks, credentials, confidence, or learning capacity, the economic significance includes a generative dimension. A regulation that changes a current price is one kind of intervention; a regulation that changes entry conditions, bargaining institutions, or the incentives through which future market structure develops reaches a different level of change.

The concept must also accommodate maintenance. Persistence across time can require continuous activity. A bridge remains usable because inspection and repair occur; a currency remains accepted through continuing institutional and social practices; an organization persists through recruitment, routines, accounting, authority, and repeated recognition; a relation of trust can remain stable because encounters repeatedly confirm expectations. In such cases, apparent sameness at the level of an outcome is produced through ongoing change at other levels. GRE should therefore avoid equating observable stability with absence of process.

Change also carries no intrinsic normative direction. Transformation can enlarge capability, reduce vulnerability, create knowledge, or regenerate ecological conditions. It can equally generate dependency, exhaustion, exclusion, concentration, ecological loss, or irreversible foreclosure. Even a change described as innovation is not thereby beneficial to all affected subjects. The primitive records transformation; the normative evaluation of that transformation requires additional criteria developed later in the programme.

Finally, change is always specified relative to an analytical resolution. A firm may appear unchanged because it retains the same legal identity while its workforce, technology, ownership, dependencies, and internal authority are transformed. A person may appear occupationally unchanged while the meaning and security of the occupation are altered. A market may display stable aggregate shares while the underlying network of suppliers becomes more concentrated. GRE therefore requires the researcher to state which differences count as changes for the local question and which dimensions are being held provisionally constant. This dependence on resolution will become important when the programme later treats scale, boundary selection, and representation.

3.3.2 Structure

Structure provides the organization within which changes and differences become intelligible. In its minimal GRE sense, a structure is a pattern of organization that relates distinguishable components, positions, transitions, or conditions with sufficient regularity to support analysis. The term does not require a single formal representation. A structure may be institutional, relational, spatial, temporal, legal, organiza-

tional, symbolic, ecological, computational, or represented through several of these descriptions at once.

This minimal definition matters because structure is often confused with rigidity. GRE instead treats structure as compatible with extensive internal change. A labor market can preserve a recognizable structure while workers and firms enter and exit. A legal system can preserve institutional continuity while rules are amended. A network can preserve a degree distribution or community pattern while particular ties change. A household can remain an administratively recognizable unit while roles and resource flows are reorganized. Structural persistence therefore concerns patterned organization at a selected resolution, not immobility of every constituent.

Structure can also exist at several analytical levels. A local structure may concern the arrangement of a small number of actors or resources. A higher-order structure may concern patterns among relations, institutions, or categories. Structures can be nested, overlapping, or partially incompatible. The same economic subject may simultaneously occupy a workplace hierarchy, a household division of care, a credit relation, a legal status, a platform ranking system, and an ecological dependency. No single structure necessarily exhausts the subject's economic position.

For GRE, structure becomes especially important when it shapes how an intervention propagates. The same allocation can have different effects under different structures because access, conversion, visibility, bargaining, and recirculation differ. A cash transfer received within a predatory debt relation may partly flow to creditors. A research grant enters a university structure that conditions hiring, procurement, intellectual-property ownership, publication, and career recognition. Access to compute can generate different capacities depending on whether technical knowledge, electricity, data, institutional permission, and collaborative networks are available. Structure therefore mediates the relation between an initial resource and the later configuration it helps produce.

Structure also helps distinguish a merely repeated occurrence from a stabilized pattern. Repetition alone can result from coincidence or independent causes. A structural claim is stronger: it proposes that the recurrence reflects an organization of relations, positions, rules, or constraints that makes certain patterns more likely, durable, or reproducible. Such claims require evidence appropriate to the domain. GRE should not infer structure from visual regularity alone; qualitative mechanisms, institutional rules, historical evidence, statistical relationships, network organization, formal models, or combinations of evidence may be needed.

Importantly, structure can itself be an outcome of prior generation. Infrastructure, property regimes, professional categories, organizational routines, standards, market conventions, and technical architectures are historically produced. Once established, they can condition later behavior and appear to subsequent actors as part of the environment. This temporal layering is central to GRE because generated structures can become conditions of future generation. The analytical movement is therefore recursive: processes generate structures; structures condition later processes; later processes may reproduce, erode, or transform those structures.

Structure should consequently be treated as relative to both scale and time. A relation that looks transient at one temporal scale may contribute to a stable pattern at another. A structure that appears fixed during a short intervention study may be historically recent. A national institution can function as background in a firm-level analysis while becoming the primary object in a comparative institutional study. GRE's

minimal concept of structure supports these shifts without requiring that one level be declared ontologically fundamental.

3.3.3 Constraint

Constraint concerns the conditioning of possible transformation. A constraint limits, channels, raises the cost of, delays, redirects, or otherwise modifies which changes are available to a configuration under specified conditions. This definition is intentionally broader than prohibition. Constraints can be hard or soft, formal or informal, material or symbolic, local or distributed, immediate or historically accumulated. They can reduce some possibilities while enabling others by stabilizing expectations, protecting boundaries, supplying standards, or coordinating action.

The enabling dimension is important. A legal rule constrains conduct while also making contracts, organizations, ownership claims, or collective action more reliable. A technical standard restricts admissible designs while enabling interoperability. A professional norm narrows acceptable practice while supporting trust. A budget constraint restricts expenditure while helping define feasible planning. Physical infrastructure limits movement to available routes while making high-volume movement possible along those routes. GRE therefore treats constraint as a transformation of an option space rather than as a synonym for oppression or deprivation.

Constraints differ in the mechanisms through which they operate. A material constraint may arise from energy, time, geography, bodily capacity, or resource availability. An institutional constraint may arise from law, organizational authority, eligibility criteria, property rights, or administrative procedure. A relational constraint may arise from dependence on another actor, obligations, network position, reputation, or bargaining asymmetry. A cognitive or epistemic constraint may arise from limited knowledge, inaccessible information, uncertainty, interpretive categories, or attention. A technological constraint may be embedded in interfaces, protocols, platforms, or computational architectures. These forms can interact, and the same observed limitation can often be generated through several different mechanisms.

Constraint is therefore relational in a weak but important sense: a condition constrains only relative to some possible transformation of a specified configuration. The absence of advanced compute does not constrain a task that requires none. A licensing rule may constrain an unlicensed entrant while enabling established professionals to coordinate around a recognized standard. A language barrier can constrain access in one institution and become irrelevant in another with translation infrastructure. The researcher must specify whose possibilities are conditioned, which possibilities are at issue, and through what mechanism the conditioning occurs.

Constraints can also be inherited. Present actors confront conditions generated by earlier processes that they did not choose: debt structures, infrastructures, ecological degradation, historical exclusions, educational systems, legal categories, standards, and accumulated concentrations of capital or knowledge. Such inherited constraints can be highly durable even when no current actor intends their continuation. GRE's concern with generation therefore includes the production and transmission of constraints across time.

At the same time, constraints are often transformable. Actors can acquire resources that relax a constraint, organize collectively to alter a rule, invent technologies that change material limits, reinterpret categories, create new infrastructures,

or exit relations that previously restricted them. An intervention can also exchange one constraint for another. Credit can relax a liquidity constraint while introducing repayment obligations. Digital platforms can reduce search costs while increasing dependency on ranking systems or data infrastructures. Automation can relax labor bottlenecks while creating new capital, compute, energy, or skill dependencies. Analysis should therefore trace transformations of the constraint structure rather than classify interventions simply as constraint-reducing.

GRE also distinguishes constraint from deterministic closure. A constraint can make a transition improbable without making it impossible, and it can make a transition formally possible while rendering it practically inaccessible. Conversely, the absence of a known constraint does not imply that a possibility will be realized. Capacities, orientations, coordination, chance, and additional conditions also matter. This distinction will later be important for economic power: asymmetry can influence option spaces and the conditions under which choices are made without reducing action to mechanical determination.

3.3.4 Difference

Difference supplies the discriminations through which change, structure, and constraint can be described. In its minimal GRE sense, a difference is a non-equivalence, contrast, distinction, gradient, or differentiation that is relevant to a specified analysis. The primitive does not assume that every observable variation is economically meaningful. A difference becomes analytically consequential when it participates in identification, interaction, selection, valuation, constraint, or subsequent generation.

This distinction between variation and consequential difference is central. Two actors can differ in height without that difference affecting a particular credit relation. They can differ in legal status in a way that radically alters eligibility, bargaining, mobility, or vulnerability. Two firms can differ in size without that difference determining market power in one industry, while in another industry scale can transform access to data, compute, distribution, or finance. GRE therefore asks how a difference enters the relational configuration and what later effects follow from its recognition or operation.

Difference can be prior to a relation, produced through a relation, or amplified by a relation. Participants may enter an exchange with different resources or capabilities. The exchange may itself create new differentiation through learning, reputation, debt, ownership, or access. Repeated interactions can amplify an initially small difference through cumulative advantage or self-reinforcement. Conversely, institutions can reduce the economic consequences of a difference through insurance, universal provision, accessibility design, anti-discrimination rules, redistribution, or shared infrastructure. The economic significance lies in the generative trajectory of the difference, not merely in its presence.

Difference also participates in the constitution of categories. Economic systems routinely classify workers, firms, borrowers, residents, consumers, citizens, dependents, owners, professionals, risks, assets, and forms of labor. Such classifications make some differences institutionally salient while suppressing others. A category can convert a continuous variation into a discrete administrative distinction, or combine heterogeneous cases under one label. Once institutionalized, the classification can affect access, rights, prices, obligations, visibility, and self-understanding. Repre-

sentational differences can thereby become causally effective within economic life.

The primitive must remain distinct from inequality. Inequality is a more specific relation involving unequal quantities, positions, opportunities, burdens, capabilities, recognition, or powers. Difference is logically weaker. Heterogeneity can be economically valuable, neutral, complementary, conflictual, or unjust depending on how differences are organized and evaluated. GRE's later treatment of heterogeneous subjects depends on preserving this distinction; a plural economy need not aim at eliminating difference, while justice may require intervention when particular differences are converted into avoidable domination or exclusion.

Difference is also scale-relative. Two configurations can be equivalent for one analytical purpose and different for another. Two households may have the same income while differing in care burdens, health needs, legal status, housing security, social networks, or exposure to environmental risk. Two firms may have identical revenue while differing in ownership, dependence on a platform, ecological footprint, or accumulated knowledge. An economic representation always selects which differences to preserve. GRE therefore treats the choice of relevant difference as part of the epistemic architecture of inquiry rather than as a transparent property of the world.

This point prevents the primitive from becoming an unlimited invitation to complexity. A research design cannot preserve every difference. The analytical task is to justify which distinctions matter to the proposed generative mechanism and to test whether omitted differences undermine the explanation. Difference thus supports pluralism while remaining disciplined by the local research question.

3.3.5 Interaction among the Four Primitives

The analytical value of the primitive structure lies primarily in interaction among its terms. Change, structure, constraint, and difference should rarely be interpreted as independent explanatory variables. Each modifies the meaning and operation of the others. A difference can alter a transition; repeated transitions can stabilize a structure; a structure can convert some differences into effective constraints; a constraint can preserve a structure by narrowing available transitions; and structural change can create new differences and remove old ones.

Consider a simple economic sequence. Two actors begin with a difference in access to finance. An institutional structure determines which forms of collateral are recognized. That structure constrains borrowing possibilities differently across the actors. The resulting difference in investment capacity alters later income, asset ownership, reputation, and access to finance. Repetition can stabilize a configuration in which the original difference is amplified and incorporated into a more durable structure. The example does not require the researcher to declare wealth, creditworthiness, institutions, or even the actors themselves to be ontological primitives. It can begin from transformations, patterned organization, conditioned possibilities, and consequential distinctions, then introduce richer objects as the analysis becomes empirically specific.

The same primitive structure can describe generative expansion. Shared infrastructure may reduce a constraint on participation. Increased participation can create new differences in specialization and knowledge. Those differences can support a more complex division of labor. The emerging structure can generate additional resources, standards, and coordination capacities, which further relax some constraints

while creating new ones. Generativity therefore need not mean monotonic liberation from constraint. New capabilities often depend on newly stabilized structures whose operation introduces obligations, dependencies, standards, or maintenance requirements.

The interaction among primitives also permits recursive analysis. A structure can constrain change, while changes can transform the structure. A difference can be produced by a constraint, while the resulting difference can later modify the constraint through political organization, market power, technological innovation, or institutional recognition. Constraint structures can become objects of economic investment; differences can become commodities, credentials, rankings, or legal statuses; structures can be deliberately designed; and change itself can be governed through procedures that determine how rules may be revised.

This recursion provides a bridge to the stronger GRE question concerning transformation of effective rules of change. At an initial analytical level, a researcher may ask how a configuration changes under a specified structure and set of constraints. At a second level, the inquiry can ask how those structures and constraints themselves change. At a third level, the procedures or mechanisms through which structures and constraints are transformed may become objects of inquiry. The primitive vocabulary can therefore support increasingly reflexive analysis without assuming that a single immutable law governs every level.

A useful discipline follows from this interaction: explanations should specify which primitive role a concept is playing at a given moment. The same institution can be treated as structure when its internal organization matters, as constraint when it conditions an actor's options, as difference when membership distinguishes eligible from ineligible actors, and as an object of change when reforms alter its operation. These descriptions are compatible because they answer different analytical questions. Confusion arises when movement among them occurs without being stated.

The primitive framework is therefore better understood as a grammar than as a taxonomy. It organizes questions about transformation without assigning each empirical object to one permanent category. This flexibility is important for economic inquiry because the same phenomenon can change analytical status across scale and time. Money can be a resource in one analysis, a relation of credit in another, an institutional structure in a third, a symbolic representation in a fourth, and a constraint through liquidity requirements in a fifth. The primitives do not replace these richer categories; they clarify how such categories can be introduced without assuming their universality in advance.

3.3.6 Emergence of Stable Configurations

GRE requires relatively stable objects because economic inquiry cannot proceed by treating every moment as ontologically unique. Contracts, firms, households, states, currencies, property rights, professions, platforms, resources, and subjects must often be tracked across time. The primitive framework therefore needs an account of how stability can become analytically legitimate without turning stability into primordial substance. The concept of *stable configuration* supplies that bridge.

A stable configuration is a patterned organization whose continuity is sufficient for a specified analytical purpose across a relevant interval, scale, or set of transforma-

tions. Stability can arise through several mechanisms: material durability, repeated interaction, institutional recognition, legal enforcement, habit, technical standards, ecological reproduction, feedback, coordinated expectations, memory, documentation, or continual maintenance. These mechanisms need not produce permanence. They produce enough persistence or recurrence for the configuration to function as an identifiable object within the inquiry.

The phrase *sufficient for a specified analytical purpose* is crucial. A corporation can be treated as the same legal entity across changes in personnel and assets, while an organizational ethnography may treat those same changes as constitutive transformations. A currency can remain nominally the same while inflation alters its purchasing power and institutional reforms alter its governance. A household can persist administratively while membership changes. Entityhood is therefore resolution-dependent. GRE treats an entity as analytically real where the stability of a configuration supports explanation, measurement, interpretation, intervention, or coordination at the chosen scale.

Relations can stabilize in the same way. A relation need not be continuously active in order to persist. A debt relation remains operative between payments; a property relation persists while the owner is absent; a professional relation can survive periods without interaction; an institutional hierarchy can remain in force outside moments of explicit command. Persistence can depend on documents, expectations, enforcement, memory, infrastructure, or recognized roles. A stable relation is therefore more than repeated contact, yet it need not be a metaphysically independent object.

Stable configurations can also acquire causal and generative efficacy. Once a classification is institutionalized, it can govern eligibility. Once a platform becomes infrastructure, it can condition market access. Once a professional credential stabilizes, it can shape labor-market sorting. Once a norm becomes widely expected, deviations can become costly even without formal enforcement. An emergent configuration can thus become part of the structure and constraint environment faced by later actors. Ontological emergence and generative recursion meet at this point: what was produced through earlier processes becomes a condition of later processes.

Stability should also be distinguished from desirability, efficiency, and equilibrium. A configuration can persist because exit is costly, alternatives are suppressed, coordination failure prevents change, or power reproduces the relevant conditions. Another configuration can be beneficial yet fragile because its maintenance depends on scarce resources or voluntary cooperation. GRE therefore treats persistence as an empirical property requiring explanation rather than as evidence of optimality.

The emergence of stable configurations gives GRE a principled basis for introducing richer objects in the next section. Entities, subjects, relations, resources, values, fields, institutions, and symbolic objects can be treated as first-class economic objects when their organization is sufficiently stabilized and their distinctions matter to the research problem. Their status remains historically and analytically conditioned. Stability licenses local objecthood; it does not establish final ontology.

3.3.7 Ontological Suspension

Ontological suspension is the discipline that keeps this primitive framework from becoming a dogmatic metaphysics. It means withholding claims about the ultimate con-

stitution of economic reality when stronger ontological commitments are unnecessary for the local inquiry. Suspension permits the researcher to use entities, relations, processes, fields, networks, states, events, or other representations where they are analytically productive while keeping open the possibility that another representation may reveal different aspects of the same empirical configuration.

Suspension differs from ontological denial. GRE does not claim that entities are unreal because they are relationally constituted, that relations are unreal because they are represented through models, or that institutions are mere descriptions because they depend on recognition. A bank account, legal status, debt, organization, or technical standard can have robust economic consequences. Ontological suspension concerns the level of metaphysical assertion attached to those consequences. The researcher can treat an object as real and causally relevant within an inquiry without claiming that its current representation exhausts what the object is.

This position also differs from unrestricted constructivism. Economic objects can resist interpretation, produce unexpected effects, and impose material constraints regardless of the researcher's preferred description. A bridge has load limits; an ecosystem can be degraded; a debt contract can be enforced; a platform can deny access; a person can become exhausted. Ontological suspension does not dissolve these realities into discourse. It requires the analyst to distinguish the empirical resistance of a configuration from the categories used to describe it.

The discipline is especially important when formal methods are used. A graph can represent relations among nodes, a state space can represent possible configurations, a field can represent distributed conditions, and a simulation can explore consequences of specified rules. Each representation can be rigorous within its assumptions. None acquires metaphysical authority merely from mathematical precision. GRE therefore asks what distinctions the representation preserves, what it suppresses, which mechanisms it assumes, and whether alternative representations change the substantive conclusion.

Ontological suspension also supports interdisciplinary communication. Economics, law, sociology, history, ecology, computer science, and philosophy can represent the same situation through different objects. A platform worker can appear as a labor supplier, contractual party, legal claimant, network node, data-generating user, organizational participant, or historically situated subject. These representations can conflict in specific claims while remaining jointly informative. GRE should compare their explanatory consequences before treating one vocabulary as universally privileged.

Finally, suspension creates a condition for theory revision. If entities, relations, and categories were fixed as final primitives, evidence that their boundaries change would threaten the coherence of the framework. A suspended ontology permits categories to be reconstructed when historical change reveals their limits. This revisability is particularly important to a programme concerned with the generation of new economic objects, technologies, institutions, and forms of subjecthood.

3.3.8 Multiple Realizations and Ontological Plurality

A minimal primitive structure also allows economically meaningful objects to have multiple realizations. The same functional or institutional role can be sustained through different material, organizational, legal, or relational configurations. Pay-

ment systems can be realized through cash, bank deposits, cards, mobile platforms, or other infrastructures. Collective production can be organized through firms, cooperatives, public institutions, households, commons, or loosely coordinated networks. Credentialing can be performed by universities, professional bodies, states, platforms, or community institutions. What counts as the same economic object therefore depends partly on the level at which equivalence is being claimed.

Multiple realization should not be confused with identity. Two configurations can perform similar functions while differing in power relations, vulnerability, ecological cost, accessibility, governance, or downstream generativity. A public payment infrastructure and a proprietary platform may both enable transactions while generating different dependencies and data relations. Two educational systems may produce comparable test scores while differing in social networks, institutional recognition, stress, curiosity, or future opportunity. GRE consequently treats functional equivalence as one possible relation among configurations rather than as proof that their broader economic consequences are equivalent.

The converse problem also occurs: similar manifestations can arise from different generative structures. Two workers can report the same income while one depends on a stable employment relation and the other on volatile platform work. Two firms can display the same output while one relies on durable local capabilities and the other on fragile external supply chains. Two communities can exhibit similar consumption while differing in debt burdens, ecological dependencies, public infrastructure, or informal care. Observable similarity therefore does not guarantee generative similarity.

Ontological plurality follows from these possibilities. GRE can permit several ontologies or representational schemes to coexist when they preserve different distinctions relevant to the research question. An entity-centered model may be adequate for one task, a network representation for another, a process account for a third, and a field-like description for a fourth. Plurality is disciplined by explanatory and evidential adequacy rather than by an assumption that every representation is equally useful.

This pluralism has limits. Representations can contradict evidence, conceal relevant mechanisms, or impose categories that systematically misdescribe the subjects they classify. A plurality of possible descriptions does not eliminate standards of criticism. GRE should ask whether a representation preserves the differences relevant to the claim, whether its boundaries are justified, whether its entities remain stable enough for the inference being made, and whether alternative representations produce materially different conclusions. Ontological plurality therefore increases the burden of comparison rather than removing it.

Multiple realization also matters normatively. Policies often target administratively standardized objects such as households, firms, jobs, schools, or regions. If those categories have heterogeneous realizations, identical interventions can generate unequal effects. A household with the same measured income can face different care obligations; a firm of the same size can possess different network dependencies; a school with similar resources can operate within different linguistic, social, or infrastructural conditions. GRE's later analysis of heterogeneous subjects and values depends on recognizing that categorical sameness can coexist with generatively consequential difference.

The primitive structure developed in this section therefore establishes a deliber-

ately modest ontological foundation for the programme. Change identifies transformation without presupposing a fixed bearer. Structure identifies patterned organization without requiring stasis. Constraint identifies the conditioning of possible transformation without implying deterministic closure. Difference identifies relevant non-equivalence without equating difference with inequality. Their interaction can generate relatively stable configurations that become legitimate objects of economic inquiry at specified scales and times. Ontological suspension prevents these objects from hardening prematurely into universal primitives, while multiple realization and ontological plurality preserve the possibility that comparable economic functions can be sustained through different configurations and that similar observations can arise from different generative histories.

This architecture is intentionally incomplete. It supplies the minimal conceptual conditions under which richer objects can be introduced; it does not yet specify which objects GRE should study. The next section can therefore move from primitive structure to the heterogeneous economic objects that become available once relative stability, analytical scale, and ontological suspension have been established.

3.4 Objects of GRE Inquiry

The primitive structure developed in Section 3.3 allows GRE to introduce richer objects without treating their present boundaries as metaphysically final. The role of this section is to specify the principal classes of objects that GRE may take as economically relevant once relative stability, analytical scale, and ontological suspension have been established. Its objective is taxonomic rather than exhaustive: to identify a working repertoire of objects through which relational and generative economic processes can be investigated. The discussion proceeds from emergent entities and subjects to relations, resources and capacities, value, conditions and constraints, fields, temporal objects, institutions, and symbolic or representational objects. Its method is constitutive and pluralist. Each category is defined by the analytical work it can perform, while overlap among categories remains permissible where an empirical configuration supports several descriptions.

An *object of inquiry* in GRE is therefore an analytically stabilized referent around which a research question, body of evidence, mechanism claim, comparison, or intervention can be organized. Objecthood in this sense is local to an inquiry. A firm may be treated as an entity when the question concerns ownership or output, as a relational configuration when the question concerns authority and contracting, as an institutionally recognized subject when the question concerns legal responsibility, and as a trajectory when the question concerns organizational transformation. These descriptions are compatible when they preserve different economically consequential distinctions. GRE does not require a single vocabulary to carry every explanatory burden.

The admissibility of an object depends on several disciplines. Its boundary should be sufficiently explicit for the claim being made. Its persistence should be adequate to the temporal resolution of the inquiry. The evidence used to characterize it should correspond to the dimensions under discussion. Its role in a mechanism should be distinguished from the representation through which that role is inferred. Finally, the analyst should remain attentive to whether the object itself changes through the pro-

cesses being studied. A category useful at the beginning of an inquiry can require revision if its constitutive relations, internal heterogeneity, or practical meaning change during the relevant history.

The categories below are therefore best understood as a research grammar. They help determine what GRE can study without implying that economic reality is naturally partitioned into ten mutually exclusive classes. Many of the most important GRE questions arise precisely where an object moves across categories: a resource becomes a capability, a repeated relation stabilizes into an institution, a symbolic classification becomes a material constraint, an event redirects a trajectory, or a distributed field of conditions contributes to the emergence of a new economic subject. The taxonomy is designed to preserve those transformations rather than eliminate them through premature classification.

3.4.1 Emergent Economic Entities

Economic analysis routinely refers to persons, households, firms, states, markets, sectors, technologies, assets, platforms, infrastructures, and other entities. GRE retains these objects while treating their entityhood as historically and analytically conditioned. An emergent economic entity is a relatively stabilized configuration that can be tracked as a distinguishable unit because some combination of boundary, continuity, recognition, organization, or causal coherence persists across the interval relevant to the inquiry.

Relative stability is central. A corporation can remain the same legal entity while employees, ownership shares, technologies, contracts, products, and internal authority change. A household can remain administratively recognizable while membership, dependency relations, income sources, and care obligations vary. A market can persist as a named domain while its technologies, participants, rules, and geographic reach are transformed. GRE can treat each as an entity when the continuity is sufficient for the local question, while preserving the possibility that another question requires decomposition of the apparent unit.

Entity boundaries can arise through several mechanisms. Law creates juridical boundaries around corporations, contracts, property, and public authorities. Accounting creates reporting boundaries around organizations and transactions. Technical architectures distinguish users, devices, accounts, services, and platforms. Social recognition can stabilize occupations, communities, or organizational identities. Material organization can generate boundaries through infrastructure, geography, or ecological dependence. These boundaries differ in durability and authority. A legal boundary may remain stable while operational relations cross it extensively; an informal organization may have no independent legal personality while displaying strong internal continuity.

The economic significance of entityhood therefore depends partly on what the boundary permits the entity to do. Recognition can make ownership, contracting, taxation, liability, borrowing, representation, or participation possible. Entity formation can pool resources, concentrate decision rights, create collective capabilities, or separate responsibility. It can also obscure internal asymmetries by presenting a heterogeneous configuration as a single actor. Treating a firm, household, state, or community as one unit can be analytically efficient while suppressing differences in who decides, who bears risk, who receives value, and who remains unrepresented.

Entity emergence can itself become an object of explanation. A group of workers can become an organization; a technical project can become a firm; a loose exchange environment can become a recognized market; a digital protocol can acquire institutional governance; a collective practice can become a sectoral standard. GRE is interested in the conditions through which such configurations become sufficiently stable, recognized, resourced, and reproduced to acquire economic consequences as entities. The transition from diffuse activity to recognized entity can alter access to finance, law, infrastructure, legitimacy, and bargaining power.

Entities can also dissolve, fragment, merge, or migrate across classifications. Insolvency can dissolve a firm while parts of its productive capacity survive elsewhere. A public service can be privatized while its infrastructure remains materially continuous. A platform can reclassify workers without changing the practical dependence through which labor is organized. These cases show why GRE treats entity identity as a question of maintained distinctions rather than a self-evident fact.

The category of emergent economic entity consequently supplies a practical unit of analysis while keeping three questions open: which relations stabilize the entity, which boundaries make the entity economically actionable, and which transformations would make the existing entity description inadequate. These questions connect entity analysis to the remaining object classes rather than isolating entities from them.

3.4.2 Subjects and Subject Positions

Subjects form a distinct class because economic participation involves more than the persistence of an entity. A subject occupies positions from which action, claim-making, evaluation, vulnerability, responsibility, recognition, or experience becomes economically consequential. GRE therefore distinguishes the existence of an entity from the constitution of a subject position. A corporation can be a juridical subject for some purposes without possessing human experience; a person can exist as a biological and social individual while being denied effective recognition as a worker, claimant, owner, borrower, resident, or political participant.

A *subject position* is a relationally and institutionally organized location from which rights, expectations, obligations, opportunities, exposures, or forms of agency become available. Employment status, citizenship, tenancy, creditor status, professional accreditation, platform membership, consumer classification, and eligibility for public support are examples of positions that configure economic possibilities. Such positions are often produced jointly by law, organizational rules, records, classifications, infrastructures, and recognition by other actors.

Subject positions can therefore change without the underlying person or organization disappearing. A worker can move from employee to contractor; a resident can gain or lose eligibility for a service; a borrower can be reclassified by a credit system; a community can become formally recognized as an eligible governance unit; a software agent can be delegated limited transactional authority. Each change modifies what the subject can do, what others may demand from it, and which relations become economically available.

GRE is especially interested in the generative consequences of these positions. A position can enable access to income, credit, education, information, legal remedies, social networks, or institutional voice. It can also create dependency, surveillance,

liability, exclusion, or constrained exit. Because positions mediate later capacities, subject formation is not merely a descriptive question about identity. It can become part of the economic mechanism through which future options are generated or foreclosed.

This perspective also preserves the difference between subjecthood and agency. A subject can be strongly constrained while remaining economically consequential. Children, persons under guardianship, refugees, patients, dependents, or algorithmically classified users can occupy economically important positions even where their formal decision authority is limited. Conversely, an actor with substantial operational agency can remain weakly recognized within a legal or moral order. GRE should therefore specify which dimension of subjecthood matters to the inquiry: capacity to act, capacity to experience, standing to claim, institutional recognition, representation, accountability, or exposure to consequences.

Heterogeneity within subject categories is equally important. Administrative categories such as household, worker, consumer, student, patient, migrant, or firm can contain subjects with markedly different capacities and dependencies. Treating category membership as sufficient description can obscure differences in language, disability, care obligations, wealth, access to networks, legal status, technical literacy, or exposure to institutional power. A GRE analysis can preserve the usefulness of the category while examining how its practical realization varies among subjects.

Subject positions can also be collectively constituted. A union, cooperative, community association, indigenous polity, professional body, or informal collective can acquire forms of representation and bargaining capacity that are unavailable to isolated members. Collective subjecthood can reorganize the field of negotiation, create shared resources, and alter the conversion of individual grievances into actionable claims. The relevant object is then neither a simple aggregate of persons nor a timeless collective substance. It is a stabilized configuration of representation, recognition, organization, and capacity.

The category will later support GRE's more detailed inquiry into human and artificial economic subjects. At the constitutional level, the key point is narrower: subjecthood is an economic object whenever the positions from which actors participate, experience consequences, make claims, or become governable are themselves generated, maintained, or transformed through economic relations.

3.4.3 Relations and Relational Configurations

Relations are central objects of GRE because economic consequences frequently depend on how actors, resources, institutions, and conditions are connected. A relation can involve exchange, authority, dependence, care, credit, ownership, recognition, information, obligation, trust, competition, cooperation, representation, access, or other structured forms of connection. GRE treats the relation itself as analytically available when its persistence, terms, or consequences matter to the research question.

Relations vary in their constitution. Some are formally specified through contracts, law, accounting, organizational rules, or technical protocols. Others depend on repeated practice, trust, custom, shared expectations, social proximity, or tacit coordination. Some are symmetric in a relevant dimension; others distribute authority, information, risk, or exit options asymmetrically. A relation can remain formally

unchanged while its practical content shifts because one party's outside options, dependence, knowledge, or institutional protection changes.

Dyadic representation is useful for many questions, yet GRE also recognizes relational configurations that cannot be adequately decomposed into independent pairs. Supply chains, families, teams, communities, standards ecosystems, financial systems, platform markets, and public infrastructures often involve higher-order or multilayer dependencies. The significance of one tie can depend on the presence of several others. A credit relation, for example, can depend on legal enforceability, informational infrastructure, collateral arrangements, reputational systems, and monetary institutions. A labor relation can depend on household reproduction, immigration status, local labor demand, professional credentials, and collective bargaining institutions.

A *relational configuration* therefore refers to an organized set of relations whose joint structure has economically consequential properties. Concentration, brokerage, segregation, reciprocity, redundancy, hierarchy, mutual dependence, and network closure can arise at the configuration level. These properties may affect bargaining power, diffusion, resilience, access, vulnerability, and capacity formation even when no single relation carries the full explanation.

GRE also distinguishes relations that connect already stabilized objects from relations that contribute to the constitution of those objects. A contract between two established firms may primarily coordinate exchange. Repeated recognition relations can help constitute a professional status. Care relations can contribute to the maintenance of persons' capabilities. Membership relations can constitute an organization. Legal relations can create ownership or corporate personality. The analytical question is therefore whether the relation is external to the identity relevant for the model, partly constitutive of it, or generative of a new stabilized object.

Relations can persist through material and symbolic infrastructures. A debt relation may be maintained through records and enforcement institutions; a platform relation through accounts, interfaces, ranking systems, and data; a professional relation through credentials and reputational networks. These mediating objects matter because they can change the relation without changing its nominal category. Digitization, automation, or legal reform can intensify monitoring, alter bargaining positions, reduce transaction costs, or enable new forms of exclusion within an apparently familiar relationship.

Relation formation and relation removal are themselves economically consequential events. Access to a mentor, lender, market, transport system, care network, professional community, or knowledge infrastructure can transform later opportunity. Loss of a relation can destroy capability even when material possessions remain unchanged. GRE therefore studies relational portfolios and configurations alongside stocks of individually held resources.

This category supplies the most direct bridge between the programme's relational commitment and ordinary economic inquiry. GRE does not require every explanation to be relation-first. It requires the analyst to make relation-dependent mechanisms visible where they materially alter economic outcomes, value trajectories, subject positions, or future generative conditions.

3.4.4 Resources and Capacities

Resources and capacities are distinct objects because possession or access does not by itself determine what an economic subject can do. A resource is something that can be mobilized, accessed, consumed, transferred, invested, preserved, or combined within an economic process. A capacity concerns an ability or practical possibility to act, produce, learn, adapt, participate, maintain, transform, or generate further possibilities. The relation between the two is mediated by context, institutions, skills, relations, infrastructure, bodily conditions, ecological conditions, and other conversion factors.

Resources can be material, financial, informational, institutional, social, technical, ecological, or symbolic. Land, equipment, money, time, data, legal rights, public infrastructure, credentials, reputation, access to a network, and environmental quality can each function as resources under appropriate conditions. Their resource character is relational because usefulness depends on what a subject can access and convert within a particular configuration. A database inaccessible to a community, a credential unrecognized by employers, or capital without complementary infrastructure can have limited practical value despite nominal possession.

Capacities likewise occur at several levels. Individuals can possess capacities for work, learning, judgment, mobility, communication, care, and political participation. Organizations can possess capacities for production, coordination, innovation, maintenance, adaptation, compliance, or collective learning. Communities can possess capacities for mutual support, governance, cultural reproduction, ecological stewardship, and collective action. Infrastructures can support capacities by making transport, communication, payment, identification, or knowledge access possible across many subjects.

GRE gives special attention to *generative capacity*: the ability of a configuration to produce or support further economically consequential possibilities. Education can generate later learning capacity; institutional trust can reduce coordination costs and enable cooperation; a research infrastructure can generate future knowledge; public health can preserve productive and participatory capacity; ecological regeneration can sustain future material possibility. Generative capacity is therefore temporally extended and often distributed across relations rather than located wholly inside a single actor.

The distinction between resource and capacity also clarifies why equal allocation can produce unequal outcomes. Subjects receiving identical monetary transfers can face different housing markets, care obligations, health conditions, legal statuses, network access, or local infrastructure. The same nominal resource can therefore generate different effective possibilities. Conversely, subjects with different resource bundles can sometimes realize comparable capabilities through different conversion arrangements. GRE is interested in the relational conditions that mediate these transformations.

Resources and capacities can also be depleted, captured, transferred, or rendered obsolete. Skill can lose market value after technological change; social capital can erode through displacement; ecological capacity can be exhausted; institutional capacity can decay through underinvestment; a public infrastructure can become inaccessible through privatization or pricing. These processes matter even when short-run output or consumption remains stable because they alter the future space of ac-

tion.

Collective and relational capacities deserve separate attention. Some capacities exist only through coordination among several subjects. A payment system, scientific community, emergency-response network, common resource regime, or democratic institution cannot be reduced to the sum of individual skills. Their capability depends on maintained relations, standards, trust, interoperability, authority, and shared infrastructures. Disruption of those relations can destroy a collective capacity while leaving individual resources physically intact.

GRE therefore treats resources and capacities as related but non-equivalent economic objects. Resource analysis asks what is available and under whose control. Capacity analysis asks what actions or transformations become practically possible. Generative analysis adds a further temporal question: how does the use, distribution, or transformation of present resources and capacities alter the production of later capacities?

3.4.5 Value and Forms of Value

Value is an object of GRE inquiry whenever economic relations create, recognize, transform, circulate, convert, preserve, capture, dissipate, or contest something treated as valuable. The category includes monetary price while extending beyond price to forms of value whose realization depends on use, relation, recognition, institutional standing, ecological condition, cultural meaning, capability, or future generativity. GRE therefore studies both valued objects and the processes through which value becomes intelligible, actionable, and convertible.

Forms of value should remain differentiated. Market value can be expressed through exchange prices under specified institutional conditions. Use value concerns usefulness relative to purposes and users. Social and relational value can depend on participation, belonging, trust, recognition, reciprocity, or the quality of continuing relations. Cultural and symbolic value can depend on meaning, status, heritage, identity, or collective recognition. Ecological value can concern the maintenance of living systems and material conditions that support present and future activity. Generative value concerns the production or return of capacities, resources, relations, knowledge, infrastructures, or other conditions that enable further generation.

These forms can interact without becoming automatically commensurable. A forest can carry market value as timber, ecological value as habitat and water regulation, cultural value for a community, and generative value through the capacities it sustains over time. A university can generate wages and patents while also producing credentials, knowledge, networks, civic capacity, and symbolic standing. A care relation can involve paid labor, emotional significance, capability maintenance, and institutional responsibility. GRE's task is to track these dimensions with enough separation to avoid converting plurality into a single metric before the research question justifies such conversion.

Valuation is therefore as important as value. Institutions, markets, professional communities, households, algorithms, legal systems, and cultural practices establish procedures through which some properties become visible and comparable. Accounting standards recognize certain assets and liabilities; credit systems assign risk categories; rankings convert heterogeneous characteristics into ordered representations;

markets translate bids and offers into prices; communities maintain values that remain outside formal exchange. These valuation processes can affect the objects being valued by changing access, incentives, recognition, or behavior.

Value conversion creates a particularly important object of inquiry. Economic processes frequently transform one form of value into another: knowledge into income, reputation into access, public infrastructure into private profit, ecological resources into commodities, care into labor-market participation, or symbolic recognition into political and economic influence. Conversion interfaces distribute power because actors differ in their ability to authorize, measure, appropriate, or resist conversion. The same relation can generate value for several parties while allowing only some of that value to be captured or monetized.

Value can also propagate beyond the initial transaction. Education provided to one person can contribute to household well-being, organizational capability, future teaching, or community knowledge. A technological standard can create value for complementary producers. A public transport investment can alter labor-market access and land values. These effects need not be reducible to externalities in a narrow sense; GRE can examine the pathways through which value becomes distributed across relational configurations and time.

Normative value requires additional care. Something can be economically valued without being normatively desirable, and a normatively important condition can remain weakly priced or administratively invisible. Profitability, efficiency, social importance, justice, and generativity are separate evaluative dimensions. Later normative sections of the programme can specify how such dimensions are assessed. At the object level, GRE preserves their distinction so that descriptive value processes do not silently determine normative conclusions.

Value thus enters GRE as a heterogeneous and dynamic object. The central questions concern which form of value is at issue, who recognizes it, through which relations it is produced or realized, how it moves or converts, who can capture it, what is lost in conversion, and how present valuations alter future generative conditions.

3.4.6 Conditions and Constraints

Economic action unfolds within conditions that shape which transitions are feasible, costly, legitimate, intelligible, or sustainable. GRE treats these conditions as objects when their distribution or transformation materially affects economic possibility. A *constraint* is a condition that restricts, redirects, or differentially prices possible action; an enabling condition expands or stabilizes practical possibility. The same configuration can perform both roles for different subjects, actions, or timescales.

Conditions can be material, ecological, institutional, legal, technical, social, epistemic, temporal, or spatial. Transport infrastructure affects geographic access; legal status conditions eligibility and enforceability; technical standards condition interoperability; language affects participation in institutions and markets; ecological limits shape production possibilities; time scarcity constrains care and learning; data access conditions computational capability; public safety affects mobility and investment. These conditions often operate before any explicit transaction occurs.

Constraints vary in strength. Some prohibit action through law or physical impossibility. Others increase cost, uncertainty, delay, or risk. Still others operate probabilistically by making some pathways easier to reproduce than others. A weak broadband

connection, lack of childcare, inaccessible documentation, reputational stigma, or absence of collateral may not formally prohibit participation, yet each can substantially reduce practical access. GRE therefore studies the topology of feasible action rather than equating freedom with formal permission alone.

Constraints can also be relationally generated. Bargaining dependence can restrict exit; debt can condition future income allocation; platform design can constrain visibility; organizational hierarchy can restrict decision rights; social obligations can direct resource use; network position can limit access to information or opportunities. These constraints arise through relations and can persist even where no single actor consciously designs them.

Enabling conditions deserve equal analytical standing. Public infrastructure, trust, open standards, education, legal protection, care systems, stable ecological conditions, and interoperable institutions can make action possible across broad populations. Their economic contribution may be difficult to assign to individual transactions because they operate as background capacities. GRE can bring such enabling structures into view by asking which later activities depend on their continued reproduction.

Conditions can become endogenous to the processes they condition. Industrial activity can degrade ecological conditions; investment can improve infrastructure; repeated discrimination can reshape expectations and network access; successful coordination can build trust; institutional reform can alter transaction costs and enforcement. A condition that is treated as fixed in one local model can therefore become an outcome in a wider temporal or system boundary.

This category is especially important for intervention analysis. Policies frequently act by changing conditions rather than directly producing final outcomes. A guarantee changes perceived risk; a public option changes outside alternatives; a legal recognition changes standing; a subsidy changes relative cost; an information system changes observability. GRE can study these interventions by tracing how modified conditions alter relations, capacities, subject positions, and later trajectories.

Conditions and constraints thus provide the connective tissue between current configuration and future possibility. Treating them as first-class objects allows GRE to examine why identical resources or formal rights can generate different practical outcomes across subjects and contexts.

3.4.7 Fields and Distributed Structures

Some economic conditions are best represented as distributed structures rather than as possessions or pairwise relations. GRE uses the term *field* cautiously for configurations in which opportunities, pressures, meanings, incentives, risks, or capacities vary across a domain and affect actors partly through their position within that distribution. The field concept is an analytical resource rather than a commitment that social reality literally instantiates a physical field.

A distributed structure can be spatial. Land prices, transport access, pollution exposure, labor demand, public services, broadband quality, and ecological conditions vary across geographic space. It can also be institutional or social. Prestige, professional opportunity, credit access, political influence, or informational visibility can vary across positions in a social or organizational configuration. Digital environments add further domains in which ranking, recommendation, search visibility, platform rules, and data access are unevenly distributed.

Field-like representation is useful when the relevant condition cannot be assigned cleanly to a single actor or relation. A local labor market exerts pressures that emerge from many employers, workers, institutions, transport networks, regulations, and expectations. A scientific field distributes prestige and attention through journals, institutions, funding systems, peer networks, and disciplinary categories. A financial environment shapes borrowing conditions through monetary policy, risk assessment, regulation, liquidity, and market expectations. No isolated tie carries the entire condition.

GRE can therefore study how distributed structures affect the formation and transformation of local relations. A person entering a region with abundant public transport and dense employment opportunities faces a different opportunity structure from an otherwise similar person in a poorly connected region. A small firm operating within an interoperable technical ecosystem faces different generative possibilities from one locked into a proprietary infrastructure. A researcher positioned in a highly visible institutional environment encounters different pathways for recognition and collaboration.

Fields can also be produced by accumulated local actions. Residential sorting can generate spatial concentrations; repeated investment can create technological clusters; platform participation can generate data advantages; institutional prestige can become self-reinforcing through hiring, funding, and citation. The distributed condition then feeds back into later local decisions. GRE is especially interested in these recursive situations because a field generated by past relations becomes a condition for future relation formation.

Boundaries of a field require explicit justification. The relevant domain may be a neighborhood, labor market, profession, platform ecosystem, jurisdiction, linguistic community, supply network, or ecological region. Different boundaries can reveal different gradients and dependencies. The researcher should therefore state what is distributed, across which domain, how position is measured, and which mechanism links the distributed structure to observed outcomes.

Field representations also help avoid attributing every effect to intentional action by identifiable actors. Unequal opportunity can arise through distributed historical structures even when no single current actor controls the whole configuration. At the same time, distributed structure does not imply absence of power. Some actors may possess disproportionate capacity to shape the field through infrastructure ownership, rule setting, investment, standardization, or control of classification systems.

Fields and distributed structures therefore enter GRE as meso- and macro-level objects that connect local relations with wider conditions. They prepare the transition to the next section's analysis of levels and scales by showing that the same economic process can be experienced locally while depending on structures distributed across a much larger domain.

3.4.8 Processes, Events, and Trajectories

GRE requires temporal objects because generation is inherently concerned with how present configurations produce later conditions. Processes, events, and trajectories provide three complementary ways of organizing temporal analysis. A process is an extended pattern of transformation or reproduction; an event is a temporally localized occurrence that changes or reveals a configuration; a trajectory is an ordered

history through a sequence of states, positions, relations, or regimes.

Processes can include accumulation, learning, institutionalization, technological diffusion, ecological degradation, care, maintenance, financialization, organizational growth, migration, professionalization, or the reproduction of inequality. Their identity depends on a pattern that persists through time even though the participating entities and local actions can change. Process analysis asks which mechanisms sustain the pattern, what inputs and relations it requires, and under which conditions its direction or intensity changes.

Events are analytically useful when temporally concentrated occurrences reorganize later possibilities. A bankruptcy, legal judgment, policy reform, infrastructure failure, technological release, merger, protest, disaster, discovery, or institutional recognition can redirect relations and expectations. The significance of an event is relational to its surrounding history. The same formal event can have different effects depending on preparedness, institutional capacity, network structure, or prior accumulation.

Trajectories preserve ordered history. Two subjects can arrive at similar present outcomes through different paths that leave different capacities, obligations, networks, expectations, or vulnerabilities. Equal current income can follow stable professional advancement, volatile gig work, inherited wealth, debt-financed education, or recent displacement. A cross-sectional measure can therefore conceal generatively important histories. GRE uses trajectory analysis to ask how sequences of relations and events shape present and future possibility.

Path dependence can arise through several mechanisms. Earlier choices can create switching costs, complementary investments, habits, classifications, reputational effects, or network structures that condition later choices. Institutional arrangements can make some transitions progressively easier and others harder. Learning can create cumulative capability. Trauma or depletion can reduce future adaptability. These mechanisms differ, so trajectory dependence should be specified rather than invoked as a generic explanation.

Temporal objects also allow GRE to distinguish maintenance from change. A stable institution or capacity may require continuous process. Public infrastructure must be repaired; professional competence maintained; ecosystems regenerated; trust reproduced; data updated; organizations staffed. A snapshot can therefore make a dynamically maintained condition appear static. Process analysis reveals the labor, resources, relations, and constraints required for persistence.

The timescale of a trajectory matters. A policy can improve short-run consumption while weakening long-run fiscal capacity; a technology can raise output while generating ecological or skill dependencies; a cost-cutting strategy can increase current profit while degrading organizational knowledge. GRE consequently studies trajectories across timescales rather than treating the immediate effect as a sufficient description of economic consequence.

Processes, events, and trajectories can themselves interact. An event can initiate a process; a process can accumulate conditions that make an event consequential; a trajectory can cross a threshold that changes the process governing subsequent evolution. These temporal objects therefore provide the language needed to connect current intervention with future generative structure.

3.4.9 Institutions and Social Facts

Institutions and social facts are objects of GRE because economic possibilities are stabilized through rules, roles, classifications, expectations, conventions, recognized statuses, and recurring practices that exceed isolated transactions. Institutions organize who may act, under what authority, through which procedures, with which forms of recognition, and under which expectations of continuity. Social facts include collectively sustained realities whose economic consequences depend on shared recognition, repeated practice, or institutional support.

An institution should be distinguished from an organization. An organization is a relatively bounded collective entity; an institution is a stabilized pattern of rules, roles, norms, or practices that can operate across many organizations. A university is an organization, while credentialing practices, academic tenure, disciplinary review, or degree recognition are institutional arrangements. A bank is an organization, while money, deposit insurance, accounting standards, or secured lending involve wider institutions. The distinction matters because organizational change can occur within persistent institutions, and institutional change can reorganize many organizations simultaneously.

Institutions stabilize expectations. Contract law affects the expected consequences of agreement; property regimes organize control and transfer; professional licensing structures entry; welfare systems define eligibility; labor law configures employment relations; standards coordinate interoperability. This stabilization can reduce uncertainty and make complex cooperation possible. It can also preserve historically produced asymmetries by assigning differential rights, burdens, recognition, or access.

Social facts can become economically real through collective recognition and practical enforcement. Currency, credentials, corporate status, property claims, rankings, occupational categories, and reputations depend partly on recognition while producing material consequences. Their socially constituted character does not weaken their reality. A person denied a credential, account, license, or legal status can face direct material exclusion even though the relevant object exists through institutional and representational practices.

GRE is interested in how institutions are generated and reproduced. Repetition can stabilize conventions; law can formalize existing practices; administrative categories can create new subject positions; technical infrastructures can embed rules into routine action; organizations can reproduce institutions through hiring, reporting, and compliance. Institutional persistence therefore requires material, symbolic, and relational supports that can themselves become objects of economic analysis.

Institutions also transform the value and meaning of other objects. A dwelling becomes mortgageable property under specific legal and financial institutions. Data become tradable or restricted through regulatory and contractual regimes. A skill becomes economically valuable when recognized by employers or credentialing systems. A relationship becomes taxable, insurable, or legally protected when institutional categories recognize it. Institutions thus participate in converting material and social differences into economically actionable distinctions.

Institutional change can produce generative effects that extend far beyond the immediate rule modification. A new legal status can enable contracting, borrowing, inheritance, representation, or access to public support. A new technical standard can create markets for complementary products. A revised accounting rule can al-

ter investment behavior. Because institutions condition many later relations simultaneously, their generative reach can be large even when the initiating intervention appears administrative.

The institutional object category therefore links GRE's analysis of stable social reality with its interest in historical transformation. Institutions provide continuity while remaining generated, maintained, contested, and revisable. Their durability makes them analytically powerful; their historical production prevents their present form from being treated as timeless.

3.4.10 Symbolic and Representational Objects

Economic life increasingly depends on symbolic and representational objects: prices, money, accounts, contracts, rankings, scores, categories, models, forecasts, identities, records, credentials, tokens, indices, dashboards, and algorithmic classifications. GRE treats such objects as economically consequential when representations mediate access, coordinate action, allocate attention, stabilize expectations, or alter the behavior of the subjects represented.

A representation should be distinguished from its referent. A credit score is not identical to a borrower's full financial condition; a ranking is not identical to institutional quality; a market price is not identical to every form of value; a model is not identical to the system modeled. The distinction matters because economic action often responds to the representation. A lender can deny credit because of a score, investors can respond to a rating, students can choose universities through rankings, managers can reorganize work around performance indicators, and public agencies can allocate resources through administrative categories.

Representations can therefore become performative or generative. Once a category is used for allocation, subjects may adapt behavior to satisfy it. Once a metric determines funding, organizations may reorganize activity around the metric. Once a risk model affects pricing, the resulting prices can alter the behavior on which future risk estimates are based. Representation enters the causal structure because institutions and actors use it to make decisions.

Symbolic objects also permit coordination across distance and scale. Money represents transferable claims; contracts encode obligations; accounting records organize complex organizations; technical standards encode compatibility; credentials communicate institutional recognition; databases preserve histories that can be acted upon by subjects who never directly observed the original events. These symbolic infrastructures expand economic coordination while creating dependencies on classification, record integrity, interpretability, and institutional trust.

The production of representations is therefore itself an economic process. Data must be collected, categories designed, models trained, records maintained, standards negotiated, and interpretations authorized. These activities require labor, infrastructure, expertise, and institutional power. Actors controlling representation systems can shape which differences become visible and which forms of value become actionable. In data-intensive economies, control over classificatory and representational infrastructure can become a major source of economic power.

Representations also have error structures. Measurement can be noisy; categories can be incomplete; models can be misspecified; historical records can be biased; proxies can drift as behavior changes. A representation can remain administratively sta-

ble while becoming less adequate to the underlying configuration. GRE therefore treats representational validity as historically revisable. The question is not only whether a representation was accurate when introduced, but whether the relations between indicator, referent, and institutional use remain sufficiently stable for current decisions.

Symbolic objects can move across contexts and acquire new effects. A credential issued for educational recognition can become a labor-market filter. A social-media metric can become an advertising asset. A legal category can become a database field used in automated decision systems. A scientific indicator can become a policy target. Such movements can alter the meaning of the representation and the incentives surrounding it.

GRE's interest in symbolic and representational objects is consequently broader than a study of information. It concerns the economic relations through which representations are created, authorized, circulated, interpreted, converted into decisions, and recursively connected to the realities they describe. The distinction between relation and representation remains central: a representation can reveal a relation, simplify it, distort it, or participate in generating a new one.

The ten object classes developed in this section provide GRE with a plural repertoire for empirical and theoretical inquiry. Emergent entities supply relatively stable units; subjects and subject positions identify locations of participation, standing, experience, and exposure; relations and relational configurations make interdependence explicit; resources and capacities distinguish what is available from what can practically be done; forms of value identify heterogeneous objects of production, recognition, conversion, and evaluation; conditions and constraints organize feasible possibility; fields capture distributed structures; processes, events, and trajectories preserve temporal organization; institutions and social facts explain stabilized collective realities; and symbolic or representational objects make visible the classificatory infrastructures through which economic action is coordinated.

These categories should remain permeable. A corporation can simultaneously be an entity, a juridical subject, an institutional configuration, a bundle of capacities, a node in relational fields, and a trajectory. Money can be a resource, an institutionally stabilized social fact, a symbolic object, and a medium through which value is represented and converted. A platform can be an organization, technical infrastructure, field, relation-generating environment, classificatory system, and economic subject under different legal arrangements. GRE gains explanatory power from selecting the representation that preserves the distinctions relevant to the local question, while comparing alternative representations when conclusions depend on that choice.

Object selection is therefore inseparable from scale. An object stable at one level can decompose into heterogeneous relations at another; a relation local to one scale can appear as a distributed field at another; an event for one subject can be part of a long institutional process at a wider temporal resolution. The next section turns explicitly to these levels and scales of inquiry, establishing how GRE can move among individual, organizational, collective, institutional, ecological, and transnational domains without assuming that the same objects retain identical boundaries across them.

3.5 Levels and Scales of GRE Inquiry

The objects identified in the preceding section become analytically meaningful only relative to a level and scale of inquiry. A household can be treated as an economic subject in one analysis, as a field of interpersonal relations in another, as a node in a credit or welfare network in a third, and as part of a larger demographic, ecological, or transnational configuration in a fourth. Generative Relational Economics therefore requires an explicit account of scale selection. The role of this section is to specify the principal levels at which GRE inquiry can be organized and to clarify how movement among levels affects what counts as an entity, relation, condition, mechanism, and consequence. Its objective is neither to impose a fixed micro–meso–macro hierarchy nor to deny the usefulness of scalar distinctions. It is to make scale an explicit analytical choice whose adequacy depends on the research question, the generative mechanism under study, and the evidential resolution available to the researcher.

Scale in GRE has several dimensions. A *spatial scale* concerns the geographic or material extent of a configuration. A *temporal scale* concerns the duration over which formation, persistence, transformation, or consequence is observed. An *organizational scale* concerns the level at which coordinated action is stabilized, from interpersonal relations to firms, states, transnational institutions, or distributed infrastructures. A *juridical scale* concerns the reach of rights, duties, jurisdictions, and recognized authority. An *ecological scale* concerns the material and living systems within which economic activity is embedded. An *analytical scale* concerns the resolution at which a researcher constructs objects and causal or generative claims. These dimensions can align, but they often diverge.

The distinction between *level* and *scale* is useful even when their boundaries remain context-dependent. A level identifies a position within a layered description, such as person, organization, institution, or transnational system. Scale identifies the extent or resolution of the phenomenon being observed. An organizational process can have a local spatial scale but a long temporal scale; an interpersonal relation can be embedded in a global platform infrastructure; a juridical rule can operate nationally while being produced through transnational negotiation. GRE therefore treats levels as analytical locations within an inquiry and scales as dimensions of extent, duration, or resolution. Neither should be assumed to map onto a single natural hierarchy.

This section proceeds across six recurrent domains of analysis—individual and interpersonal, organizational, community and collective, institutional and juridical, ecological and more-than-human, and inter-system and transnational—before turning to two cross-cutting issues: scale-relative entityhood and cross-scale generative effects. The method is constitutive rather than classificatory in a rigid sense. The purpose is to define a usable architecture for GRE research while preserving the possibility that empirical cases require different or additional levels.

3.5.1 Individual and Interpersonal Scales

Individual and interpersonal scales concern persons, households, dyads, small groups, and recurrent relations whose immediate organization is accessible at the level of situated interaction. At this scale, GRE can study how economic capacities, constraints, expectations, obligations, identities, and values are generated through

relations among concrete subjects. The focus is wider than individual choice in isolation. Choice remains important, but the inquiry asks how the conditions under which choices become available, intelligible, affordable, legitimate, or sustainable are relationally formed.

An individual can be analyzed as an economic subject with resources, preferences, capabilities, legal standing, knowledge, vulnerabilities, and temporal commitments. Yet these attributes frequently depend on relations that exceed the individual. Income can depend on employment relations; credit access can depend on institutional classification and social history; capability can depend on care, education, infrastructure, or recognition; preference formation can depend on social learning and available categories of action. GRE therefore treats individual-level observations as legitimate without treating the individual as analytically self-sufficient.

Interpersonal relations can themselves generate economic effects. Trust can reduce monitoring costs and make cooperation feasible. Care can maintain or expand another person's practical capacities. Advice can alter information, confidence, or opportunity. Repeated exchange can create expectations of reciprocity. Family relations can redistribute resources across time and persons. Friendship and professional ties can provide access to information, employment, finance, or institutional navigation. These effects can be valuable without being fully priced, and they can generate dependency or unequal obligation as well as support.

Households illustrate the importance of distinguishing the administrative recipient from the relational field. A transfer formally delivered to one household member can alter bargaining power, care allocation, educational investment, consumption, savings, mobility, or future exit options for several people. A wage increase can change household time allocation and dependency patterns. Debt undertaken by one member can constrain future resources of others. The relevant unit therefore depends on the mechanism being studied rather than on the administrative unit through which a programme or transaction is recorded.

Temporal scale is especially important at the interpersonal level. Some effects are immediate, such as payment, consumption, or access. Others accumulate through repeated interaction. Trust, skill, reputation, dependency, and caregiving capacity are often generated through histories rather than single encounters. A relation that appears beneficial over one month can create vulnerability over several years; a costly educational investment can generate capabilities whose effects become visible much later. GRE inquiry should therefore specify the time horizon over which an interpersonal relation is being evaluated.

The individual and interpersonal scale also reveals the difference between formal equality and relational position. Two persons may hold the same legal right while facing different exit costs, knowledge, network access, or dependence. Equal monetary transfers can have different generative effects because subjects occupy different relational configurations. This does not imply that every analysis must reconstruct the full social history of each person. It means that the scale of analysis should be broad enough to capture the relations necessary for the specific generative claim.

At this level, evidence can include interviews, ethnography, surveys, administrative records, experiments, transaction histories, diaries, social-network data, or mixed-method designs. The appropriate evidence depends on whether the claim concerns subjective meaning, observed behavior, resource flow, causal effect, relational structure, or long-horizon change. Individual-scale data do not automatically

support interpersonal or institutional claims, just as aggregate data can conceal mechanisms operating through concrete relations.

The individual and interpersonal scale is therefore a legitimate entry point rather than a privileged foundation. GRE can begin with persons and direct relations when that resolution is adequate, while remaining prepared to enlarge the analytical boundary when the observed capacities, constraints, or trajectories depend on organizational, institutional, ecological, or transnational structures.

3.5.2 Organizational Scales

Organizational scales concern coordinated configurations that stabilize roles, procedures, decision rights, resource pools, routines, information flows, and boundaries of participation. Firms, public agencies, universities, hospitals, cooperatives, non-governmental organizations, platforms, laboratories, and project teams can all become objects at this scale. The relevant question is not simply whether an organization exists as a legally recognized entity. GRE asks how organizational arrangements generate capacities and constraints for participants and how those arrangements reproduce or transform their own conditions of operation.

Organizations can pool resources that individuals cannot mobilize alone. They can create specialized roles, accumulate knowledge, establish infrastructure, coordinate long production processes, and distribute risk. They can also concentrate decision authority, create informational asymmetries, and determine access to opportunities. An organization therefore appears simultaneously as an emergent entity and as a relational architecture through which people, technologies, rules, and resources become coordinated.

Organizational boundaries are analytically important because many contemporary production processes extend beyond formal employment or ownership. A platform can rely on independent contractors, users, complementors, cloud providers, advertisers, moderators, data-labeling workers, and public infrastructure. A manufacturing firm can depend on suppliers distributed across jurisdictions. A university can rely on temporary researchers, publishers, funders, accreditation systems, and digital services. The legal boundary of the organization is one relevant boundary, but it may not coincide with the generative boundary of the economic process.

GRE can therefore distinguish between organizational membership and organizational dependence. A person may depend economically on an organization without being an employee. A community may bear environmental or infrastructural consequences of organizational activity without participating in governance. A supplier may become technologically locked into a dominant buyer. A public institution may depend on proprietary software whose provider sits outside its formal hierarchy. These relations affect the organization's generative reach and the distribution of benefits, risks, and future options.

Organizational scale also makes internal heterogeneity visible. Departments, teams, occupational groups, and technical systems can operate under different incentives and temporalities. A firm can appear coherent at the market level while containing conflicts over investment, labor conditions, safety, innovation, and accounting. An organization can therefore be treated as a unit for one research question and decomposed into internal relational configurations for another. The adequacy of aggregation depends on which mechanisms matter to the inquiry.

Organizational learning is one important generative process. Routines, archives, training systems, informal norms, and technological infrastructures can preserve knowledge beyond individual tenure. Conversely, turnover, outsourcing, or fragmentation can dissipate capabilities even when short-term financial indicators improve. Investment in organizational capacity can therefore generate future possibilities that are not visible in current output, while extraction from organizational knowledge or trust can reduce later adaptability.

Governance within organizations is similarly generative. Decision procedures determine whose information enters deliberation, which risks become visible, how conflict is resolved, and who can revise rules. Participation can create knowledge and legitimacy; concentrated authority can accelerate decisions in some contexts while suppressing local information in others. GRE does not presume one organizational form to be normatively superior across cases. It studies how specific governance architectures shape the production, distribution, and transformation of future capacities.

Organizational scale thus mediates between interpersonal relations and wider institutional structures. Organizations translate law, markets, technologies, and cultural expectations into local procedures, while their actions can reshape sectors, communities, standards, and political economies. Their analysis requires attention both inward to internal relational architecture and outward to the fields in which they operate.

3.5.3 Community and Collective Scales

Community and collective scales concern forms of coordination and shared dependence that do not necessarily coincide with formal organizational boundaries. Neighborhoods, professional communities, scientific fields, cultural groups, commons, mutual-aid networks, open-source communities, social movements, informal markets, and distributed publics can exhibit patterns of collective action without constituting a single organization. GRE includes these formations because economically consequential capacities can emerge through repeated participation, shared norms, common infrastructures, and distributed recognition.

A community can generate resources that are difficult to assign to individual producers. Shared knowledge, reputation systems, linguistic conventions, safety expectations, informal credit, professional standards, and norms of reciprocity can enable action across many participants. Their value often depends on continued collective reproduction. If participation declines, trust erodes, common infrastructure deteriorates, or knowledge ceases to circulate, the resource itself can weaken even when no discrete asset has been destroyed.

Collective scale also matters for the formation of economic subjects. Membership in a professional, cultural, or local community can provide categories through which people understand opportunities and obligations. Collective narratives can shape expectations about work, entrepreneurship, education, debt, care, or acceptable risk. These processes need not imply homogeneous values. Communities can contain disagreement, hierarchy, exclusion, and multiple overlapping memberships. GRE therefore treats collective identity as an empirical configuration rather than an assumption of unity.

Commons provide a particularly useful illustration. A resource can be collectively

used and governed through rules that define access, contribution, monitoring, sanction, and adaptation. The relevant economic object is then neither only the resource nor only the individual user. It includes the relation among resource conditions, user practices, governance arrangements, and external pressures. Changes in any of these can alter the viability of the collective system.

Digital communities extend these issues beyond geographic proximity. Open-source projects, online knowledge communities, creator networks, and platform-mediated groups can generate software, information, cultural value, reputation, and social support through dispersed participation. Their infrastructures can nevertheless remain privately owned or technically centralized. A community can therefore be distributed at the level of participation while depending on concentrated control at the infrastructural level. This asymmetry becomes visible only when multiple scales are analyzed together.

Collective action can also produce public or quasi-public capacities. Community organizing may improve bargaining power; professional associations may establish standards; neighborhood networks may coordinate disaster response; scientific communities may produce shared methods and repositories. These capacities can benefit participants unevenly and can create boundaries around membership or recognition. GRE can study both the generative contribution of collective organization and the distribution of access to what is collectively generated.

The temporal scale of communities often exceeds individual participation. Institutions of memory, ritual, documentation, mentorship, and repeated practice can transmit norms and capacities across cohorts. At the same time, a community can transform rapidly under migration, technological change, political conflict, or economic restructuring. Analyses that treat collective structure as fixed can miss the processes through which membership, meaning, and governance are continually reproduced.

Community and collective scales therefore provide a middle range in which distributed relations acquire partial stability without necessarily becoming formal organizations. They are especially important for GRE because generation frequently occurs through participation that is economically consequential yet only partially represented in contracts, prices, or administrative categories.

3.5.4 Institutional and Juridical Scales

Institutional and juridical scales concern relatively stabilized systems of rules, recognized roles, procedures, classifications, rights, duties, jurisdictions, and authorized decisions. At this scale, GRE studies how economic possibility is structured through the formal and informal arrangements that determine what can be owned, exchanged, licensed, enforced, recognized, taxed, subsidized, inherited, represented, or contested. Institutions are not merely background conditions. They actively generate categories of action and subject positions.

Law provides one especially explicit architecture of economic possibility. Corporate law makes certain collective entities legally actionable. Property law organizes claims over resources. Contract law structures enforceable commitments. Labor law defines employment relations and protections. Bankruptcy law redistributes consequences of failure. Immigration law can shape access to labor markets and public support. Intellectual-property law conditions the circulation and appropriation of knowledge. These arrangements alter incentives, but they also constitute the legal

identities and relations through which economic action proceeds.

Juridical scale should not be reduced to national legislation. Municipal regulations, administrative agencies, courts, professional licensing bodies, treaty regimes, private arbitration systems, technical standards, and organizational rules can each exercise authority over different domains. Jurisdictions overlap, and actors can move or strategically position activity among them. GRE therefore asks which authority is operative for the relation under study and how jurisdictional boundaries affect the distribution of rights, risks, and generative opportunities.

Institutional categories can have constitutive effects. Eligibility rules determine who counts as a beneficiary. Accounting standards determine which assets and liabilities become visible. Educational credentials authorize access to professions. Credit classifications influence borrowing conditions. Statistical categories shape policy populations. Once institutionalized, such classifications can alter behavior and resource flows, thereby contributing to the reality they purport to describe.

Institutional scale also introduces temporal depth. Rules inherit prior conflicts and compromises; administrative routines accumulate; precedents stabilize expectations; legal categories outlive the conditions under which they were formed. Economic actors adapt to these structures, and repeated adaptation can create constituencies that support their continuation. Institutional persistence can therefore be generated through feedback among rules, investments, expectations, and organized interests.

Change at this scale can be discontinuous. A legal recognition, regulatory decision, court judgment, or policy reform can rapidly transform the feasible set of actions for many actors. Yet implementation remains relational. Formal change can produce uneven effects when local administrative capacity, information, infrastructure, or social recognition differs. GRE consequently distinguishes institutional rule change from the distributed processes through which a rule becomes effective in practice.

Institutional and juridical scales also mediate normative questions. Rights, procedural protections, and public obligations can constrain economically efficient arrangements for reasons of justice, dignity, or political legitimacy. Conversely, legal authority can stabilize extractive or exclusionary relations. GRE does not infer normative validity from institutional existence. It treats institutions as economically generative structures whose consequences and justification require separate evaluation.

This scale is indispensable whenever the relevant causal or generative mechanism depends on recognized authority. A transaction between two persons may appear interpersonal, yet its enforceability, tax treatment, property consequences, and admissible terms can be institutionally constituted. The juridical environment therefore enters GRE inquiry whenever it materially changes what relations can exist and what they can generate.

3.5.5 Ecological and More-than-Human Scales

Ecological and more-than-human scales concern the living, material, energetic, climatic, and technological systems through which economic activity becomes possible and consequential. GRE includes these scales because economic relations are embedded in conditions that are neither produced solely by human exchange nor adequately represented as passive inputs. Soil fertility, water systems, biodiversity, atmospheric conditions, energy infrastructures, animal populations, computational systems, and built environments can shape and be transformed by economic processes.

Ecological scale complicates conventional boundaries around the economic unit. A factory can be analyzed as an organization, but its production may depend on watersheds, energy grids, mineral extraction, transport corridors, and waste sinks distributed across large regions. Agricultural production can depend on pollination, soil microbiomes, climate patterns, seed systems, and water availability. The relevant generative configuration can therefore extend far beyond the spatial boundary of the producing organization.

Temporal scale becomes especially consequential here. Ecological regeneration, depletion, contamination, and climate effects can unfold over decades or generations. Short accounting periods can therefore classify an activity as productive while externalizing degradation of the conditions that make later production possible. GRE can address this mismatch by treating ecological conditions as part of the generative system rather than only as exogenous constraints encountered by economic actors.

More-than-human inquiry also raises questions about agency and subjecthood. GRE need not resolve a general metaphysics of non-human agency in order to study how animals, ecosystems, technical systems, or artificial agents participate causally in economic configurations. A river can constrain settlement and transport; a disease vector can alter labor and health systems; an algorithm can allocate visibility or credit; an automated system can modify production decisions. The analytical status of these participants should be specified relative to the claim being made rather than predetermined by a universal hierarchy of subjects.

Technological systems illustrate the overlap between ecological and organizational scales. Energy networks, communication infrastructures, logistics systems, and machine-learning platforms have material footprints, operational dependencies, maintenance requirements, and failure modes. Their economic effects emerge through coupled human and technical relations. Treating technology as a neutral tool can obscure how technical architecture redistributes practical capacities and how its maintenance depends on resource extraction, labor, standards, and institutional support.

Ecological relations also generate value that can resist simple monetization. A wetland can support flood protection, habitat, cultural practice, recreation, and future ecological resilience. Assigning a price to one service can assist a particular decision while leaving other forms of value unrepresented. GRE therefore permits multiple valuation registers at ecological scales and requires transparency about which dimensions are included in a given economic representation.

More-than-human scales also expand the population affected by economic decisions. Future people, non-human organisms, and ecosystems can bear consequences without participating in present transactions. This creates a temporal and representational problem: current subjects make decisions under institutions that may weakly represent distant or non-speaking affected parties. GRE can study the mechanisms through which those absences become economically consequential without assuming that a single metric resolves the normative problem.

Ecological and more-than-human scales thus prevent the research boundary from stopping where conventional organizational or market boundaries stop. They make visible the material conditions, distributed dependencies, and long-duration transformations through which present economic generation can either sustain or erode future possibility.

3.5.6 Inter-System and Transnational Scales

Inter-system and transnational scales concern relations that cross organizational fields, institutional orders, jurisdictions, sectors, infrastructures, or national boundaries. Contemporary economic processes frequently operate through such crossings. Finance, migration, supply chains, digital platforms, scientific collaboration, humanitarian assistance, trade, energy systems, taxation, and data governance can connect actors governed by different rules and situated within different value structures. GRE therefore requires a scale at which interactions among systems become objects in their own right.

A transnational supply chain illustrates the problem. Production may involve design in one jurisdiction, components from several others, assembly elsewhere, finance through global institutions, shipping through international logistics, and consumption in distant markets. Labor rights, environmental rules, currencies, tax regimes, and political risks differ across locations. The economic relation cannot be understood fully through the bilateral transaction between buyer and seller because value generation and vulnerability are distributed across the chain.

Inter-system analysis is broader than geographic internationalization. Health systems can interact with labor markets; education systems with migration regimes; financial systems with housing; scientific systems with intellectual-property institutions; humanitarian systems with border governance. Each system can maintain its own classifications, objectives, and evaluative criteria. Their coupling can create gaps, contradictions, or conversion points through which subjects gain or lose access.

Conversion across systems is therefore a central object. A qualification recognized in one jurisdiction may not convert into professional standing elsewhere. Financial capital can cross borders more easily than labor. Data can be generated in one legal environment and processed in another. Carbon emissions can be produced locally while their climatic effects are globally distributed. Humanitarian categories can determine access to assistance but interact imperfectly with immigration categories. GRE can study these interfaces as generative sites where differences among systems produce new capacities or constraints.

Transnational scale also changes the distribution of governance capacity. Some actors can choose jurisdiction, route investment, relocate data, restructure ownership, or negotiate directly with states. Others remain territorially or institutionally fixed. Mobility itself therefore becomes an economic capability. The ability to cross boundaries can alter bargaining power even when formal rules are equal within each jurisdiction.

Distributed infrastructures further complicate territorial analysis. Payment networks, cloud computing, communications, shipping, and digital identity systems can operate across many jurisdictions while being controlled by a limited number of organizations or standards bodies. Failure or policy change at one infrastructural node can propagate across distant systems. The relevant scale is then neither purely national nor simply global; it follows the architecture through which dependence and coordination are organized.

Transnational processes also operate across heterogeneous temporalities. Trade agreements, infrastructure investments, migration histories, debt contracts, and climate commitments can bind actors over long periods. Short-term political cycles may interact with long-term obligations. GRE can therefore examine how institutional

time horizons become coupled and how present decisions distribute future adjustment costs across places and populations.

Inter-system and transnational scales are consequently necessary whenever the generative relation crosses the boundary of the system in which the initial action is recorded. They direct attention to interfaces, conversions, jurisdictional differences, infrastructural dependencies, and the unequal capacity to move among systems.

3.5.7 Scale-Relative Entityhood

The preceding scales reveal a central constitutional principle of GRE: entityhood is often scale-relative. A configuration that functions as a coherent entity at one analytical level can become a field of heterogeneous relations at another. A household can be a unit in a national survey and a contested relational configuration in an ethnographic study. A corporation can be a market actor in industrial analysis and a network of departments, contracts, algorithms, workers, and investors in organizational analysis. A state can be treated as an actor in international negotiation and decomposed into agencies, courts, political coalitions, infrastructures, and administrative practices in institutional analysis.

Scale-relative entityhood does not imply that entities are unreal. It specifies the conditions under which treating a configuration as an entity is analytically productive. Relative stability, boundary persistence, coordinated action, recognized identity, and causal integration can justify entity-level analysis. The same configuration can nevertheless be decomposed when internal structure becomes relevant to the question. Ontological suspension therefore supports practical realism: the analyst can work with entities while remaining open to changing the level of resolution.

Aggregation is one mechanism through which entities appear. Individual transactions can produce market-level regularities; organizational decisions can produce sectoral patterns; local ecological changes can accumulate into regional effects. Yet aggregation alone does not guarantee that the higher-level object has independent explanatory value. GRE asks whether higher-level patterns feed back into lower-level behavior, constrain possible transitions, or stabilize classifications and expectations. When they do, the higher-level configuration can become causally or generatively relevant in its own right.

Decomposition likewise requires care. Explaining an organization through individuals alone can omit rules, infrastructures, and emergent coordination. Explaining a legal order through statutes alone can omit administrative practice and social recognition. Explaining a market through transactions alone can omit standards, network effects, and institutional conditions. Reduction to a finer scale can therefore lose structure just as aggregation can conceal heterogeneity.

The choice of scale also affects attribution. If a worker acquires a skill, the generative contribution may involve individual effort, teachers, organizational training, public education, family support, digital infrastructure, and prior scientific knowledge. Different scales reveal different contributors. GRE should therefore match attribution to the level of the claim and avoid converting a multi-scale generative process into a single-agent narrative without justification.

Scale-relative entityhood also matters for normative evaluation. Benefits and harms can reverse appearance across scales. A firm-level efficiency gain can impose community-level unemployment; a household-level coping strategy can reproduce

gendered burdens; a national growth policy can create ecological costs elsewhere; a local conservation rule can restrict livelihoods while sustaining long-run regional resilience. Evaluation should therefore state the population, temporal horizon, and scale to which a conclusion applies.

Remark 3.1 (Scale-relative entityhood). Treating a configuration as an entity is a modeling and evidential commitment justified by the local inquiry. It does not require the same configuration to remain indivisible, homogeneous, or equally salient at other scales.

This principle gives GRE a disciplined way to move among levels without declaring one level ultimately fundamental. The research question determines the initial resolution, while empirical anomalies, mechanism evidence, or downstream effects can require expansion or decomposition of the analytical boundary.

3.5.8 Cross-Scale Generative Effects

Cross-scale generative effects occur when processes organized at one level alter capacities, constraints, structures, or possibilities at another. These effects are central to GRE because economic generation often propagates beyond the scale at which an intervention, transaction, or decision is initially observed. A scholarship allocated to one person can affect a household, professional network, organization, or future community. A local technological innovation can reshape industry standards. A national regulation can reorganize firm behavior and interpersonal opportunities. A transnational platform rule can alter the visibility and income of individual creators.

Cross-scale effects can move upward through accumulation, coordination, diffusion, or institutionalization. Repeated individual behavior can create market conventions. Local experiments can become organizational routines. Collective practices can become recognized standards. Distributed demand can support an industry. Social expectations can become politically salient and eventually codified. The relevant mechanism should be specified rather than assumed from the observation that lower-level and higher-level change occur together.

Effects can also move downward. Institutional classifications shape individual eligibility; organizational rules structure team behavior; market concentration alters bargaining conditions; national monetary policy changes borrowing costs; ecological degradation constrains household livelihoods. Higher-level patterns can therefore become conditions of lower-level action even when they originated historically from distributed processes.

Horizontal propagation across scales is equally important. A change in one sector can alter another through labor, finance, infrastructure, or regulation. A technological standard adopted by one industry can create complementary markets elsewhere. A health crisis can transform education, transport, employment, and care. These processes are not captured adequately by a single vertical hierarchy because the relevant systems can be partially autonomous yet strongly coupled.

Cross-scale generation can also involve delayed effects. Investment in early childhood can influence educational trajectories years later; infrastructure can shape settlement and productivity over decades; ecological damage can accumulate before crossing thresholds; institutional reforms can alter expectations gradually. A local analysis may therefore be accurate within its immediate horizon while incomplete for longer generative consequences.

Feedback among scales creates additional complexity. An organizational policy can alter worker behavior; aggregated behavior can change organizational performance; performance can lead to a revised policy. A legal reform can change market practices; those practices can generate new political coalitions; the coalitions can reshape subsequent law. In such cases, scale is part of the mechanism because causal influence circulates among levels rather than traveling in one direction.

Cross-scale effects also create attribution difficulties. When value or harm propagates across several levels, assigning the outcome to the initial actor alone can overstate individual contribution, while attributing it only to structure can erase situated agency. GRE therefore treats generative attribution as potentially distributed. The relevant task is to identify the relations through which capacities or constraints were produced and the points at which different actors or structures materially altered the trajectory.

Measurement should reflect this distributed character. Data collected at one scale can miss effects at another. Firm-level productivity data may not reveal household care burdens; household income data may not reveal ecological depletion; national statistics may not capture transnational tax shifting; platform-level engagement metrics may not capture community-level cultural effects. Multi-level designs, linked data, comparative cases, qualitative tracing, and simulation can each contribute where appropriate, provided the relation between evidence and claim remains explicit.

Cross-scale analysis finally has a governance implication. Interventions aimed at one level can generate consequences elsewhere, so institutional responsibility may need to follow generative reach rather than administrative jurisdiction alone. This does not imply unlimited responsibility for every remote consequence. It creates a research question about which downstream effects are sufficiently connected, foreseeable, material, or governable to enter evaluation and design.

The architecture established in this section therefore gives GRE a way to specify where an inquiry begins, how far its analytical boundary extends, and when movement among scales becomes necessary. Individual, organizational, collective, institutional, ecological, and transnational levels are recurrent sites of inquiry rather than a closed hierarchy. Entityhood remains relative to analytical scale, and generative effects can propagate upward, downward, horizontally, and across time. With these levels clarified, the next task is to state the characteristic questions through which a GRE inquiry can interrogate a concrete economic situation.

3.6 Illustrative Questions in Generative Relational Economics

The preceding sections have specified the disciplinary identity, problem-space, methodological primitives, objects, and scales of Generative Relational Economics. Those elements define a field of possible inquiry, but they remain abstract until translated into questions that can organize empirical, historical, formal, interpretive, and normative research. The role of this section is therefore illustrative. It identifies recurrent question-forms that make the distinctive concerns of GRE operational without turning them into a mandatory sequence or a closed checklist. The objective is to show how a researcher can move from a conventional economic problem toward

a generative-relational formulation by asking what relations constitute the situation, what is generated through them, how value and capacity travel, where asymmetries are converted into power, and how present arrangements alter later conditions of possibility.

These questions are intentionally broader than particular methods. A question concerning value propagation might be studied through administrative data, interviews, network analysis, accounting records, historical archives, ethnography, simulation, or some combination of these. A question concerning subject formation may require interpretive evidence that differs from the evidence required to identify a resource flow. GRE therefore treats the question-form as analytically prior to method selection. Methods are chosen according to the object, scale, mechanism, and evidential problem rather than according to a presumption that one technique defines the field.

The questions are also non-exclusive. A single research project may begin with one and encounter several others. An analysis of a training subsidy may ask who formally receives the subsidy, which household or organizational relations mediate its use, what capacities are generated, how those capacities propagate through employment networks, which forms of value are realized or lost, and whether the programme changes the future bargaining position of workers. The value of the GRE perspective lies partly in making these connections available for investigation while preserving distinctions among them.

The thirteen question families below should consequently be read as an open repertoire. They do not exhaust GRE inquiry, and they do not imply that every project must answer all thirteen. Their function is to reveal characteristic directions of attention: constitution, displacement beyond the administrative recipient, generation, propagation, conversion, recirculation, capacity transformation, access to generative capacity and conditions, subject formation, power formation, orientation, foreclosure, and recursive transformation of the conditions of change.

3.6.1 Relational Constitution of the Economic Situation

A GRE inquiry can begin by asking which relations make the observed economic situation possible and intelligible. The question directs attention away from treating visible entities as analytically self-sufficient. A worker, firm, household, platform, loan, public service, or market transaction enters an already organized field of legal, infrastructural, contractual, social, technical, ecological, and symbolic relations. Some of these relations are proximate and observable; others operate as background conditions. The task is to identify which of them materially affect the phenomenon under investigation.

This question is selective rather than totalizing. GRE does not require reconstruction of every relation surrounding an object. The relevant relations are those whose inclusion changes explanation, evaluation, or intervention. A study of household energy insecurity, for example, may need to include income, housing quality, tenancy status, energy pricing, family composition, climate exposure, and access to public support. The entire history of the household is unnecessary unless some part of that history affects the mechanism under study. Relational analysis becomes useful when it improves the adequacy of the inquiry rather than when it simply multiplies context.

The question also encourages distinctions among kinds of relation. A legal relation of entitlement differs from an interpersonal relation of trust; a supply relation

differs from an ownership relation; a technical dependency differs from a political authorization; an ecological dependency differs from a contractual obligation. Several may intersect in one case without being reducible to one another. Mapping constitution therefore requires enough conceptual resolution to preserve the mechanism carried by each relation.

Relational constitution can also be asymmetric. One party may depend on another without reciprocal dependence of the same magnitude or kind. A small supplier can depend heavily on a dominant buyer whose dependence on that supplier is negligible. A migrant worker can depend on an employer for income, legal sponsorship, housing, or information. A municipality can depend on a private platform for an infrastructure it does not control. Asking which relations constitute the situation therefore prepares later analysis of bargaining position, exit, capture, and power.

The practical result is a boundary decision. Once the constitutive relations have been identified, the researcher can justify why some actors, institutions, infrastructures, temporal histories, or ecological conditions are inside the analytical frame and others remain outside it. The boundary remains revisable as evidence accumulates. GRE thus treats relational mapping as a disciplined way to construct the object of inquiry rather than as a demand for unlimited contextual description.

3.6.2 Economic Effects beyond the Administrative Recipient

Economic programmes and transactions are frequently recorded through an administrative recipient: the person receiving a transfer, the firm receiving a subsidy, the borrower named on a loan, the patient receiving a service, or the organization holding a grant. GRE asks what changes beyond that formally designated unit. The question matters because economic effects often propagate through relations that administrative data do not treat as recipients.

A cash transfer received by one person may alter household consumption, bargaining power, care responsibilities, debt repayment, education, mobility, or support to relatives. A grant to a small firm can affect employees, suppliers, clients, landlords, local tax revenue, or competing firms. A scholarship can transform not only the student's education but household expectations, future remittances, professional networks, and the aspirations of younger family members. The administrative recipient remains an important object, but it does not automatically define the boundary of effect.

This question is not equivalent to measuring conventional spillovers alone. GRE is interested in the relational pathways through which effects move. Two programmes with similar average indirect effects can operate through different mechanisms. One may propagate through knowledge sharing, another through household redistribution, another through changes in bargaining position, and another through infrastructure created for the initial recipient. Identifying the pathway helps distinguish incidental correlation from generated consequence.

The question also exposes burdens that move beyond the recipient. A policy that expands employment for one group can transfer unpaid care to another group. Debt relief for a firm can preserve jobs while imposing losses on pension funds or public budgets. Digital convenience for consumers can shift risk and time costs onto gig workers. The analysis therefore follows both enabling and constraining consequences beyond the administrative unit.

A useful GRE design can make this boundary extension explicit at the outset. The researcher can specify the formal recipient, identify connected subjects and systems likely to be affected, determine which effects are theoretically relevant, and select evidence capable of observing those pathways. The resulting analysis does not reject administrative categories; it treats them as one layer within a wider relational field.

3.6.3 Generative Effects of Economic Relations

A central GRE question asks what an economic relation produces beyond its immediate exchange or recorded output. The relevant generated objects can include income, knowledge, capability, trust, dependency, reputation, infrastructure, organizational routine, institutional legitimacy, ecological burden, expectations, data, symbolic standing, or new relations. Generation concerns the production of later conditions and possibilities, not merely the transfer of an already existing object from one holder to another.

Consider employment. A wage relation transfers income in exchange for labor, but it can also generate skill, professional identity, social networks, credentials, routines, health effects, dependence, bargaining experience, or exclusion from alternative opportunities. Which of these effects matters depends on the research question. A GRE analysis does not assume that every employment relation generates the same bundle. It asks which outputs are produced in this case, through which mechanisms, for whom, and with what temporal persistence.

The distinction between output and generation is especially useful where the immediate output is easy to measure but longer-term transformation is economically important. A training programme can produce a certificate immediately while generating later confidence, network access, occupational mobility, or employer recognition. A public library can provide books and space while generating study routines, weak ties, civic participation, or access to digital services. An open technical standard can coordinate present interoperability while generating an ecosystem of future complementary production.

Generated effects can be intended or unintended. Organizations can deliberately build capability, loyalty, or infrastructure, while other consequences emerge from repeated interaction without centralized design. Some generated effects become visible only retrospectively. GRE therefore distinguishes the existence of a generated consequence from claims about intention. The question concerns the causal or constitutive production of a later condition, not whether an actor planned that condition.

Generation can also be negative in practical or normative terms. A predatory credit relation may generate debt dependency and reduced future exit options. Repeated precarity may generate risk aversion or the erosion of professional capacity. An extractive production process may generate ecological degradation that constrains later economic activity. The category of generation is therefore descriptive before it is evaluative. Evaluation requires additional criteria concerning whose capacities, values, or futures are affected.

3.6.4 Propagation of Value

Value produced or realized in one relation can travel through a wider configuration. GRE asks how that propagation occurs, which pathways carry it, where it amplifies

or decays, and who becomes able to use or capture it. The question begins from the observation that valuable effects rarely remain confined to the site at which they first appear.

Knowledge provides a clear example. A skill acquired by one worker can improve team performance, be taught to colleagues, contribute to organizational routines, support innovation, or become embodied in a product used elsewhere. Public infrastructure can raise the productivity of many firms and households. Trust accumulated through repeated cooperation can reduce coordination costs for later projects. A scientific result can enable downstream technologies, standards, or educational materials. The original site of value generation and the later sites of value realization can therefore be separated in space, time, and institutional ownership.

Propagation has a topology. Some value moves through direct exchange; some through imitation, learning, standards, networks, public goods, reputation, or price changes. Some pathways require institutional authorization. A professional qualification becomes valuable partly because employers and regulators recognize it. A digital protocol becomes valuable as adoption expands. A neighborhood amenity can propagate into land prices through property markets. Mapping the pathway helps determine whether value is widely distributed, locally concentrated, or captured at a bottleneck.

Propagation can also be blocked. Intellectual-property restrictions, incompatible standards, discriminatory networks, lack of infrastructure, language barriers, licensing rules, organizational secrecy, or geographic isolation can prevent generated value from reaching potential users. A GRE analysis can therefore investigate not only how value travels but which relations determine its transmissibility.

This question does not require that heterogeneous forms of value be collapsed into a common unit. Monetary gains, capability expansion, ecological support, recognition, and relational trust can propagate through different mechanisms and may require different measurements. The analytical task is first to identify the form of value and its pathway. Comparison or aggregation comes later, if the research purpose justifies it.

3.6.5 Cross-Form Value Conversion

Economic life contains interfaces at which one form of value becomes convertible into another. GRE asks how those conversions occur, which institutions authorize them, whose valuations determine the rate or terms of conversion, and what is lost or created in the process. Conversion is analytically distinct from propagation. Propagation concerns movement of value through a relational configuration; conversion concerns a change in the form through which value is recognized or realized.

Education can be converted into credentials, credentials into employment access, employment into income, income into housing security, and housing security into educational opportunity for another generation. Reputation can become credit access. Cultural attention can become advertising revenue. Publicly produced knowledge can become private intellectual property. Ecological capacity can be converted into commodity production, while financial resources can sometimes be converted into restoration or conservation capacity. Each conversion requires a specific institutional and relational interface.

Conversion interfaces are often sites of asymmetry. Actors differ in their ability

to define categories, certify equivalence, set prices, control access, or refuse conversion. A platform may convert user attention into advertising income while users lack a comparable mechanism for realizing the monetary value of their data. A credentialing institution can translate learning into recognized status. A financial system can translate property into collateral and collateral into borrowing capacity, thereby privileging subjects who already possess assets recognizable by that system.

Conversion can be lossy. Meaning, context, ecological complexity, or relational quality can disappear when translated into a scalar metric. Conversely, conversion can create new practical possibilities by making heterogeneous resources interoperable. Monetization can enable exchange across distance; standardized credentials can enable mobility; technical standards can connect previously incompatible systems. GRE therefore treats conversion neither as inherently exploitative nor as inherently beneficial. Its consequences depend on the forms involved, the terms of translation, and the distribution of authority over the interface.

Research can make these interfaces explicit. Instead of asking only how much value exists, it can ask which forms are recognized, which remain invisible, who can perform conversion, what conversion costs arise, who captures the resulting surplus, and whether repeated conversion changes the source form itself. Such questions are especially important when policy seeks to make previously unrecognized value legible to markets or administrative systems.

3.6.6 Recirculation, Dissipation, and Extraction

Generated resources and value can return to the relations that produced them, spread elsewhere, decay, or be extracted by actors positioned to capture them. GRE therefore asks what recirculates, what dissipates, and what leaves the generative configuration. This question focuses on reproduction through time. A relation can remain productive only if enough of the conditions supporting it are replenished, repaired, or renewed.

Recirculation occurs when generated value or capacity contributes to the maintenance or expansion of the relations that produced it. A cooperative can reinvest surplus in shared infrastructure. A university can use research income to support laboratories and training that enable later research. A community enterprise can return part of its income to local services and networks. Trust generated through successful cooperation can make later cooperation easier. Recirculation can therefore create self-reinforcing dynamics without implying that the resulting configuration is socially desirable.

Dissipation concerns loss through time, friction, obsolescence, leakage, neglect, or ecological degradation. Skills can decay when unused; infrastructure can deteriorate without maintenance; trust can erode; institutional knowledge can disappear through turnover; ecological capacity can be depleted; attention can fragment. Some dissipation is unavoidable, while some reflects institutional choices about maintenance and renewal. An analysis focused only on gross production can miss the cost of replacing dissipated conditions.

Extraction occurs when generated value or capacity is appropriated in ways that weaken the configuration from which it arises or concentrate its benefits elsewhere. Rent extraction from a local economy, uncompensated appropriation of community knowledge, financial distributions that undermine productive investment, or plat-

form capture of user-generated value can all become candidates for investigation. The concept requires mechanism evidence. The fact that one actor gains more than another does not by itself establish extraction; the analysis must identify the relation through which value is captured and the effect on the generative configuration.

Recirculation, dissipation, and extraction can coexist. A profitable firm can reinvest some surplus, distribute some to workers or suppliers, lose some through depreciation, and transfer some to distant owners. A public programme can generate local capacity while trained workers later migrate. The question is therefore compositional: what proportion or form of generated value follows each pathway, and how do those pathways alter future capability?

3.6.7 Transformation of Future Capacities

GRE places particular emphasis on the transformation of future capacity. An economic arrangement matters not only because of what it produces now but because it changes what subjects and systems can do later. This question links present allocation and relation to the future space of feasible action.

Capacity transformation can occur through learning, infrastructure, health, care, institutional reform, ecological change, debt, technological dependency, network formation, or depletion. A loan can expand productive capacity by financing equipment, while repayment obligations can constrain future cash flow. Employment can build skill and reputation while narrowing alternative career paths. A subsidy can help an industry acquire capabilities that persist after the subsidy ends. Environmental degradation can generate present income while reducing the future productive capacity of an ecosystem.

The temporal profile matters. Some interventions impose immediate costs in order to generate later capacity. Others create immediate gains by drawing down capacities that become scarce only later. A short evaluation window can therefore reverse the apparent ranking of alternatives. GRE does not prescribe one universal horizon, but it requires the horizon to be explicit and adequate to the mechanism claimed.

Capacity is also subject-specific and relational. The same infrastructure can expand the capacity of one group while reducing another's control over land or resources. A technology can increase organizational capacity while deskilling particular workers. A regulatory change can expand consumer choice while increasing compliance burdens for small producers. Asking whose future capacity changes prevents aggregate improvement from automatically standing in for distributed capability.

The question also creates an interface with uncertainty. Future capacities cannot always be observed directly at the time of intervention. Researchers may need intermediate indicators, historical comparison, simulation, qualitative evidence, or repeated observation. GRE therefore treats claims about future generativity as evidentially demanding. The more distant the claimed effect, the more explicit the mechanism and uncertainty should become.

3.6.8 Access to Generative Capacity and Conditions

A further GRE question asks who can enter, mobilize, influence, maintain, and modify the processes through which economic generation occurs. The question is related to allocation but is not exhausted by it. Receiving an output is different from being able

to call upon the capacity that produces further outputs, and both are different from participating in the formation of the conditions under which that capacity develops.

The distinction can be organized through three analytical layers. The first concerns generated outcomes: who obtains what has already been produced? The second concerns generative capacity: who can mobilize labor, knowledge, organizations, machines, artificial systems, or institutional capabilities to produce something new? The third concerns generative conditions: who can shape infrastructures, legal permissions, standards, education, data, compute, energy, networks, recognition, and other conditions that make particular forms of generation possible? A GRE project may focus on any one layer, but it should avoid assuming that access at one layer entails access at the others.

Artificial intelligence makes the distinction unusually visible. If increasingly capable artificial systems reduce the need to obtain some goods or services through another person's direct labor, the political-economic problem does not necessarily disappear. It can shift toward access to the artificial generative system and toward control over the conditions under which that system operates and evolves. The relevant research question therefore becomes less exclusively who receives the product and more broadly who can make use of, influence, and participate in the development of generative capacity.

This question opens later analysis of capital, power, exploitation, common infrastructure, and generative autonomy without deciding those issues here. Its role in the present repertoire is diagnostic. It asks whether an observed distribution of outputs conceals a more consequential distribution of capacities and conditions, and whether apparently abundant production remains organized through asymmetrical dependence on access to future generation.

3.6.9 Generation and Stabilization of Economic Subjects

Economic analysis often begins with subjects already defined as workers, consumers, owners, borrowers, firms, entrepreneurs, citizens, beneficiaries, or investors. GRE asks how such positions are generated, recognized, stabilized, and transformed. The question concerns practical economic subjecthood rather than a final theory of personhood.

Subject positions can be produced through legal categories, contracts, organizational roles, technologies, data systems, professional standards, markets, and social expectations. A person becomes a borrower not simply by possessing an individual preference for credit but through eligibility rules, identity documentation, scoring systems, collateral conventions, and lender recognition. A platform worker occupies a subject position shaped by contract classification, algorithmic management, customer ratings, payment infrastructure, and labor regulation. A firm becomes an investable object through legal incorporation, accounting practices, governance arrangements, and financial representation.

Stabilization requires continuity. Roles persist because institutions recognize them, records maintain them, counterparties respond to them, and subjects often organize their own expectations around them. This continuity can enable planning and rights while also producing path dependence. A classification that initially facilitates coordination can later restrict access or define subjects in ways that no longer fit their circumstances.

Economic subjects can also be generated through participation. Repeated saving can produce a recognized credit history; apprenticeship can produce professional identity; membership in a cooperative can develop capacities for collective decision-making; long-term unemployment can alter institutional classification and self-expectation. Subject formation is therefore partly an economic process because access to resources, roles, and relations can reshape practical identity and future action.

The question becomes especially important under technological change. Artificial agents, automated systems, platforms, and hybrid human-machine arrangements can perform functions previously associated with human economic subjects. GRE can ask which dimensions of subjecthood are relevant in each domain: productive agency, control over resources, capacity to enter recognized relations, continuity across time, liability, representation, or normative standing. These dimensions need not coincide, and functional capability does not settle moral or legal status.

3.6.10 Economic Power through Relational Asymmetry

Differences in resources, knowledge, capability, network position, or technical capacity are ubiquitous. GRE asks when such asymmetries become economic power. The question prevents a simple equation between difference and domination. Power arises when asymmetry is connected to relations through which one actor can shape another's feasible actions, terms of participation, exposure to risk, access to resources, or future capacities.

A firm with superior technology does not automatically hold power over every other actor. Power emerges when that capability is linked to ownership, market position, contractual authority, infrastructure control, legal privilege, dependency, standard-setting, or capture of a bottleneck. Likewise, information asymmetry becomes power when one party can use informational advantage to determine terms, classify others, restrict alternatives, or impose costs that the other party cannot readily avoid.

Exit and dependence are therefore central. A relation can be formally voluntary while one side faces much higher exit costs. Workers may be able to leave an employer in principle but lose legal sponsorship, health insurance, housing, or accumulated benefits. Users may be free to leave a platform but face network effects, data lock-in, or loss of professional visibility. Suppliers may be free to reject a dominant buyer while lacking alternative markets. Power analysis asks how these relational conditions transform nominal options into practical constraints.

Power can also be infrastructural and impersonal. No single actor may intentionally dominate others, yet standards, algorithms, payment systems, zoning rules, or inherited property structures can distribute capacities asymmetrically. GRE can therefore examine power embedded in relational architectures as well as direct command. Identifying power does not require attributing malicious intention; it requires showing how a configuration systematically shapes the options or capacities of differently positioned subjects.

The question naturally leads to generative consequences. Power can reproduce itself by generating the resources, information, legitimacy, or dependency that sustain the original asymmetry. It can also erode its own conditions when extraction undermines cooperation or when concentrated authority produces institutional resistance.

GRE therefore studies power not only as a present relation but as a potentially self-reinforcing or self-transforming generative configuration.

3.6.11 Orientation within Generative Processes

Generation has direction because economic systems selectively develop some possibilities while leaving others unrealized. GRE asks what orients that selection. Markets, institutions, professional communities, public policy, cultural expectations, metrics, aesthetic judgments, scientific questions, organizational goals, and individual aspirations can all influence which objects receive attention and investment.

The question is broader than incentive analysis while remaining compatible with it. Prices and expected returns orient activity, but so do legal mandates, research agendas, rankings, reputational systems, narratives of desirable futures, and perceptions of what is interesting or feasible. A research organization can direct resources toward questions regarded as scientifically significant even when immediate commercial returns are uncertain. A city can prioritize mobility, housing, tourism, or environmental restoration according to institutional and political judgments that structure later investment.

Orientation can operate before explicit choice by shaping salience. Subjects do not evaluate every imaginable possibility. They encounter a selected field of options made visible by institutions, technologies, language, education, and social experience. Recommendation systems, professional curricula, funding categories, procurement rules, and media attention can influence which possibilities become thinkable or practically available. GRE can therefore study the production of the option field as well as selection within it.

Orientation is also heterogeneous. Different subjects can pursue incompatible forms of value or imagine different desirable futures. Economic coordination then involves negotiation, conflict, coexistence, or institutional procedures for selecting among directions. The presence of plural orientations means that generativity alone cannot supply a normative criterion. A system can be highly generative while producing futures that some affected subjects reject.

Research on orientation can ask who participates in defining goals, which signals are amplified, which possibilities are rendered invisible, what feedback modifies priorities, and how orientation changes after new capacities or knowledge emerge. These questions prepare the more systematic treatment of orientation later in Chapter 3 while showing why the direction of generation is already an economic question.

3.6.12 Generative Foreclosure and Its Conditions

Generation can expand future possibility, but it can also close alternatives. GRE therefore asks under what conditions the production of one pathway forecloses others. Foreclosure can arise through irreversible investment, ecological depletion, institutional lock-in, debt, standardization, network effects, path-dependent learning, spatial development, or the concentration of control over key resources.

A technology can create new capabilities while making older infrastructures uneconomic to maintain. An urban development project can generate housing and commercial value while eliminating community uses of land that cannot easily be reconstructed. A standardized platform can enable broad interoperability while reducing

space for alternative technical architectures. Specialized education can generate high competence in one domain while increasing the cost of changing fields later. These examples show why generation and foreclosure can occur together.

Foreclosure is not identical to constraint. Every realized choice excludes some alternatives simply because resources and time are finite. The analytical question concerns consequential closure of future possibilities, especially where the closure becomes difficult to reverse or is imposed unevenly across subjects. The degree of reversibility, distribution of exit costs, and availability of alternative pathways therefore become relevant indicators.

Some foreclosure can be justified or desirable. Safety regulation intentionally eliminates dangerous production methods; environmental rules can close destructive extraction pathways; technical standards can reduce costly incompatibility. GRE does not treat openness as an unconditional good. It asks which possibilities are being closed, for whom, by what authority, with what reversibility, and in pursuit of which values.

The question is particularly important for policy evaluation. An intervention can appear successful according to immediate outcomes while narrowing later adaptability. Conversely, a policy that preserves optionality can look inefficient in a short horizon because it maintains redundant capacity or multiple institutional pathways. GRE can therefore include future option structure as part of economic evaluation when the case warrants it.

3.6.13 Recursive Transformation of Generative Conditions

The final illustrative question concerns recursive transformation. Economic relations can generate outcomes that alter the mechanisms through which later change occurs. A market can produce firms that reshape regulation; a platform can generate network effects that change entry conditions; a labor arrangement can produce new worker organizations; a financial innovation can change the infrastructure through which future credit is allocated. The object of inquiry is therefore not only change within a structure but change in the conditions that organize subsequent change.

This question requires careful separation among levels of transformation. A system can move from one state to another while its basic rules remain stable. Parameters can change while the form of the mechanism remains intact. Institutions can revise rules while preserving their authority structure. More strongly, actors, categories, boundaries, or mechanisms can be reconstituted so that the previous model of change no longer describes the later situation adequately. GRE is especially interested in the transition among these cases because historical economic development often involves several simultaneously.

Recursive transformation can be deliberate. Legislators can redesign institutions, firms can alter governance, communities can create new property arrangements, and regulators can modify market rules in response to observed outcomes. It can also emerge without centralized design as repeated practices create new conventions, standards, expectations, or dependencies. In either case, the researcher should identify the pathway through which earlier relations modify later generative conditions.

Reflexivity intensifies the problem. Economic subjects can observe models, policies, forecasts, and classifications and respond to them. A credit score changes behavior because actors know that the score affects access. A policy target can reorganize

organizational reporting. A market forecast can affect expectations and transactions. Representation can therefore enter the causal field it describes. GRE treats such reflexive loops as empirically investigable rather than as a reason to abandon formal or causal analysis.

The evidential standard should remain demanding. Claims that a system has transformed its own rules can easily become rhetorical if the relevant rule, boundary, or mechanism is left unspecified. A strong analysis identifies what changed, which earlier relations contributed to that change, how the new arrangement differs operationally from the previous one, and what consequences follow for later possibilities. The concept is useful precisely when it distinguishes ordinary state change from transformation in the organization of change itself.

Taken together, these thirteen question families define a characteristic style of GRE inquiry without establishing a closed doctrine. They invite researchers to move beyond the immediate recipient, transaction, or output when doing so materially improves explanation; to track generation, propagation, conversion, and recirculation across heterogeneous relations; to examine future capacities, access to generative capacity and conditions, subject formation, power, orientation, and foreclosure; and to remain alert to recursive changes in the conditions of change. A project can enter this problem-space through any one of these questions and combine them according to the object and evidence at hand.

The next section converts this repertoire of questions into a more explicit analytical sequence. It distinguishes allocation, relational mediation, generation, propagation, conversion, recirculation, extraction, structural transformation, and changes in generative conditions. That sequence is not intended as a universal causal chain. Its role is to provide GRE with a reusable perspective for deciding which stages of an economic process require attention in a particular inquiry.

3.7 The Distinctive Analytical Perspective of GRE

The preceding sections have specified the problem-space, primitive structure, admissible objects, scales, and illustrative questions of Generative Relational Economics (GRE). The role of the present section is to state more explicitly the analytical perspective that organizes those elements into a characteristic mode of economic inquiry. Its objective is to describe a sequence of analytical moves through which an allocation, transaction, policy, institution, or other economic event can be followed beyond its immediate recipient and immediate output into the relations, generated capacities, value pathways, structural changes, and altered conditions of future change that it helps produce. The sequence is presented as a research grammar rather than a universal causal law. A concrete study may enter at any point, omit stages that are irrelevant, distinguish several parallel pathways, or discover feedbacks that make the ordering recursive. The analytical value of the sequence lies in keeping distinct processes that conventional evaluation can easily compress into a single outcome measure.

The perspective begins from allocation because allocation remains a central economic operation. Resources, rights, attention, credit, land, labor, data, infrastructure, authority, and institutional recognition are distributed through decisions and arrangements that place something somewhere under particular terms. GRE treats

that placement as an initial intervention into a relational configuration. The allocation changes access, bargaining positions, expectations, dependencies, opportunities for coordination, and sometimes the identities or capacities of the participants. Those changes can generate new resources and forms of value, which may propagate through a wider configuration, convert across forms, recirculate into the relations that produced them, dissipate, or become subject to extraction. Repeated or sufficiently consequential processes can alter institutional and relational structure, transform the conditions that enable future generation, and in some cases change the effective rule through which subsequent transformations occur.

This perspective therefore extends the temporal and relational horizon of economic analysis without prescribing one metric of success. Monetary return, productivity, capability, recognition, ecological capacity, knowledge, trust, security, autonomy, and other forms of value can remain heterogeneous. GRE asks how they are generated and connected before deciding whether comparison, aggregation, or normative judgment is warranted. It also keeps mechanism claims separate from moral evaluation. A self-reinforcing process can be economically powerful while normatively objectionable; a process that dissipates one form of value can generate another; a structural transformation can expand some future possibilities while foreclosing others. The following subsections develop the ten analytical moments in this perspective.

3.7.1 Allocation as an Initial Intervention

Allocation is the analytical point of departure because many economic processes become administratively visible at the moment when a resource, entitlement, burden, opportunity, or authority is assigned. Public budgets allocate funds to programmes. Firms allocate capital and labor. Banks allocate credit. Households allocate time and care. Platforms allocate visibility. Legal institutions allocate rights and liabilities. Educational institutions allocate credentials and access. These operations remain central to GRE, yet GRE reads them as interventions into already structured relations rather than as terminal distributions among self-contained recipients.

An allocation changes more than possession. Receiving credit can alter a firm's bargaining position with suppliers, its ability to hire, its exposure to debt service, and the confidence of other financiers. A housing subsidy can change household security, neighborhood demand, landlord expectations, and local land values. Allocation of research funding can change laboratory composition, collaboration networks, training capacity, and the future distribution of expertise. Even an apparently simple transfer enters a field of existing institutions, expectations, power relations, and conversion mechanisms.

The analytical unit is therefore the allocation-in-context. A useful GRE study specifies what is allocated, under which institutional conditions, to whom or to which configuration, at what time, with what duration, and through which rights or obligations. It also identifies the baseline relations into which the allocation enters. These relations determine what the allocation can become. The same monetary amount can have different generative effects when recipients possess different infrastructure, debt burdens, social recognition, legal status, network access, or ecological conditions.

Allocation can also concern non-scarce or symbolically abundant objects. Atten-

tion, rankings, reputational signals, software, information, and institutional recognition can be allocated through procedures that differ from the allocation of rival material goods. Their economic significance often arises from the relations that make them consequential. A search ranking matters because users, advertisers, platforms, and firms respond to it. A credential matters because institutions recognize it. A dataset matters because actors possess complementary computational and organizational capacities. GRE therefore treats allocation as a broad intervention category whose meaning depends on the relational conditions of use.

Starting from allocation preserves continuity with established economic analysis while widening the subsequent inquiry. The initial question remains who receives what, under which conditions. GRE then asks what relations are activated or reconfigured by that placement, what becomes possible because of it, and which downstream effects remain outside the administrative boundary of the allocation itself.

3.7.2 Relational Mediation

An allocation acquires practical significance through relational mediation. Resources rarely produce identical effects independently of the relations through which subjects can use, interpret, exchange, protect, combine, or transform them. Relational mediation names the set of pathways through which an initial intervention becomes economically operative. These pathways can include contractual relations, kinship and care relations, organizational routines, infrastructures, legal recognition, technical standards, reputational systems, financial arrangements, ecological dependencies, and informal networks of trust or exclusion.

Mediation can enable use. A loan becomes productive when a borrower can purchase equipment, hire workers, obtain permits, reach customers, and sustain repayment. A public dataset becomes generative when users have the skills, computational infrastructure, legal permission, and institutional incentives required to employ it. A school meal programme can affect educational participation through household budgets, health, attendance routines, and parental expectations. The intervention therefore passes through a configuration of relations whose structure conditions the realized effect.

Mediation can also redirect or neutralize an intervention. A subsidy intended for tenants can be partly captured through rent increases. A wage increase can produce limited household security when debt obligations absorb the gain. New infrastructure can intensify land speculation and displace the population whose mobility it was intended to improve. These outcomes do not imply that the allocation itself is analytically irrelevant. They show that its effect is co-produced by the relations through which it travels.

GRE therefore distinguishes administrative recipient from relational incidence. The person or organization named in a programme may be only one node in a larger set of affected relations. Suppliers, creditors, family members, competitors, property owners, workers, public institutions, ecosystems, or future participants can experience consequential effects. The boundary of relevant incidence should follow the mechanism under investigation rather than the accounting category alone.

Relational mediation also includes interpretation. Economic subjects respond to signals through historically and institutionally formed meanings. A tax incentive can be interpreted as temporary or durable. A guarantee can change perceived risk. A

government purchase can signal future market demand. A platform rule can alter expectations about visibility and participation. Such interpretive mediation affects behavior without requiring that every actor hold the same belief.

The analytical task is to identify which relations materially condition the pathway from intervention to effect. GRE does not require exhaustive mapping of an entire social world. It requires enough relational specification to explain why the intervention produced the observed or anticipated consequences and why those consequences differ across subjects, sites, or periods.

3.7.3 Generation

Relational mediation can produce new capacities, resources, meanings, institutions, practices, identities, expectations, and forms of value. GRE uses *generation* for this productive moment. Generation concerns the emergence or augmentation of economically relevant possibilities through a relation or configuration. The generated object may be material, symbolic, institutional, ecological, epistemic, or relational. Its significance lies in the fact that later action becomes possible, easier, harder, or differently organized because the configuration has changed.

Production and generation overlap in many cases, yet their analytical emphases differ. Production commonly directs attention toward an output: goods, services, income, knowledge, or measurable performance. Generative analysis asks what further capacities and conditions are created in producing, using, distributing, or maintaining those outputs. A training programme produces instruction and credentials; it can also generate professional networks, self-confidence, recognized status, organizational routines, and future learning capacity. A transport project produces mobility services; it can generate new patterns of settlement, commercial access, land valuation, and ecological pressure. A cooperative produces goods or services while potentially generating shared governance capability and durable norms of reciprocity.

Generation can occur without an intended designer. Repeated market exchange can generate conventions. Repeated platform participation can generate data and reputational histories. Shared exposure to risk can generate mutual-aid institutions. Competitive pressure can generate organizational routines or technological standards. Conversely, deliberate interventions can fail to generate the capacities they target because the necessary relational conditions are absent.

Generated outcomes are frequently distributed unevenly. A technology can generate organizational productivity while reducing the bargaining power or skill development of particular workers. A financial instrument can generate liquidity for one group while creating systemic exposure elsewhere. Public infrastructure can generate collective access while simultaneously generating private land rents. The generative question therefore includes the location and distribution of newly created capacities and constraints.

A GRE analysis should identify the mechanism through which generation occurs. The presence of a later capacity after an intervention does not establish that the intervention generated it. Competing pathways, background trends, selection effects, and independent causes remain relevant. Historical, qualitative, quantitative, comparative, causal, formal, and computational methods can each contribute depending on the problem. Generative language becomes analytically useful when it sharpens mechanism and temporal structure rather than merely redescribing change.

Generation also includes the production of constraints. Debt can generate purchasing capacity and repayment obligations. Digital infrastructure can generate access and dependency. Standardization can generate interoperability and exclusion of incompatible practices. Institutional recognition can generate rights and categories that narrow alternative forms of identity. GRE therefore treats generativity as directionally open: what is generated may expand, stabilize, redirect, or constrain future possibility.

3.7.4 Propagation

Generated effects can move beyond the relations in which they first appear. Propagation concerns the transmission, diffusion, amplification, attenuation, or replication of resources, capacities, constraints, meanings, and forms of value through a wider relational configuration. It extends the analysis from local generation to the pathways through which generated effects become consequential elsewhere.

Propagation can occur through exchange, learning, imitation, network contact, infrastructure, standards, prices, legal precedent, organizational replication, migration, ecological flows, media, or technical interoperability. A skill acquired within one workplace may spread through labor mobility. A protocol developed by one organization may become an industry standard. A reputation produced in one network may affect credit access in another. An innovation can diffuse through suppliers and competitors. Pollution can propagate across ecological and jurisdictional boundaries.

The structure of the pathway matters. Dense networks can accelerate some forms of diffusion while creating redundancy. Centralized networks can enable rapid dissemination while producing bottlenecks or concentrated control. Institutional filters can privilege particular carriers and suppress others. Spatial distance can be reduced by digital infrastructure for information while remaining decisive for housing, care, logistics, or ecological impact. A GRE account therefore asks through which relations the effect propagates and how topology, access, and institutional authority condition that movement.

Propagation is also selective. An intervention that generates knowledge may propagate technical information more easily than tacit practice. Monetary gains may cross organizational boundaries through payments while trust remains locally embedded. Recognition can travel across institutions only when credentials or reputational signals are mutually accepted. Ecological damage can propagate physically even when financial liability does not. The form of what moves and the medium through which it moves should therefore be distinguished.

Amplification and attenuation are important possibilities. A small innovation can become economically large when network effects, complementary investment, or standardization amplify adoption. A substantial local intervention can dissipate as effects pass through weak or incompatible connections. The magnitude observed at the origin gives limited information about the magnitude realized elsewhere.

GRE also considers the distribution of access to propagation pathways. Actors positioned at interfaces, platforms, logistics hubs, standards bodies, financial intermediaries, or institutional gateways can influence what travels and under which terms. Propagation can therefore become a source of power as well as a mechanism of diffusion. The relevant inquiry concerns the relational architecture through which generated effects acquire reach.

3.7.5 Conversion

Propagation frequently encounters interfaces at which one form of resource or value is translated into another. Conversion concerns these transformations among forms. Income can become education, housing security, political access, or health. Knowledge can become credentials, intellectual property, technical standards, or market advantage. Attention can become advertising revenue. Reputation can become creditworthiness. Land can become collateral. Ecological capacity can become commodity output, while financial resources can sometimes become restoration capacity.

Conversion differs from movement within a single form. A payment transferred between accounts remains monetary propagation. A credential used to obtain employment converts recognized educational achievement into labor-market access. A public research result licensed into proprietary technology passes through an institutional conversion interface that changes the rights and forms through which its value can be realized. The distinction helps identify where commensuration, authorization, pricing, certification, or institutional recognition becomes necessary.

Conversion interfaces are rarely neutral. Actors differ in their ability to define categories, establish equivalence, set prices, issue credentials, certify quality, recognize claims, or deny access. A bank decides which assets count as acceptable collateral. A university determines which learning qualifies for a degree. A platform determines which forms of attention can be monetized and by whom. A legal system determines which interests can become enforceable rights. Control over conversion can therefore become a source of economic power.

Conversions can be partial or lossy. Rich forms of knowledge can be reduced to a credential or score. Ecological complexity can be translated into a carbon metric. Care can be monetized without preserving every relational quality attached to unpaid care. Standardization may sacrifice contextual detail while enabling interoperability across institutions. GRE therefore keeps the source form and converted form analytically distinguishable and asks what information, capacity, meaning, or control is gained or lost in translation.

Conversion can also generate additional value. A technical standard can make separate systems interoperable. A recognized qualification can enable geographic mobility. Monetization can permit resources to be exchanged across otherwise disconnected contexts. Legal incorporation can allow a collective project to contract, borrow, or hold assets. The normative significance of conversion depends on the terms, distribution, reversibility, and consequences of the transformation rather than on conversion as such.

Because heterogeneous values may resist full commensuration, GRE does not assume a universal conversion metric. Some forms may be partially convertible, institutionally incomparable, or normatively protected from exchange. The analytical task is to identify the interface, the actors who govern it, the terms under which conversion occurs, and the effects of repeated conversion on both the source and destination forms.

3.7.6 Recirculation

Generated and converted value can return to the relations and capacities that helped produce it. Recirculation concerns this return and the possibility that an economic

configuration reproduces or expands its own generative conditions through the value it creates. Recirculation provides a bridge from one-time effects to recurrent economic dynamics.

A firm may reinvest earnings in productive equipment, worker training, research, or supplier development. A cooperative may return surplus to shared infrastructure. A university may use research income to support laboratories and students who enable later research. A community institution may reinvest revenue in local services and networks. Trust produced through successful collaboration can reduce the cost of subsequent collaboration. In each case, an output contributes to the maintenance or enlargement of a condition that supports later generation.

Recirculation is broader than financial reinvestment. Knowledge can return through teaching and mentorship. Institutional capacity can return through improved procedures. Ecological value can return through restoration. Recognition can return through strengthened membership and participation. Data generated by users can be used to improve a service that then attracts further users. The relevant object is the pathway by which generated value reconnects to a generative configuration.

The rate, distribution, and governance of return matter. An organization can generate large value while returning little to the workers, communities, infrastructures, or ecosystems that sustain it. Another can deliberately allocate returns to maintain those conditions. The existence of some recirculation does not by itself establish sufficiency or justice. A system can remain self-reinforcing while distributing benefits unequally or depleting unmeasured conditions outside its accounting boundary.

Recirculation can create positive feedback. Additional capability increases later generation, which supplies further resources for capability formation. Such loops can support cumulative development, institutional persistence, or technological lock-in. Their effects depend on the underlying configuration. A virtuous cycle for one group can become an exclusionary barrier for another when access to the loop is restricted. Self-reinforcement is therefore a dynamical property to be analyzed separately from normative desirability.

GRE uses recirculation to ask whether generated value contributes to the reproduction of the capacities and relations on which future generation depends. This question is especially important where conventional accounts register output or profit while leaving maintenance, care, learning, ecological renewal, and institutional reproduction analytically peripheral.

3.7.7 Dissipation and Extraction

Generated value does not necessarily return to its generative configuration. Some of it dissipates through depreciation, obsolescence, friction, neglect, entropy, institutional turnover, loss of trust, or ecological degradation. Some is extracted by actors positioned to appropriate value without proportionately sustaining the conditions from which it arises. GRE treats dissipation and extraction as distinct pathways because their mechanisms and policy implications differ.

Dissipation can occur without an appropriating beneficiary. Infrastructure decays when maintenance is deferred. Skills weaken when unused. Organizational memory disappears through turnover. Trust erodes after repeated coordination failures. Ecological capacity can decline through cumulative pressure. Data lose relevance. Knowl-

edge becomes obsolete. These processes imply that the maintenance of a generative configuration often requires recurrent inputs rather than a one-time investment.

Extraction involves a relational mechanism of capture. Rent can be appropriated because ownership or control over a bottleneck allows an actor to claim part of the value generated elsewhere. A platform can capture value from user activity through control of infrastructure and monetization interfaces. A financial arrangement can transfer returns away from productive reinvestment. A firm can rely on public education, care work, or ecological capacity while externalizing part of the cost of reproducing those conditions. The analytical claim requires evidence of the pathway through which value is captured and of its relation to the generative configuration.

Unequal distribution alone does not establish extraction. A participant can receive a large return because it supplies scarce capital, bears risk, contributes specialized knowledge, or performs coordination. GRE therefore asks what relation supports the claim, what alternative arrangements are feasible, whether the captured value weakens or sustains the source configuration, and how bargaining power and institutional rights shape the terms of appropriation.

Dissipation and extraction can interact. Deferred maintenance can make an organization dependent on external financing, which can increase opportunities for future extraction. Extractive arrangements can reduce resources available for training or ecological renewal, accelerating dissipation. Conversely, some forms of external appropriation can finance infrastructure that improves the source configuration. Mechanism and temporal sequence matter more than categorical labeling.

The analytical purpose is to account for where generated value goes. A process that appears productive at one accounting boundary may look fragile once maintenance requirements, externalized costs, and captured returns are traced over time. This wider accounting remains plural: GRE need not translate every dissipated or extracted form into money in order to analyze its economic significance.

3.7.8 Structural Transformation

Repeated allocations, mediations, generation, propagation, conversion, recirculation, dissipation, and extraction can alter the relational structure within which later economic action occurs. Structural transformation concerns changes in relatively persistent configurations of access, authority, dependency, coordination, classification, ownership, infrastructure, and institutional recognition. The analytical horizon therefore moves from flows through a structure to changes in the structure itself.

A credit programme can gradually create new financial histories that alter who is considered bankable. Platform adoption can reorganize market access and bargaining relationships. Public infrastructure can change settlement patterns and land values. Repeated outsourcing can transform organizational boundaries and labor relations. An educational expansion can change occupational competition and credential requirements. Long-term extraction can concentrate ownership sufficiently to reshape political and market power. These effects persist because the relations through which later actors operate have changed.

Structural transformation can be cumulative. Small changes in network access, standards, expectations, or institutional categories may become mutually reinforcing. Once a technical standard reaches broad adoption, complementary investments increase switching costs. Once a legal category becomes embedded in administrative

systems, data structures, and organizational routines, later decisions may reproduce it. Such persistence does not imply irreversibility, yet reversal can require interventions different in kind from those that produced the initial change.

Structure is scale-relative. A transformation that appears structural for a household may be local from the perspective of a national economy. A regulatory change can be structural for an industry while leaving broader institutional arrangements intact. GRE therefore specifies the scale and boundary at which structural transformation is claimed. The term should signal a change in the organization of relations relevant to the inquiry rather than function as a synonym for any large effect.

Structural transformation can redistribute generative capacity. New infrastructure can enable some actors to participate while making others dependent on centralized systems. Consolidation can create investment capacity and reduce diversity of organizational forms. A new property regime can make resources legible and tradable while displacing customary claims. GRE asks how the changed structure reorganizes the possibilities available to different subjects and which later pathways become easier, harder, visible, or inaccessible.

At this stage, the analytical perspective begins to become recursive. Structures mediate later allocations and generation, while those processes can further transform structure. The economy is therefore approached as historically layered: present relations carry residues of earlier allocations, conversions, institutions, conflicts, and generative cycles.

3.7.9 Transformation of Generative Conditions

Structural change becomes especially significant when it alters the conditions that make later generation possible. Generative conditions include capacities, infrastructures, ecological resources, legal permissions, institutional trust, knowledge bases, standards, networks, interpretive categories, and other background arrangements through which new economic possibilities can emerge. Transformation of generative conditions concerns changes in this enabling and constraining environment.

The distinction between generated output and generative condition is temporal and relational. A research project can produce a paper as an output while training researchers who become a condition for later inquiry. A transportation system can provide current mobility while also changing the accessibility structure through which future firms and households choose locations. A legal reform can resolve a present dispute while changing the institutional expectations that shape later contracting. Restoration can generate present employment and rebuild ecological capacity that supports future livelihoods.

Conditions can become more or less diverse. An economy can accumulate specialized capabilities that deepen productive potential within one technological trajectory while reducing adaptability to alternative trajectories. Standardization can create broad interoperability while narrowing variation. Concentrated infrastructure can generate scale economies while increasing dependency on a small number of providers. GRE therefore examines the composition of generative capacity, including redundancy, diversity, reversibility, and dependence.

Generative conditions are distributed. The capacity to innovate may depend on public education, care systems, research institutions, finance, standards, migration regimes, energy infrastructure, social trust, and ecological stability. No single ac-

tor needs to own these conditions for them to shape economic possibility. This distributed character makes attribution and governance difficult: benefits may be privatized while maintenance costs remain collective, or collective institutions may fail to recognize contributions occurring outside formal accounting systems.

Changes in generative conditions can also alter who counts as an economic subject. Digital identity systems can enable participation for some subjects and exclude others. New organizational forms can recognize collective actors. Artificial systems can acquire delegated decision capacities that change the distribution of agency in markets and institutions. Educational and technical infrastructures can transform the capacities through which persons become able to participate in particular forms of production or exchange. These questions prepare the more focused treatment of economic subjecthood in the following section, while the present subsection keeps attention on the background conditions through which such subject positions become possible.

The GRE perspective therefore evaluates interventions partly by their effects on future generativity. Immediate welfare or output remains important, yet an intervention can also be assessed by whether it expands, concentrates, diversifies, depletes, or forecloses the conditions from which later value and action can emerge. Such evaluation requires an explicit temporal horizon and awareness that future uses cannot be fully specified in advance.

3.7.10 Transformation of the Effective Rule of Change

The deepest analytical extension concerns situations in which economic processes transform the effective rule through which subsequent change occurs. A structural configuration can change while the basic mechanisms governing adjustment remain similar. In other cases, the mechanisms themselves are reorganized: new institutions redefine permissible transactions, technologies create new categories of action, collective learning changes how actors respond, platforms redesign market matching, legal reforms alter rights and enforcement, or artificial systems introduce new forms of automated selection and adaptation. GRE treats such cases as transformations of the effective rule of change.

The phrase *effective rule* is deliberately modest. It does not imply that an economy possesses one literal master equation. It refers to the locally relevant mechanisms, institutional procedures, response functions, selection environments, and constraints through which changes in the studied configuration are produced. Different methods can represent these rules differently. A historian may reconstruct them through institutional sequences, an economist through behavioral or equilibrium relations, a network analyst through evolving topology, an ethnographer through changing practices, and a computational model through explicit update procedures.

Rule transformation occurs when later dynamics cannot be adequately described by holding those mechanisms fixed. A market governed by bilateral bargaining can become a platform-mediated market in which ranking algorithms and platform rules shape matching and price formation. A monetary system can acquire new instruments that change transmission mechanisms. A labor process can move from human supervision to algorithmic allocation, altering how performance is measured and how workers adapt. A regulatory reform can change the criteria through which organizations become eligible, compliant, or sanctionable. The later system is con-

nected historically to the earlier one while operating through modified mechanisms.

Rule transformation is especially important under reflexivity. Economic subjects learn, anticipate policies, reinterpret categories, and adapt to models used to govern them. Institutions respond to observed behavior. Firms redesign strategies when competitors imitate them. Regulators revise rules when existing rules generate unintended effects. The object of analysis can therefore react to the representations and interventions applied to it. A stable rule may remain a useful local approximation, yet GRE keeps open the possibility that repeated interaction changes the mechanisms on which the approximation depended.

The transformation of effective rules also raises a governance problem. Interventions can influence more than outcomes within a given system; they can shape the procedures through which future outcomes will be produced. A procurement rule can determine which organizational forms survive long enough to compete later. A data standard can define what becomes measurable and therefore governable. Intellectual-property rules can influence the future distribution of innovation incentives and knowledge access. Educational assessment can alter what institutions teach and what learners treat as valuable. These interventions operate partly at the level of the future change process itself.

This final analytical moment does not make every economic change a case of rule transformation. The claim requires evidence that the mechanisms generating later transitions have materially changed. Maintaining this threshold preserves the distinction among movement within a structure, transformation of structure, transformation of generative conditions, and transformation of the effective rule of change.

Taken together, the ten moments of the GRE perspective provide a layered way to follow economic action through time and relation. Allocation identifies an initial placement of resources, rights, burdens, or attention. Relational mediation specifies the configuration through which that placement becomes operative. Generation identifies newly produced capacities, constraints, values, subjects, or possibilities. Propagation follows their movement; conversion follows changes of form; recirculation follows return to generative configurations; dissipation and extraction account for loss and capture. Structural transformation asks how persistent relations are reorganized. Transformation of generative conditions asks how the capacity for later generation changes. Transformation of the effective rule of change asks whether the mechanisms producing future transitions have themselves been altered.

The sequence remains a heuristic research architecture. Empirical cases can contain loops, branching pathways, simultaneous processes, and multiple scales whose temporal order is only partially recoverable. GRE's distinctive perspective lies in making these layers available for explicit inquiry while preserving the possibility that a narrower established economic analysis may be sufficient for a particular question. The next section turns from this analytical architecture to one of its most consequential objects: the economic subject itself, whose identity, recognition, capacities, and persistence can be treated as historically and relationally generated rather than analytically fixed in advance.

3.8 GRE and the Economic Subject

Generative Relational Economics (GRE) requires a conception of the economic subject that is sufficiently stable for analysis and sufficiently open to account for historical transformation. The role of this section is to specify that conception after the preceding sections have established GRE's objects, scales, problem families, and distinctive analytical sequence. Its objective is to explain how persons, organizations, artificial systems, and other configurations can occupy economically consequential subject positions without assuming that subjecthood is a timeless property given prior to economic relations. The discussion proceeds through eight connected problems: the movement from given agents to relationally situated subjects; institutional recognition; relational persistence; the coexistence of human and artificial economic subjects; heterogeneity among subjects; capability asymmetry and ontological distinction; participation under conditions in which productive necessity may decline; and subject formation itself as an economic process. The method is constitutive rather than taxonomic. GRE does not attempt to settle the metaphysics of personhood, consciousness, or agency. It specifies a working analytical conception of subjecthood adequate to economic inquiry while preserving ontological suspension and explicit normative separation.

Within this framework, an *economic subject* is a relatively stabilized locus of economically consequential participation that can be identified within a relational configuration. Such participation may include choosing, claiming, producing, consuming, owning, borrowing, contracting, coordinating, representing, interpreting, allocating, governing, bearing risk, receiving recognition, or being made answerable for an economic event. Different forms of subjecthood need not contain the same capacities. A human worker, a household, a corporation, a public agency, and an automated trading system can occupy very different kinds of economic subject position. Their inclusion within a common analytical vocabulary records their participation in economic relations; it does not establish metaphysical, experiential, juridical, or moral equivalence among them.

This distinction is especially important because economic theory often gains tractability by beginning with an already individuated agent. GRE can use such models when the research question warrants them, yet its broader programme keeps open the prior question of how the agent became recognizable, durable, capable, and economically situated. The economic subject can therefore be treated both as a participant in economic dynamics and as a possible product of those dynamics. Wage relations, property regimes, credit systems, organizational membership, legal classifications, technical infrastructures, educational institutions, platforms, and systems of representation can all help constitute which subjects exist for an economic process, what they can do, how they are recognized, and which futures become available to them.

3.8.1 Relationally Situated Economic Subject

A large class of economic models begins with agents whose identities, preferences, feasible actions, and relevant resources are specified before the modeled interaction begins. This abstraction can be highly productive. It makes possible clear analysis of choice, exchange, strategic interaction, allocation, and equilibrium. GRE retains

these analytical resources while adding a complementary question: under which relations did the modeled agent become the kind of subject for whom those preferences, capacities, resources, and feasible actions are available?

The move from a given agent to a relationally situated subject changes the analytical starting point. A worker enters a labor market with skills formed through education, family relations, health, language, migration status, credentialing, and previous employment. A firm enters a market through legal incorporation, ownership arrangements, financing, supplier relations, infrastructure, standards, and accumulated organizational routines. A consumer appears in a platform economy through accounts, payment systems, identity verification, recommendation systems, device access, and categories through which demand is represented. In each case, the subject remains a meaningful analytical unit, while its capacities and boundaries are understood as relationally conditioned.

Relational situatedness does not imply that a subject is reducible to its relations. GRE requires enough analytical independence to speak about a subject's actions, interests, experiences, holdings, or capabilities when those categories are warranted. The point is that such independence is historically and institutionally achieved to varying degrees. A property owner can act independently with respect to an asset because institutions stabilize ownership claims. A worker can negotiate because labor law, organizational rules, scarce skills, collective representation, or outside options provide a position from which negotiation is possible. A household can plan because some flows of income, care, residence, and obligation persist through time. Subjecthood therefore contains a relation between relative individuation and continuing dependence.

This approach also prevents agency from being treated as a single scalar quantity. A subject may possess substantial agency in one relation and little in another. A highly skilled employee may exercise considerable control over technical decisions while possessing limited bargaining power over employment conditions. A small firm may choose its product design while remaining strongly constrained by a dominant platform or creditor. A government agency may have formal authority but limited informational or implementation capacity. GRE therefore asks which dimensions of agency are operative, through which relations, and at which scale.

Relational situatedness further allows preferences and objectives to be historically formed without assuming that they are infinitely malleable. Education, advertising, professional communities, organizational cultures, social norms, technologies, and repeated interactions can affect what subjects attend to, expect, desire, or regard as feasible. A research programme can study these processes without denying that subjects also exhibit persistence, reflection, resistance, and internally organized commitments. GRE's analytical interest lies in the conditions through which orientation is formed and revised, a problem developed more directly in the following section on the orientation of generation.

The relationally situated subject therefore supplies an intermediate analytical position. It is more structured than an undifferentiated relational field because it permits attribution of action, capacity, burden, and value to relatively stabilized participants. It is more historically open than a permanently given agent because its boundaries, capacities, orientations, and recognized positions can themselves become objects of inquiry. This duality is central to GRE's treatment of subjecthood.

3.8.2 Subjecthood and Institutional Recognition

Economic subjecthood depends partly on recognition. Institutions specify who can open an account, hold property, enter a contract, receive a payment, owe a tax, register a company, claim a benefit, represent an organization, access a market, or be counted within an administrative category. Recognition converts a potential participant into a legible participant for a particular institutional process. The resulting subject position can carry rights, obligations, expectations, records, and pathways for future action.

Recognition is distributed across institutions rather than concentrated in a single act. Legal systems recognize persons, organizations, property titles, and contractual capacities. Firms recognize employees, managers, vendors, customers, and authorized representatives. Financial institutions recognize account holders, borrowers, guarantors, and beneficial owners through their own procedures. Platforms recognize users, creators, advertisers, sellers, developers, and automated processes through technical accounts and permissions. Public programmes recognize beneficiaries through eligibility categories. Statistical systems recognize populations through classifications that subsequently shape policy and resource allocation.

These forms of recognition need not coincide. A participant can be economically active while remaining weakly represented in administrative data. A person can be recognized by one institution and excluded by another. An organization can exist juridically while possessing limited practical capacity to act. A platform account can exercise extensive economic functions while the relevant legal obligations remain assigned to a human or organizational principal. GRE therefore treats recognition as relation-specific. It asks who or what recognizes the subject, for which purpose, under which criteria, and with which consequences.

Institutional recognition can also generate capacities. Registration can permit access to banking, procurement, insurance, or legal enforcement. A professional credential can authorize entry into a labor market. A credit history can create or restrict borrowing possibilities. A platform reputation can affect visibility and transaction opportunities. Recognition is therefore more than descriptive classification. Under some conditions it becomes a productive resource whose possession changes future possibilities.

The converse process is economically consequential as well. Misrecognition, weak recognition, or exclusion from relevant categories can constrain participation even when material capacity exists. A skill that lacks accepted certification may command less value. Informal work can remain economically important while receiving limited legal protection or statistical visibility. Care activities can sustain productive systems while remaining weakly represented in monetary accounts. GRE can analyze these situations by separating material contribution, institutional recognition, representational visibility, and normative valuation rather than treating them as a single dimension.

Recognition also creates subject positions that may reshape conduct. A person classified as debtor, beneficiary, employee, high-risk customer, eligible applicant, or verified creator encounters a different opportunity structure and may respond to the expectations associated with that position. The category becomes economically generative when it affects access, incentives, treatment by others, or self-understanding. The same mechanism applies to organizations. Classification as a regulated institu-

tion, nonprofit entity, startup, contractor, or systemically significant actor can alter available strategies and obligations.

GRE therefore treats institutional recognition as one mechanism through which economic subjecthood becomes stabilized. It remains distinct from ultimate personhood or moral status. Institutional categories can be revised, contested, strategically used, or shown to be inadequate. Their analytical importance lies in the fact that economies operate through such acts of recognition, and those acts participate in generating the subjects that economic analysis subsequently encounters.

3.8.3 Subjecthood and Relational Persistence

Recognition at one moment is insufficient for many economic processes. Credit, employment, ownership, reputation, insurance, investment, planning, responsibility, and cooperation depend on some capacity to identify a subject across time. GRE therefore treats relational persistence as another condition of economic subjecthood. Persistence means that a configuration can remain sufficiently identifiable across a sequence of interactions for expectations, records, obligations, capacities, and value to accumulate around it.

Persistence does not require immutability. A corporation can change employees, owners, strategies, and assets while remaining recognizable as the same juridical organization for relevant purposes. A household can change membership while retaining continuing obligations and resources. A person can change occupation, preferences, health, wealth, and social position while maintaining biographical and institutional continuity. An artificial system can be updated or retrained while an operational identity, account, mandate, or deployment context persists. Subjecthood therefore depends on criteria of continuity that vary by domain.

Different institutions stabilize continuity through different devices. Names, identifiers, contracts, registries, records, credentials, accounts, signatures, organizational charts, audit trails, reputational histories, and technical logs can all support persistence. These devices allow past interactions to influence present treatment. They make possible credit histories, employment records, accumulated reputation, continuing ownership, delegated authority, and accountability. In this sense, memory is partly institutionalized in economic relations.

Persistence has generative consequences because accumulated history changes future opportunities. Trust can deepen through repeated cooperation. Debt can compound. Reputation can open or close markets. Skills can accumulate through practice. Organizational routines can increase coordination capacity. A history of exclusion can constrain later access even when formal rules change. Economic subjecthood therefore has a temporal dimension: the subject is often a carrier of selectively preserved history.

The preservation is always partial. Institutions decide which past events remain legible and which disappear. Credit systems preserve some payment histories while ignoring many contextual circumstances. Employment records preserve formal roles while omitting informal contribution. Platform metrics preserve selected traces of participation. Historical records may be unequally available across groups and organizations. GRE therefore treats persistence as an epistemic and institutional construction as well as a temporal fact. The subject that appears stable to an analyst may be stabilized by selective recording.

Relational persistence can also fail. Organizations dissolve, identities become contested, records disappear, contractual relations end, platforms remove accounts, or political and technological transformations invalidate previous classifications. Such failures can release subjects from prior constraints, erase accumulated value, disrupt responsibility, or create opportunities for reconstitution. Subject dissolution is therefore part of the economic analysis of subjecthood rather than a mere exception to stable identity.

This temporal view enables GRE to analyze subject formation without assuming a permanent core that economic relations simply reveal. A subject can become more or less coherent, legible, capable, autonomous, or constrained through time. The relevant question is which mechanisms sustain continuity, what they preserve, what they suppress, and how persistence alters the subject's future generative possibilities.

3.8.4 Human and Artificial Economic Subjects

The increasing delegation of economically consequential tasks to artificial systems makes the category of economic subject more complex. Software already performs functions such as ranking, pricing, matching, forecasting, bidding, recommending, filtering, scheduling, allocating attention, and executing transactions under specified conditions. More capable artificial systems can also participate in extended sequences of planning, communication, and decision support. GRE requires a vocabulary that can analyze such participation without presuming that functional capability settles questions of consciousness, personhood, moral standing, or legal status.

A useful distinction is between *human subjecthood* and *artificial operational subjecthood*. Human economic subjects are embodied, vulnerable, temporally finite participants whose economic lives are connected to experience, welfare, social membership, care, rights, and material dependence. Artificial operational subjects can occupy functionally stabilized positions in economic processes when systems are authorized, configured, or institutionally treated as loci through which actions are selected and executed. Their economic relevance can be substantial even when ultimate responsibility, ownership, or legal personality remains assigned elsewhere.

Operational subjecthood can arise through delegation. An organization may authorize a software system to execute trades within limits, set prices, route logistics, select advertisements, or communicate with customers. The system then becomes a proximate locus of economically consequential action. The relevant GRE questions concern the relations that enable this delegated position: who defines the objective, who supplies data, who controls deployment, who bears losses, who can override the system, how actions are attributed, and how generated value returns to the surrounding organization.

This approach avoids a binary choice between treating artificial systems as mere passive tools and treating them as equivalents of human persons. The appropriate analytical status can vary with the inquiry. For a study of market microstructure, an automated trading agent may be a meaningful economic subject because its decisions affect prices and counterparties. For a study of moral injury, welfare, or distributive justice, the same system may be better analyzed as infrastructure or delegated mechanism while the human and organizational subjects bearing consequences remain central. Subject classification is therefore question-relative.

Artificial systems can also become components of hybrid subjects. A professional using advanced decision support may acquire capacities unavailable to either the human or the system considered independently. A firm can reorganize around automated coordination. A scientific team can distribute cognitive work across researchers, instruments, databases, and models. A platform can combine algorithms, human moderators, sellers, and users into an operational configuration. GRE can treat such configurations as composite subjects when the composite exhibits sufficient persistence, coordination, and causal relevance for the local question.

The distribution of agency within hybrid configurations is a separate problem from identifying the composite. Delegation can obscure responsibility when an outcome is attributed to “the algorithm” despite organizational choices concerning data, objectives, thresholds, deployment, monitoring, and recourse. Conversely, attributing every artificial action directly to one human decision-maker can ignore emergent behavior, organizational fragmentation, and the practical autonomy created by scale and speed. GRE therefore encourages mechanism-specific attribution across the relations that produce the action.

The coexistence of human and artificial economic subjects also changes the ecology of capability. Artificial systems can amplify the productive and cognitive capacity of some human or organizational subjects more than others. Access to compute, proprietary data, infrastructure, legal expertise, capital, and distribution can determine who benefits from artificial capability. The economic significance of artificial subjecthood consequently lies not only in what a system can do, but in how its capability is situated within ownership, institutional recognition, delegation, and return structures.

3.8.5 Heterogeneous Subjects

GRE treats heterogeneity among economic subjects as a constitutive feature of inquiry rather than a residual deviation from a representative agent. Subjects can differ in material needs, bodily vulnerability, temporal horizon, information, attention, cognitive style, social recognition, bargaining position, legal status, technological access, organizational scale, ecological dependence, and forms of value they regard as significant. These differences shape both immediate economic behavior and the generative consequences of economic relations.

Heterogeneity matters even when subjects receive formally identical resources. A monetary transfer can have different effects depending on debt, housing security, health, care obligations, local prices, social networks, or access to complementary services. The same information can be useful to one subject and unusable to another because complementary knowledge or infrastructure differs. The same employment opportunity can expand freedom for one person and intensify constraint for another because mobility, care responsibilities, or legal status differ. GRE therefore asks how an intervention interacts with subject-specific and relation-specific conditions.

Heterogeneity also concerns value. Subjects can evaluate the same outcome through different normative, cultural, professional, ecological, or experiential frameworks. A land-use change may appear as increased asset value to one actor, loss of livelihood to another, ecological degradation to a third, and disruption of cultural continuity to a fourth. Economic analysis can sometimes translate these differences into a common measure for a specific decision. GRE does not assume in advance that

every relevant value admits such conversion without remainder.

Subjects also differ in their capacity to make their valuations institutionally consequential. Some can purchase expertise, influence standards, control platforms, set contractual terms, or withdraw resources. Others possess weak bargaining power or limited representational access. Heterogeneity therefore interacts with asymmetry. A plural economy does not merely contain different preferences; it contains differently empowered subjects whose ability to stabilize their preferred classifications, metrics, and conversion rules can vary substantially.

Artificial and organizational subjects add further dimensions of heterogeneity. A corporation can persist for durations and command resources unavailable to an individual. An automated system can process information at a speed and scale that differs from human cognition. A public institution can exercise authority through rules rather than exchange. A household coordinates care and consumption through relations that are only partially contractual. Treating these subjects as analytically identical would conceal the mechanisms through which they act.

GRE's response is methodological pluralism at the level of subject modeling. Some questions can use utility functions, representative agents, or homogeneous populations. Others require types, distributions, networks, institutional categories, narratives, or qualitative reconstruction. The choice should follow the mechanism and scale of interest. Heterogeneity becomes analytically important when differences among subjects alter generation, propagation, conversion, bargaining, recognition, or exposure to risk.

This perspective also protects against interpreting difference as deficiency. A subject whose capacities do not match the requirements of a particular market or institution may still possess substantial capabilities that the institution does not recognize or reward. Economic subjecthood is therefore partly relational to the evaluative and infrastructural environment. The same person or organization can appear highly capable in one configuration and weakly capable in another. GRE analyzes that relational fit rather than converting every difference into a single hierarchy of subject quality.

3.8.6 Capability Asymmetry and Ontological Distinction

Economic subjects can differ enormously in capability. A multinational firm and an individual consumer do not command comparable resources. A state and a household occupy different institutional positions. A specialized artificial system can outperform a human participant on a bounded computational task while lacking many features that organize human economic life. GRE therefore separates capability comparison from ontological classification and from normative status.

Capability is multidimensional. It can concern computation, memory, prediction, physical action, social coordination, capital access, legal authority, mobility, learning, creativity, endurance, attention, bargaining, or the capacity to absorb loss. A subject can be strong on one dimension and weak on another. Aggregate labels such as "more capable" therefore require explicit specification of the relevant capability domain and the task or environment in which it is measured.

The distinction becomes especially important in human-artificial comparison. Superior performance by an artificial system on prediction, optimization, search, coding, or information processing demonstrates a capability difference in the specified

domain. It does not by itself establish equivalence in embodiment, vulnerability, experience, social membership, moral standing, legal personality, or other ontological and normative dimensions. Conversely, inferior productive performance by a human subject does not imply diminished moral status or a weaker claim to social participation. Productive capability and normative worth belong to different analytical registers.

GRE therefore resists deriving subject status directly from productivity. Economies routinely assign value to capacities that are historically contingent: strength in one technological regime, literacy in another, credentialed expertise in another, computational skill in another. Technological change can rapidly alter which capacities command market value. If recognition or participation were tied directly to currently scarce productive capabilities, changes in technology could destabilize subject status in ethically and politically consequential ways. GRE treats that possibility as an object of economic analysis rather than as a normative conclusion supplied by productivity itself.

Capability asymmetry also generates power when it affects the terms under which others can participate. A platform with superior information and scale can shape market access. A creditor with greater liquidity can impose conditions on a constrained borrower. An organization equipped with advanced artificial systems can negotiate, monitor, or produce at a level unavailable to smaller actors. The relevant issue is the conversion of capability difference into durable relational advantage. Not every asymmetry becomes power, and the mechanism of conversion requires specification.

Institutional design can amplify or moderate capability asymmetry. Standards, interoperability, public infrastructure, collective bargaining, competition rules, education, access to compute, liability arrangements, and rights of appeal can change how capability differences affect participation. GRE's interest lies in the resulting generative structure: which subjects gain new capacities, which become dependent, which forms of value are captured, and whether the asymmetry reproduces itself through control over the conditions of future generation.

The separation among capability, ontology, and normativity thus performs several analytical functions. It permits precise comparison where comparison is meaningful. It prevents performance metrics from silently becoming theories of personhood. It allows economic analysis to study artificial subjects without assuming human equivalence. It also preserves a space in which questions of justice, rights, dignity, or welfare can be evaluated through appropriate normative arguments rather than inferred from market productivity.

3.8.7 Subjective Participation beyond Productive Necessity

Technological development raises a further question for the constitution of the economic subject: how is participation organized when a subject's contribution is no longer required for a particular productive task? Automation has long displaced and transformed tasks, while new technologies have also created new occupations, complementary roles, and forms of demand. GRE does not assume a predetermined endpoint of this process. It identifies a structural problem that becomes more visible as productive capability can be supplied by machines or highly concentrated organizations: economic participation and social subjecthood may become less tightly coupled

to productive necessity.

Historically, many economic institutions connect income, recognition, schedule, social interaction, insurance, status, training, and future opportunity to employment or productive contribution. When a task disappears, the loss can therefore extend beyond wages. A subject can lose routines, networks, bargaining position, identity, institutional recognition, and pathways for capability development. Analyses that record only the change in output or income can miss this wider transformation of subject position.

GRE uses the idea of *subjective participation* to name participation through which a person or collective can remain an active locus of choice, recognition, relation, contribution, and value formation within economic life. Productive work can be one important form of such participation, but the category is broader. Care, learning, civic contribution, cultural production, scientific inquiry, community activity, consumption, stewardship, and relational maintenance can all organize economically consequential participation even when their market valuation is limited or indirect.

The economic question is therefore partly institutional. If productive necessity declines for some subjects, which mechanisms connect them to resources, capabilities, recognition, and opportunities for meaningful participation? Several institutional arrangements are conceivable, and GRE need not select among them at the level of disciplinary constitution. The research programme can instead examine how different arrangements affect autonomy, dependence, value generation, social recognition, bargaining power, capability development, and the distribution of future possibilities.

This problem also applies within organizations. An employee whose routine tasks are automated can become more capable when artificial tools release time for judgment, learning, care, design, or coordination. The same technological change can instead narrow the employee's role to monitoring a system controlled elsewhere. The distinction depends on ownership, training, discretion, workflow design, evaluation, and bargaining relations. Automation therefore transforms subjecthood through the surrounding institutional field rather than through task substitution alone.

Artificial systems intensify the question because they can participate in economic processes without requiring the same conditions for welfare, livelihood, social membership, or embodied reproduction as human subjects. A production system organized solely around output can therefore allocate increasingly large shares of economically consequential activity to artificial or organizational subjects while human participation becomes administratively residual. Whether and how institutions respond is a normative and political question; the economic analysis concerns the relations through which such a configuration affects value, demand, bargaining, recognition, capability, and social reproduction.

GRE thus separates the right to analyze productive contribution from the broader question of subject participation. It does not assume that economic inclusion must be earned through scarcity of labor, nor does it presume a specific institutional alternative. It asks how systems generate or foreclose forms of participation when technological and organizational change modifies the economic necessity of particular human capacities. The answer will depend on the orientation of generation, the subject of the following section.

3.8.8 Subject Formation as an Economic Process

The preceding subsections imply a final constitutional claim: subject formation is itself an economic process. Economic relations do more than coordinate already formed subjects. They participate in producing the capacities, identities, expectations, dependencies, temporal horizons, and recognized positions through which subjects subsequently act. GRE therefore includes subject formation within its field of inquiry whenever economic mechanisms materially contribute to that formation.

Labor markets provide a clear illustration. Education and credentialing prepare subjects for occupational categories; hiring procedures classify them; employment develops some skills while allowing others to decay; organizational hierarchies distribute authority; compensation affects outside options; performance metrics orient attention; career ladders shape expectations about the future. The resulting worker is neither created wholly by the labor market nor independent of it. Subject formation occurs through the interaction of economic, educational, familial, legal, cultural, technological, and biological processes.

Credit relations can similarly generate debtor subject positions. Access to credit expands purchasing or investment capacity while repayment schedules reorganize future income. Credit histories affect later access. Default categories alter institutional treatment. Financial literacy, risk tolerance, and expectations can change through repeated borrowing. The economic subject that returns to a credit market is therefore historically modified by previous participation.

Platforms generate other subject forms through accounts, metrics, rankings, recommendation systems, monetization rules, and categories of permissible participation. A person can become a seller, creator, driver, host, advertiser, moderator, or rated customer through platform-specific infrastructures. These positions can create capabilities and income while also subjecting participants to new dependencies, forms of visibility, and evaluative systems. Artificial systems can likewise acquire operational subject positions through permissions, interfaces, memory, delegated objectives, and persistent identifiers.

Property institutions contribute to subject formation by stabilizing relations of control, responsibility, inheritance, exclusion, and expectation. Welfare institutions constitute beneficiary categories. Tax systems recognize households, firms, dependents, and taxable events. Corporate law stabilizes organizations that can persist beyond individual members. Monetary institutions constitute account holders and counterparties. Economic subjecthood therefore emerges repeatedly through institutional architectures that define who can do what, with which resources, under which records and obligations.

Subject formation also has recursive effects. Once a subject position is stabilized, subjects can act to preserve, reinterpret, contest, or transform the relations that formed them. Workers organize; firms lobby; consumers coordinate; professional groups set standards; communities create institutions; platform participants develop practices that alter platform design. Subject formation is therefore compatible with reflexivity. Generated subjects can become generators of subsequent institutional change.

This recursive structure connects subject analysis to GRE's broader concern with transformation of generative conditions. An economic system can generate subjects whose capacities and orientations reinforce the system. It can also generate subjects

capable of questioning, modifying, or leaving it. Educational investment can create workers suited to an existing industrial structure while also producing knowledge that enables new industries. Financial systems can stabilize prevailing ownership while funding innovations that disrupt incumbent firms. Organizational routines can reproduce hierarchy while creating expertise that later supports institutional reform. The direction of subject formation is therefore neither mechanically reproductive nor inherently emancipatory.

For empirical work, treating subject formation as an economic process requires evidence appropriate to the mechanism. Administrative records can reveal changing classifications and access. Longitudinal data can track capability or income trajectories. Organizational records can show role transformation. Interviews and ethnography can recover changes in interpretation, identity, and perceived possibility. Experiments can identify bounded responses to institutional arrangements. Computational methods can trace large-scale patterns of classification or interaction. GRE does not privilege one method; it requires the method to match the dimension of subject formation being claimed.

The economic subject can now be located within the constitutional architecture of Chapter 3. GRE treats subjects as relatively stabilized participants whose capacities, recognition, persistence, and orientations are relationally conditioned and historically transformable. Human, organizational, and artificial subjects can all enter economic analysis while remaining ontologically and normatively distinct. Capability asymmetry can shape power without determining moral status. Participation can remain economically important even when particular productive contributions lose scarcity. Subject formation itself can be generated through economic relations and can recursively transform those relations in return.

This account also identifies the next constitutional problem. If economic relations help generate subjects, capacities, attention, and future possibilities, the direction of that generation cannot be treated as analytically empty. Economic systems select, reward, amplify, suppress, and stabilize different possibilities. Section 76 therefore turns from the constitution of subjects to the orientation of generation: the processes through which attention, curiosity, aesthetic judgment, epistemic priorities, institutional selection, and heterogeneous value structures influence what becomes economically generative.

3.9 GRE and the Orientation of Generation

Generative Relational Economics treats economic generation as more than the production of additional outputs from given inputs. Economic relations can enlarge, redirect, stabilize, or close future possibilities; they can generate capacities, questions, representations, institutions, expectations, forms of value, and modes of participation. Once generation is understood in this wider sense, a further analytical problem becomes unavoidable: generative processes are oriented. Among many possible objects of attention, questions, investments, designs, interpretations, and institutional trajectories, some become salient and others remain peripheral. The role of this section is to make that directional dimension explicit within the constitution of GRE. Its objective is to identify several mechanisms through which orientation is formed and economically consequential without reducing orientation to a single pref-

erence ordering or normative criterion. The discussion proceeds through attention and salience, curiosity and question formation, aesthetic judgment, epistemic orientation, institutional selection, and heterogeneous value structures before locating orientation itself as an economic and political problem. The method remains constitutive rather than exhaustive: these mechanisms identify admissible objects of GRE inquiry and can be combined differently across empirical domains.

Orientation occupies a position between possibility and realized generation. A field can contain several technically feasible innovations, several plausible interpretations of evidence, several ways of organizing care, several institutional reforms, or several investments capable of producing future value. Generativity alone does not determine which possibility receives resources, recognition, attention, or continued development. Selection occurs through subjects, organizations, infrastructures, norms, evaluative conventions, histories, and unequal capacities to make one possibility visible or actionable. GRE therefore asks not only what a relation can generate, but how its generative direction becomes selected, reinforced, contested, or revised.

This problem is distinct from saying that every economic process possesses a conscious purpose. Orientation can arise without centralized intention. Search rankings alter attention; funding rules privilege some questions; professional conventions stabilize standards of relevance; prices redirect investment; built environments make some actions easier than others; inherited categories determine what can be recorded; and repeated interaction can make one trajectory increasingly probable. Orientation can therefore be intentional, institutional, distributed, emergent, or mixed. What matters for GRE is the mechanism through which a space of possibilities becomes unevenly weighted and how that weighting changes subsequent generation.

3.9.1 Direction within Generative Processes

Generation becomes analytically directional whenever several possible continuations are available and the realized process favors some over others. A research group can investigate several questions but allocates effort to a subset. A firm can deploy capital across several technologies but selects particular projects. A city can support several mobility arrangements but builds infrastructure that makes some trajectories easier to reproduce. A household can convert additional income into consumption, education, savings, care, mobility, or debt reduction. In each case, resources enter a relational configuration whose later consequences depend partly on how possibilities are selected.

Direction should be distinguished from destination. A destination specifies an endpoint toward which activity is explicitly organized. Direction can be weaker and more distributed. It can consist in a persistent bias toward particular questions, objects, timescales, values, or forms of recognition even when no actor has specified a final state. An institution that rewards measurable short-term outputs may orient inquiry toward easily countable achievements without formally prohibiting long-horizon research. A credit system can orient firms toward revenue models compatible with repayment schedules without prescribing a specific product. A platform can orient cultural production through visibility metrics even when creators retain formal freedom over content. GRE is interested in these directional effects because they alter the future distribution of generative opportunity.

Orientation should also be distinguished from deterministic selection. A strong directional field can coexist with novelty, resistance, and contingency. Subjects can reinterpret incentives, institutions can be repurposed, and unexpected relations can open alternatives. The analytical claim is therefore probabilistic and structural: some configurations make particular generative pathways easier to enter, sustain, fund, legitimate, or recognize than others. The strength of orientation is an empirical question that can vary across scales and historical periods.

The concept also permits several levels of analysis. At the level of a subject, orientation can concern attention, aspiration, perceived possibility, or evaluative judgment. At the organizational level, it can concern strategy, metrics, hiring, budgeting, and project selection. At the institutional level, it can concern law, professional standards, eligibility rules, and classification systems. At the infrastructural level, it can concern access, interoperability, search, transportation, or computation. At the cultural level, it can concern what appears admirable, credible, urgent, or worth pursuing. These levels can reinforce or conflict with one another.

Direction becomes especially consequential when orientation feeds back into the conditions of future choice. A selected research programme develops specialized instruments and expertise, making adjacent questions easier to investigate. An industry cluster attracts suppliers and workers, increasing the relative feasibility of further investment in the same domain. A classification adopted for administrative convenience can accumulate datasets organized around its categories, making alternative classifications harder to operationalize. What begins as selection among possibilities can therefore become a transformation of the possibility structure itself.

GRE treats this recursive effect as one reason to study orientation separately from immediate allocation. Allocation determines where resources initially go. Orientation concerns the relational processes that make some uses, interpretations, and continuations more likely to become generative. Their interaction can produce path dependence without requiring that the path was planned in advance. Orientation is thus a bridge between local selection and historical transformation.

3.9.2 Attention and Salience

Attention is a scarce and selective condition of economic participation. Subjects, organizations, and institutions encounter more signals, opportunities, demands, and possible actions than they can process with equal intensity. What enters attention can therefore influence what becomes available for evaluation and generation. GRE treats attention not simply as an internal cognitive resource but as relationally organized through environments, interfaces, institutions, social expectations, and distributions of visibility.

Salience is one mechanism through which this organization occurs. An object can become salient because it is perceptually striking, institutionally emphasized, repeatedly measured, socially endorsed, economically rewarded, emotionally charged, or strategically amplified. Salience need not indicate importance in any independent normative or causal sense. A highly visible indicator can dominate decision making while a less visible condition exerts larger long-term effects. Conversely, a previously neglected relation can become salient when a crisis, measurement innovation, public controversy, or new interpretive framework makes it perceptible as an economic problem.

The economic consequences of salience are therefore twofold. First, salience affects allocation of attention in the present. A firm monitors some indicators more closely than others; an investor notices some opportunities; a public agency prioritizes some risks; a consumer sees some products; a researcher encounters some literatures. Second, repeated attention can alter the object itself. Metrics invite optimization, visibility attracts resources, and recognized problems acquire organizations, professions, and infrastructures devoted to them. Attention can consequently become generative rather than merely observational.

Digital mediation intensifies this issue because ranking, recommendation, notification, and search systems actively order visibility. Their orientation effects may arise from commercial objectives, relevance models, engagement metrics, moderation rules, personalization, or technical constraints. The resulting distribution of attention can affect demand, reputation, cultural production, political communication, and the formation of economic subjects. GRE need not assume that a platform fully controls these outcomes. It can instead ask which mechanisms structure exposure, how users respond, and how visibility feeds back into production and value.

Attention also interacts with inequality. Subjects differ in their capacity to command attention and in their ability to protect their own attention from external capture. Advertising budgets, institutional prestige, network centrality, media access, and control over interfaces can increase one actor's capacity to make objects salient to others. At the same time, workers, consumers, citizens, and researchers can face environments saturated with demands on attention. The distribution of attention therefore has both productive and power dimensions.

A GRE analysis should avoid equating attention with endorsement. A subject may attend to an object because it is threatening, unavoidable, controversial, or institutionally mandatory. Nor should measured engagement be treated as a complete representation of attention. Observable clicks, purchases, dwell time, or citations are partial indicators conditioned by the platform or institution through which they are recorded. The relation between salience, attention, interpretation, and later action requires empirical specification.

Attention becomes a problem of orientation when it changes which possibilities can enter generative processes. What remains persistently unseen may receive neither investment nor institutional articulation. What becomes hyper-salient can attract disproportionate resources and narrow alternative exploration. GRE therefore studies the production and distribution of salience as part of the economic organization of possibility.

3.9.3 Curiosity and Question Formation

Curiosity introduces a different form of orientation. Attention identifies what enters a field of concern; curiosity can transform an encountered difference, anomaly, absence, or possibility into an object of inquiry. This transformation matters economically because new questions can redirect research, entrepreneurial activity, public investment, education, and institutional experimentation before the value of an answer is known.

Question formation is generative in a stronger sense than information acquisition. A subject seeking a known datum operates within a pre-specified problem. A newly formulated question can reorganize the problem-space itself by distinguishing pre-

viously conflated phenomena, proposing a new comparison, or making an unrecognized relation investigable. The economic consequences can be substantial. Scientific questions create research programmes; engineering questions motivate design trajectories; policy questions define measurable problems; entrepreneurial questions organize searches for unmet needs or new combinations.

Curiosity should not be romanticized as an unconstrained internal virtue. Opportunities for curiosity are institutionally distributed. Time, income security, educational access, research infrastructure, mentorship, mobility, archival access, computational resources, and tolerance for failure all affect who can pursue uncertain questions. A person may possess strong curiosity while lacking the relational conditions required to sustain inquiry. Conversely, organizations can create protected spaces in which exploratory questions become economically viable despite uncertain short-term returns.

Question formation is also socially mediated. A discipline defines which questions appear legitimate, mature, trivial, or impossible. A market communicates demand signals that make some problems commercially visible. Public institutions define categories of need. Communities preserve practical knowledge that can make different questions salient from those generated in professional research settings. Interdisciplinary contact can expose assumptions that remain invisible within a single field. Curiosity therefore emerges within histories of classification, authority, and encounter.

The economic orientation of curiosity becomes visible in the distribution of exploratory resources. Research grants, venture finance, procurement programmes, universities, laboratories, foundations, public challenges, and organizational slack all influence which uncertain inquiries can be sustained long enough to generate results. These mechanisms differ from ordinary exchange because expected value may be difficult to estimate *ex ante*. Selection often relies on judgments concerning plausibility, novelty, promise, social relevance, or strategic fit rather than on known outputs.

GRE can therefore analyze curiosity as a relational capacity with downstream economic effects. It can ask how an environment makes questions possible, how inquiry becomes sustained, how failed questions still generate capabilities or networks, and how exploratory activity alters the future set of feasible projects. It can also examine exclusion: whose questions receive recognition, which experiences become researchable problems, and which uncertainties remain institutionally invisible.

This perspective does not imply that more curiosity is always better. Unbounded exploration can consume resources, produce distraction, or impose risks on others. Some domains require reliability, maintenance, and disciplined exploitation of established knowledge. GRE's task is not to assign curiosity an intrinsic positive value, but to make visible the conditions under which question formation becomes economically generative and the trade-offs through which exploratory orientation is governed.

3.9.4 Aesthetic Judgment

Economic generation often proceeds under incomplete evidence. Researchers choose among conjectures before proof is available. Designers compare forms before market response is known. Investors assess emerging projects with limited histories. Engineers select architectures before every downstream consequence can be calculated. Public institutions imagine futures for which no complete dataset exists. In such set-

tings, judgment frequently includes an aesthetic dimension: a sense that a problem, pattern, design, explanation, or possibility is elegant, coherent, beautiful, compelling, fertile, proportionate, or otherwise worthy of continued attention.

GRE treats aesthetic judgment as a possible orientation mechanism rather than as a universal or infallible faculty. The term refers here to evaluative responses that help rank possibilities when propositional evidence does not fully determine selection. Such judgments can concern mathematical elegance, conceptual simplicity, visual form, narrative coherence, spatial atmosphere, craftsmanship, symbolic resonance, or the perceived fertility of a question. Their content varies across practices and communities.

Aesthetic judgment can become economically consequential because it directs scarce exploratory resources. Scientists choose which problems feel deep or promising. Architects and planners create environments that shape movement and encounter. Consumers attach value to form and atmosphere. Organizations cultivate identities through design. Investors may respond to narrative and presentation alongside formal projections. Cultural industries depend directly on aesthetic differentiation. In each case, aesthetic orientation participates in the generation of value without being reducible to price.

The relational character of aesthetic judgment is important. Judgments are neither simply arbitrary private tastes nor automatically universal properties of objects. They are formed through histories of training, exposure, comparison, convention, embodiment, and social interaction. What appears elegant to a mathematician, trustworthy to a patient, refined to a consumer, or harmonious to a community can depend on learned repertoires and material environments. Institutions can therefore cultivate, standardize, or marginalize aesthetic criteria.

This relationality creates both generative possibility and power. Shared aesthetic repertoires can coordinate collaboration and make complex quality judgments possible without complete formalization. They can also become exclusionary when dominant groups define legitimate taste, professional style, or intellectual beauty. A funding committee's sense of what constitutes an "interesting" question, for example, may reproduce disciplinary histories that favor some objects and methods. Aesthetic judgment can thus influence resource allocation even when it is not formally acknowledged.

GRE should keep aesthetic judgment distinct from truth, welfare, and justice. An elegant theory can be empirically wrong. A beautiful design can be inaccessible or harmful. A compelling narrative can conceal exploitation. A technically awkward solution can nevertheless generate substantial social value. The analytical significance of aesthetic judgment lies in its role in orientation under uncertainty, not in a presumption that aesthetic approval validates the selected object.

Aesthetic orientation also interacts with serendipity. Encounters that were not sought for instrumental reasons can become generative when a subject experiences them as salient, intriguing, beautiful, strange, or worth pursuing. The generative consequence depends on both encounter and judgment. An environment rich in variation does not guarantee innovation; subjects and institutions must still recognize some differences as invitations to inquiry or creation. This suggests an economic problem of field design: how can environments sustain heterogeneous encounters and exploratory judgment without attempting to pre-engineer the exact novelty that should emerge?

Within GRE, aesthetic judgment therefore belongs to the analysis of orientation because it can influence which possibilities receive further attention, articulation, resources, and institutional support. Its mechanisms require contextual investigation, and its normative status remains open to separate evaluation.

3.9.5 Epistemic Orientation

Economic generation is also directed by epistemic orientation: the standards, classifications, methods, evidential expectations, and interpretive habits through which subjects and institutions decide what can be known, what counts as relevant evidence, and which uncertainties deserve investigation. Epistemic orientation does not merely affect description after economic processes occur. It can shape which processes become actionable and therefore which futures are generated.

Measurement provides a direct example. Once an organization adopts a metric, activity can reorganize around what the metric makes visible. Data collection creates categories, time series, benchmarks, and comparison groups. These representations can improve coordination and accountability, but they also privilege some dimensions over others. A phenomenon that cannot be recorded within the existing schema can remain difficult to govern even when participants experience it as important. Epistemic orientation therefore influences institutional capacity through the design of observability.

Methods likewise orient inquiry. Randomized experiments, econometric identification, ethnography, archival reconstruction, simulation, network analysis, participatory research, and legal interpretation provide access to different dimensions of a problem. Their strengths are domain-specific. When one method becomes institutionally dominant, questions that fit its evidential architecture can become easier to legitimate and fund. GRE's methodological pluralism is partly a response to this orientation effect: the research problem should guide method selection rather than allowing an inherited method to define the only admissible problem.

Classification is another generative mechanism. Administrative categories determine eligibility, statistics, taxation, regulation, and rights. Market classifications affect comparability and exchange. Scientific classifications shape research populations. Professional categories define expertise. Once stabilized, classifications can influence behavior and identity, making the represented distinctions increasingly consequential. Epistemic orientation therefore links representation to ontology without collapsing the two: categories can help generate social effects even though the category remains analytically distinct from the object it represents.

Epistemic orientation has a temporal dimension. Institutions inherit archives, standards, vocabularies, and datasets from earlier periods. These resources make some historical comparisons possible while leaving other experiences poorly recorded. New questions are therefore conditioned by the epistemic infrastructure accumulated in the past. At the same time, present recording decisions shape what future investigators will be able to reconstruct. The organization of knowledge becomes part of intertemporal economic capacity.

Disagreement over epistemic orientation can be productive. Competing models, disciplinary perspectives, and interpretive frameworks can reveal different aspects of a system. GRE does not require premature convergence on a single representation. It asks whether the plurality of representations is explicit, whether their assumptions

and domains of validity are understood, and whether institutions preserve the capacity to revise their epistemic orientation when anomalies or changing conditions make existing categories inadequate.

This emphasis also limits the role of formal precision. A precisely estimated quantity can answer a poorly oriented question, while a qualitative observation can reveal a relation that has not yet been formalized. GRE values formal and computational methods where they perform genuine analytical work, but epistemic orientation precedes technique in the sense that the researcher must first decide what distinctions, scales, and forms of evidence are relevant to the inquiry.

3.9.6 Institutional Selection of What Is Generated

Orientation becomes institutional when durable rules, organizations, infrastructures, and evaluative procedures repeatedly privilege some generative pathways over others. Institutions do not need to specify the content of future outcomes in order to shape them. By controlling eligibility, resources, recognition, standards, timing, and access, they can alter which possibilities survive long enough to become self-sustaining.

Funding systems provide an obvious case. Research grants, venture investment, bank credit, public procurement, philanthropy, and internal organizational budgets each use different selection criteria. Those criteria can favor measurable returns, strategic importance, novelty, reliability, social need, collateral, prior reputation, or compatibility with existing infrastructure. A funding architecture therefore orients generation before the downstream value of a project is known. Its effects accumulate when successful projects create expertise, reputation, and networks that improve their access to future resources.

Legal and regulatory institutions also orient generation. Intellectual-property rules affect incentives and diffusion. Liability rules influence experimentation. Licensing can protect safety while raising entry barriers. Competition policy changes the conditions under which scale can consolidate. Data governance shapes access to informational resources. Labor and social-protection institutions influence the risks subjects can bear when changing occupations or starting new projects. In each case, legal structure changes the feasible and attractive trajectories available to economic actors.

Educational institutions orient generation by shaping capabilities, vocabularies, disciplinary boundaries, and aspirations. Curriculum determines which problems become familiar. Credentials affect access to professions and organizations. Mentorship can make previously invisible pathways imaginable. Evaluation systems influence whether students optimize for standardized performance, exploration, collaboration, or independent inquiry. Education therefore participates in economic generation long before its effects appear as wages or productivity.

Markets themselves are institutional selection environments. Prices, demand, competition, and profitability orient resources toward some activities and away from others. GRE retains this insight while asking how market selection interacts with other orientation mechanisms. Markets depend on property rules, infrastructures, classifications, information, financing, and distributions of purchasing power. A profitable opportunity can reflect genuine social demand, concentrated wealth, regulatory design, network effects, or externalized costs. Market orientation is therefore economi-

cally powerful without being normatively self-interpreting.

Platforms and algorithmic systems add another layer by combining infrastructure, ranking, rule enforcement, and data collection. Their selection mechanisms can shape which sellers are visible, which workers receive tasks, which content gains distribution, and which behaviors become economically rewarded. Because participants often adapt to these selection systems, the platform's orientation can become recursive: metrics influence behavior, behavior supplies new data, and new data update the mechanism that structures visibility or access.

Institutional orientation also creates lock-in and complementarity. Once organizations invest in a technology, standard, profession, or accounting category, adjacent investments may become more valuable. Alternative pathways then face higher switching costs even if they are technically feasible. The resulting persistence can be efficient when coordination benefits are large, but it can also preserve arrangements whose original justification has weakened. GRE therefore asks how institutional selection creates future dependency and what forms of optionality remain available.

The analytical objective is not to identify a single institution responsible for orientation. Selection is often distributed across finance, law, culture, infrastructure, expertise, and public authority. A GRE inquiry traces how these mechanisms combine and where control over selection becomes concentrated, contested, or open to revision.

3.9.7 Plural Orientations under Heterogeneous Values

Economic systems contain subjects and communities whose orientations differ. They may disagree about desirable outcomes, relevant time horizons, legitimate evidence, acceptable risk, ecological obligations, cultural continuity, forms of recognition, or the value of particular capabilities. GRE treats this heterogeneity as a constitutive feature of orientation rather than assuming that all relevant directions can be represented by one shared scalar objective.

Plural orientation creates coordination problems. A project that expands aggregate income can weaken a local form of life. A conservation policy can protect ecological conditions while constraining livelihoods unless transition mechanisms are provided. A technological system can increase convenience for users while intensifying surveillance or labor precarity. A research programme can generate broadly useful knowledge while concentrating intellectual property. These tensions cannot always be resolved by discovering a hidden common metric.

Value conversion can help decision making when the conversion rule is explicit and appropriate. Monetary valuation, cost-effectiveness, multi-criteria analysis, voting, deliberation, legal balancing, and negotiated compromise are among the mechanisms institutions use to compare heterogeneous claims. GRE does not reject such conversions. It asks what is gained and lost through them, whose valuations enter the procedure, and whether the conversion becomes mistaken for an ontological equivalence among the values involved.

Plural orientation also means that generativity itself can be evaluated differently. One group may value rapid innovation; another may value reliability and continuity. One institution may prioritize employment; another ecological regeneration; another strategic autonomy; another freedom of inquiry. A relation can therefore be highly generative according to one orientation while appearing destructive according

to another. The disagreement concerns both produced outcomes and the standards through which generation is interpreted.

Institutions can respond to plural orientation through several architectures. They can aggregate preferences into a single decision, allocate separate domains of authority, preserve local autonomy, establish rights that constrain aggregation, create deliberative procedures, or maintain experimental diversity across jurisdictions and organizations. Each architecture has generative consequences. Centralization can coordinate large-scale investment but narrow local variation. Decentralization can preserve experimentation but weaken collective capacity. Rights can protect vulnerable subjects while limiting some forms of optimization. GRE treats these trade-offs as empirical and normative objects rather than deriving a universal institutional design.

The distribution of voice matters because heterogeneous values do not enter decision processes with equal force. Wealth, legal status, expertise, organizational capacity, time, language, and control over infrastructure can affect which orientations become institutionally consequential. A formally plural process can therefore reproduce asymmetry if some actors possess much greater ability to define agendas, supply evidence, or sustain participation. Analysis of orientation must consequently include the conditions of representation and participation.

Plurality also has an epistemic benefit. Different orientations can reveal consequences that a dominant framework misses. Workers, users, local communities, engineers, ecologists, regulators, and investors can perceive different dimensions of the same system. Maintaining structured disagreement can therefore increase the system's capacity to detect emerging harms or opportunities. Diversity of orientation is not automatically valuable, but under some conditions it functions as a distributed sensing and exploration mechanism.

For GRE, the constitutional implication is that economic orientation should remain representationally plural unless a specific analytical or decision context justifies aggregation. Heterogeneous values are not noise to be removed before economic reasoning begins. They are part of the relational field through which generation is directed and evaluated.

3.9.8 Orientation as an Economic and Political Problem

Orientation becomes an economic problem because it influences the allocation and generation of scarce capacities across time. Attention, research effort, capital, infrastructure, education, organizational commitment, and institutional legitimacy cannot be devoted equally to every possibility. Selection therefore shapes which capabilities accumulate, which industries form, which questions receive answers, which risks become visible, and which subjects gain access to future opportunities. Orientation is economically consequential even when no market transaction directly prices it.

It becomes a political problem when the authority to orient generation is unevenly distributed or collectively contested. Governments set research priorities and infrastructure plans. Firms select technologies and business models. Platforms organize visibility. Financial institutions influence investment trajectories. Professional bodies define standards. Universities establish curricula and disciplines. Communities defend or transform local practices. Individuals exercise agency within these fields but do not enter them with equal resources. Orientation is therefore partly a question of who can shape the conditions under which future possibilities become more

or less available.

This form of power is upstream from many observable outcomes. Control over a final allocation matters, but control over the categories, infrastructures, questions, and selection procedures through which future allocations will be made can have longer-lived effects. A subject that determines what can be measured, funded, connected, certified, or searched can influence generation without dictating every downstream action. GRE can analyze this as power over generative conditions while still requiring concrete mechanisms rather than inferring power from asymmetry alone.

The political character of orientation also appears in conflicts over temporality. Short electoral cycles, quarterly reporting, long infrastructure lifetimes, ecological regeneration, intergenerational obligations, and scientific research operate on different temporal horizons. Institutions that privilege one horizon can redirect generation away from possibilities whose value emerges later. The question is not simply whether actors discount the future, but how organizational and institutional arrangements determine whose future, which risks, and which forms of value remain actionable in the present.

A generative orientation can also produce foreclosure. Investment in one infrastructure can make alternatives expensive. A dominant technical standard can exclude incompatible innovations. A classification can make some identities administratively invisible. A business model can generate dependency that reduces exit options. Foreclosure is therefore the counterpart of orientation: selecting and reinforcing one trajectory changes the feasibility of others. GRE evaluates orientation partly by tracing these changes in future option sets rather than only immediate outputs.

This does not imply that preserving every option is desirable. Coordination, commitment, specialization, and institution building often require closing alternatives. A society cannot maintain every infrastructure standard simultaneously, and an organization cannot pursue every project. The analytical question concerns the terms under which closure occurs, its reversibility, who bears the resulting constraints, and whether institutions retain capacities for revision when conditions change.

Orientation also connects economic analysis to governance. A governance system can attempt to specify desired outcomes directly, or it can shape fields in which desirable forms of generation are more likely to emerge. The latter approach may involve public infrastructure, open standards, rights, research capacity, plural participation, safety constraints, or mechanisms for feedback and revision. Such field-oriented governance does not eliminate political choice; it relocates part of that choice to the design of enabling and constraining conditions.

The constitutional position of GRE is therefore neither that generation should be maximized nor that orientation should be centralized. GRE makes orientation visible as an object of economic inquiry. It asks how attention, curiosity, aesthetic judgment, epistemic practices, institutions, and heterogeneous values combine to direct generative processes; how orientation distributes future capacities and risks; how power enters selection; and how orientations themselves change through history.

This completes the present chapter's account of one major dimension of GRE's problem-space. Economic generation is mediated by subjects, but subjects themselves are formed through relations; generation is directional, but direction arises through multiple cognitive, institutional, symbolic, and political mechanisms. The next constitutional task is methodological. The following section therefore distinguishes the principal modes through which GRE can describe, explain, reconstruct,

compare, interpret, formalize, evaluate, and intervene in the economic processes identified here.

3.10 Modes of GRE Inquiry

Generative Relational Economics requires methodological breadth because its objects are heterogeneous and its questions concern several different kinds of claim. A study may need to describe a relational configuration, explain how it is reproduced, reconstruct how it emerged historically, compare it with alternative configurations, interpret the meanings through which subjects act, identify causal effects, formalize a mechanism, simulate possible trajectories, evaluate consequences normatively, or design an intervention. These tasks are related, but they are not interchangeable. The role of this section is to distinguish the principal modes through which GRE can conduct inquiry while preserving their mutual compatibility. Its objective is methodological clarification rather than the prescription of a single research design. The discussion proceeds from descriptive and explanatory inquiry through historical, comparative, interpretive, causal, formal, computational, normative, and intervention-oriented modes. Across them, the governing principle is that each mode must make explicit what kind of claim it is entitled to support, which evidence or representation bears that claim, and where its warrant ends.

The distinction among modes concerns the epistemic work being performed rather than a rigid classification of disciplines or techniques. An interview can contribute to descriptive, interpretive, historical, causal, or normative inquiry depending on how it is used. A regression can support description, comparison, or causal inference under different designs. Archival material can reconstruct a historical sequence while also revealing institutional meanings and mechanisms. A simulation can clarify the consequences of specified assumptions without establishing that the modeled mechanism exists empirically. GRE therefore classifies inquiry by the relation between question, evidence, representation, and warranted conclusion rather than by the surface form of the method alone.

The modes also differ from the objects and scales identified earlier in this chapter. The same object can be approached through several modes. A platform can be described as an organization and infrastructure, interpreted through the classifications embedded in its interface, studied causally through changes in ranking rules, reconstructed historically through its institutional development, represented formally as a multilayer network, evaluated normatively through the distribution of generated capacities and harms, and examined interventionally through alternative governance designs. Methodological plurality becomes useful precisely because the object does not determine a unique mode of inquiry.

GRE does not require every project to use every mode. A narrowly designed causal study can be valuable if its boundaries are clear. A historical reconstruction can illuminate the emergence of a generative structure without formalization. An interpretive study can reveal categories that would otherwise be mismeasured. A formal model can clarify possible mechanisms before adequate data exist. The methodological demand is therefore fit rather than comprehensiveness: the mode or combination of modes should match the question and should remain corrigible by evidence or arguments arising from other modes when their domains overlap.

3.10.1 Descriptive Inquiry

Descriptive inquiry establishes what is present, how it is distributed, how it is related, and how it changes over a specified observational domain. In GRE, description can concern entities, subjects, relations, resources, capacities, forms of value, constraints, institutional rules, symbolic representations, trajectories, or fields. Its importance is easily underestimated because description is sometimes treated as a preliminary stage before “real” explanation. Yet a relational research programme depends heavily on careful description: a mistaken boundary, omitted relation, inappropriate unit, or unstable category can distort every later explanatory or normative claim.

A GRE description is therefore more than an inventory of isolated attributes. It can map relational incidence: who is connected to whom, through which mechanism, under what terms, and with what asymmetries. It can characterize distributions of access, exposure, recognition, risk, or capability. It can identify temporal patterns such as persistence, turnover, accumulation, or decay. It can distinguish administrative recipients from affected subjects and can trace where value, constraints, or opportunities appear outside the nominal boundary of a programme or transaction. Description thereby makes the relational field empirically available before deeper attribution is attempted.

The construction of descriptive categories requires explicit judgment. Terms such as worker, household, platform, community, firm, beneficiary, asset, skill, trust, or harm are not self-interpreting. Their operationalization can depend on legal definitions, institutional records, self-identification, measurement conventions, or analytical reconstruction. GRE therefore treats descriptive categories as representations whose adequacy must be justified relative to the question and scale. A category can be useful without being ontologically final, and a stable administrative classification can remain inadequate for a relational question if it suppresses relevant interactions or affected subjects.

Description also has a temporal dimension. Cross-sectional description captures a configuration at a moment or interval, while longitudinal description tracks changes in states, relations, or distributions. The latter becomes especially important when generation concerns future capacities. A programme that appears distributively modest at one date may substantially change later educational, technological, organizational, or relational possibilities. Conversely, an apparent short-term gain may dissipate or convert into dependence. Descriptive inquiry can reveal these trajectories without yet claiming a mechanism for them.

Rich description can combine quantitative and qualitative evidence. Administrative records may establish scale and distribution; interviews may reveal unrecorded relations; ethnographic observation may show how formal rules are enacted; network data may identify patterns of connectivity; documents may clarify institutional categories; spatial data may reveal infrastructural concentration. GRE has no reason to privilege one evidence type in advance. The relevant standard is whether the descriptive representation captures the features required by the question while making omissions and uncertainty visible.

Descriptive adequacy also depends on boundaries. A study of a firm’s wage policy can stop at employees, extend to households, include subcontractors, or incorporate local labor markets and public services. Each boundary produces a different descriptive object. GRE does not assume that the widest boundary is always best; wider

boundaries increase complexity and can reduce tractability. The researcher instead states why a boundary is appropriate and tests whether excluded relations materially alter the description.

The output of descriptive inquiry is therefore a warranted account of configuration rather than a claim about why the configuration exists. It establishes patterns that explanatory, historical, causal, interpretive, or normative inquiry may subsequently address. In GRE, this mode is foundational because relational and generative claims become meaningful only after the relevant configurations, transitions, and affected subjects have been specified with sufficient empirical discipline.

3.10.2 Explanatory Inquiry

Explanatory inquiry asks how and why an observed configuration, transition, or regularity occurs. GRE gives particular attention to mechanisms through which relations produce, reproduce, transform, amplify, or constrain later possibilities. Explanation can therefore address immediate effects, recursive feedback, institutional reproduction, conversion among forms of value, subject formation, cross-scale propagation, or changes in the conditions under which subsequent generation occurs.

Explanation requires more than naming a correlation or attaching a familiar concept to an outcome. To say that an outcome results from power, incentives, norms, networks, institutions, culture, or path dependence is incomplete unless the operative process is specified sufficiently to connect conditions to consequences. A GRE explanation should identify the relevant actors or configurations, the relations through which effects travel, the enabling and constraining conditions, the temporal sequence where it matters, and the observations that would distinguish the proposed mechanism from plausible alternatives.

Mechanistic explanation can operate at different levels. A change in organizational behavior may be explained through individual incentives, professional norms, governance rules, technological affordances, inter-organizational dependence, or combinations among them. These explanations need not compete if they address different parts of the process. GRE is particularly interested in explanations that connect levels without treating one as automatically fundamental. A legal rule can alter organizational incentives; organizational practices can reshape individual capabilities; repeated individual actions can stabilize a convention; a convention can later become codified. The explanatory task is to show how these relations connect rather than to reduce them to a single privileged scale.

Generative explanation extends the temporal horizon beyond the immediate outcome. A scholarship programme may explain increased enrollment through reduced cost, but GRE may also ask how participation generates networks, expectations, credentials, institutional capacities, or new constraints that alter later educational and labor-market trajectories. This does not mean every explanation must trace indefinitely downstream. It means that when later capacities are central to the research question, the explanatory account should not stop at the first measurable output merely because it is administratively convenient.

Explanatory inquiry can draw on several other modes. Historical evidence can reveal how a mechanism became possible. Interpretive evidence can show how subjects understand and respond to classifications. Causal designs can estimate whether an intervention changes an outcome. Formal models can clarify whether a proposed

mechanism is internally coherent. Comparative cases can test whether the explanation travels across configurations. Computational models can explore implications that are difficult to derive analytically. Explanation is therefore often integrative, but the contributions of these components should remain distinguishable.

The standard of explanatory sufficiency depends on the claim. A local explanation of a policy effect requires less than a theory of institutional transformation. Claims about altered generative conditions require evidence that the later opportunity structure, rule environment, capacities, or relations changed in a way relevant to subsequent processes. Claims about transformation of the effective rule of change require still stronger evidence that the mechanism governing later transitions itself changed. GRE therefore scales explanatory ambition to evidential support.

Explanatory inquiry is central to GRE because the framework is concerned with more than relational association. It seeks to understand how relations become consequential through identifiable processes. At the same time, explanation remains compatible with ontological suspension: a useful mechanism model can explain an empirical pattern without establishing that its analytical categories constitute the ultimate ontology of the economic system.

3.10.3 Historical Inquiry

Historical inquiry reconstructs how economic configurations, categories, subjects, institutions, and generative conditions emerge and transform through time. Its role in GRE is constitutive rather than supplementary. If entities and relations can be historically generated, then their present form cannot always be understood by treating them as fixed inputs to analysis. Historical inquiry asks how the objects that later appear stable became available, how alternative possibilities were closed or retained, and how prior trajectories condition present generative capacity.

A historical GRE study can begin with an institution, technology, classification, market, profession, infrastructure, or relation and reconstruct the sequences through which it acquired its current form. The relevant history may include legislation, organizational decisions, conflict, technical development, demographic change, cultural interpretation, investment, crises, accidents, or encounters with other systems. The aim is not to produce chronology for its own sake. The analytical objective is to identify transformations that changed what later actors could perceive, do, coordinate, own, exchange, contest, or generate.

Historical inquiry is especially important for categories that appear natural after stabilization. The distinction between employee and contractor, the legal form of a corporation, a standardized credential, a property right, a data category, a currency regime, or a professional jurisdiction can become embedded in administrative systems and everyday expectations. Once stabilized, these categories structure evidence and action. Historical reconstruction can reveal their contingency, the relations that produced them, and the alternatives that were once viable. Such reconstruction supports ontological suspension by showing that analytical objects may have histories of constitution.

Temporal ordering can also bear explanatory weight. The same set of conditions can produce different outcomes when encountered in different sequences. Early infrastructure can create increasing returns; a legal designation can precede and enable market formation; a crisis can accelerate an institution that had previously remained

marginal; a technical standard can become difficult to displace after complementary investments accumulate. Historical inquiry can therefore identify path-dependent mechanisms while avoiding the loose use of “history matters” as an explanation.

GRE also treats methods and evaluative categories as historical. What counts as reliable evidence, recognized value, legitimate participation, acceptable risk, or relevant harm can change. A historical study may therefore examine not only the object of evaluation but the evolution of the evaluative and epistemic apparatus itself. This becomes particularly important when contemporary assessment applies categories that did not exist, had different meanings, or excluded relevant subjects in earlier periods.

Historical evidence is heterogeneous. Archives, legal documents, organizational records, correspondence, material artifacts, statistical series, oral histories, media, technical standards, and retrospective testimony can each illuminate different aspects of a process. Their survival is itself selective. GRE therefore treats the archive as part of the historical relational field: who could record, whose records were preserved, which categories were administratively legible, and which forms of experience remained unrecorded can shape what later researchers are able to reconstruct.

Historical inquiry does not imply that every present problem requires a complete genealogy. The relevant temporal horizon depends on the process. Some mechanisms can be understood through recent organizational history; others depend on decades of institutional accumulation or longer histories of law, infrastructure, or social classification. The methodological requirement is to extend the historical frame far enough that the object and its operative conditions are not mistakenly treated as timeless when their formation is relevant to the explanation.

3.10.4 Comparative Inquiry

Comparative inquiry examines similarities and differences across cases, configurations, periods, scales, or institutional arrangements. In GRE, comparison is valuable because relational and generative mechanisms are often conditional. A relation that generates capability in one institutional environment may generate dependence in another; a governance arrangement that supports participation at one scale may produce exclusion at another; the same technology can reorganize value differently under different property, labor, or regulatory structures.

Comparison can therefore reveal which features are specific to a configuration and which travel across contexts. Cases may be organizations, regions, legal systems, historical episodes, technologies, communities, markets, or interventions. A comparison can hold some features relatively stable while examining variation in others, or it can compare broader configurations whose differences are themselves analytically meaningful. GRE does not require all comparisons to approximate experiments. Configurational comparison can be valuable when the research question concerns how combinations of relations produce different generative trajectories.

The major methodological problem is commensurability. Cases become comparable only through selected dimensions, and the choice of dimensions can obscure differences in meaning or institutional constitution. “Employment,” “household income,” “community participation,” or “innovation” may be measured similarly across jurisdictions while referring to materially different social arrangements. Comparative inquiry must therefore justify both the common dimension and the retained

differences. Translation among categories can be part of the research rather than a preliminary technical step.

Comparison across time presents a related problem. A variable can retain its label while the institutional relations that constitute it change. Longitudinal comparisons of occupations, assets, industries, educational attainment, or household forms may therefore require attention to changing definitions and social significance. GRE treats historical comparability as an empirical and interpretive achievement, not an automatic consequence of having a numerical series.

Comparative inquiry is also useful for mechanism assessment. If a proposed explanation depends on a particular relation, cases in which that relation differs can help evaluate the claim. A platform governance mechanism can be compared across ownership models; a welfare intervention across administrative designs; a cooperative across legal environments; a knowledge commons across licensing regimes. The objective is not necessarily to identify a single universally best arrangement. Comparison can instead map how different relational configurations generate different distributions of capacity, value, risk, or closure.

Negative and deviant cases can be especially informative. A case in which an expected self-reinforcing process fails may reveal a missing enabling condition. A community that resists a dominant institutional trajectory can disclose alternative relations that preserve options. A technological diffusion that remains limited despite strong incentives may reveal interpretive, infrastructural, or legal constraints. GRE can use such cases to refine mechanisms rather than treating them as noise around an average effect.

Comparative inquiry thus provides a disciplined way to study plurality. It can test portability without assuming invariance, and it can illuminate alternative economic arrangements without reducing them to a single ranking dimension. Its contribution is strongest when the basis of comparison, the boundaries of each case, and the limits of generalization are stated explicitly.

3.10.5 Interpretive Inquiry

Interpretive inquiry examines the meanings, classifications, narratives, symbols, expectations, and practical understandings through which economic subjects perceive and act within relational configurations. GRE requires this mode because many economic objects are symbolically mediated. Prices, contracts, credentials, reputations, categories, metrics, risk scores, organizational roles, and legal statuses acquire consequences partly through shared or contested interpretations.

Interpretation enters economic processes in several ways. Subjects respond to what they believe a rule requires, what they expect others to do, what a category signifies, or what an action communicates. An institutional classification can alter behavior because it changes eligibility or sanctions, but also because subjects understand themselves and others through it. A market signal can influence investment because actors interpret its informational content. A policy can fail because its official category does not correspond to the categories through which affected communities organize practice. Meaning is therefore neither an ornamental layer nor a universal substitute for material explanation. It is one mechanism through which relations become actionable.

Interpretive inquiry can focus on language, documents, interviews, practices, rit-

uals, interfaces, images, classifications, or institutional procedures. The researcher asks how a representation is produced, which distinctions it makes salient, how subjects use or contest it, and what practical consequences follow. Interpretive evidence can reveal why formally identical incentives generate different responses, why some risks remain unrecognized, or why an institutional reform changes subject positions even when resource distributions move little.

GRE distinguishes the meaning attributed by subjects from the analyst's representation. Researchers can misdescribe a relation if they impose categories that erase locally consequential distinctions. Conversely, subjects' interpretations do not exhaust causal explanation. An institution can have effects that participants neither intend nor perceive. Interpretive inquiry therefore contributes one layer of evidence within a plural methodology: it reconstructs situated meaning while remaining open to material, institutional, statistical, and historical evidence about effects beyond conscious understanding.

Symbolic mediation becomes particularly important under conditions of representational abundance. Rankings, dashboards, automated classifications, recommendation systems, financial models, and AI-generated representations can shape what becomes visible and credible. Interpretive inquiry can examine how these representations acquire authority and how subjects orient action around them. It can also ask how categories designed for one purpose migrate into other domains and begin to organize allocation, recognition, or exclusion.

Interpretive disagreement is itself an economic phenomenon. Different actors may attach incompatible meanings to the same resource, relation, technology, or institutional change. A redevelopment project can signify investment to one group and displacement to another; data sharing can signify innovation, surveillance, or public infrastructure depending on the relation. GRE does not require these meanings to be collapsed into a single utility metric before analysis begins. Their coexistence can shape conflict, coalition, legitimacy, and future generative possibilities.

Interpretive inquiry thus expands what counts as economically relevant evidence while remaining disciplined by context and consequence. Its aim is not to replace causal or material analysis with discourse, but to identify when meaning and representation form part of the mechanism through which economic relations are generated, sustained, or transformed.

3.10.6 Causal Inquiry

Causal inquiry asks whether and through what conditions a change in one factor contributes to a change in another. GRE requires causal discipline because relational language can otherwise encourage unwarranted attribution. The presence of a relation, asymmetry, institution, or field does not by itself establish that it caused an observed outcome. Causal inquiry therefore provides tools for distinguishing association, sequence, mechanism, and intervention-relevant effect.

Causal questions can be narrow or generative. A narrow question may ask whether a transfer increases school attendance. A broader question may ask whether the transfer changes household bargaining, peer networks, expectations, credential accumulation, or later labor-market options. These questions operate on different outcomes and time horizons, and they may require different designs. GRE's contribution is not to replace established causal inference but to broaden the set of causally rele-

vant downstream and relational outcomes when theory gives reason to expect them.

Counterfactual reasoning remains central. To claim that an intervention caused an outcome requires some account of what would have occurred under a relevant alternative. Randomization, natural experiments, quasi-experimental designs, matching, synthetic controls, longitudinal models, process tracing, comparative case analysis, and mechanistic evidence can support counterfactual claims under different assumptions. GRE is methodologically plural about these tools but not indifferent to identification. The choice of design must match the causal claim.

Relational settings create additional challenges. Interference can violate assumptions that one unit's treatment does not affect another. Network spillovers can make the administrative recipient a poor unit for causal analysis. Institutional reforms can change the categories through which outcomes are measured. Feedback can make causes and effects mutually reinforcing across time. Selection into relationships can confound observed associations. GRE therefore treats relational structure as part of causal design rather than as a reason to abandon causal inference.

Causal attribution can also be distributed. A harmful outcome may depend on a sequence of financing rules, organizational incentives, technical standards, local decisions, and infrastructural constraints. No single element is sufficient on its own, yet the configuration can reliably generate the outcome. GRE can analyze such conjunctural causation while distinguishing it from claims that every contributing condition bears equal explanatory or normative weight.

Generative causal inquiry may ask whether an intervention changes later capacities to produce further effects. This creates nested causal questions. A training programme can directly change skill, which changes network access, which changes employment opportunities, which changes household investment. The causal chain can branch and feed back. Researchers need not estimate every link simultaneously, but they should distinguish measured effects from hypothesized downstream mechanisms and avoid presenting an observed endpoint as evidence for the entire generative story.

Causal inquiry therefore disciplines GRE's ambition. It permits strong claims where design and evidence support them and encourages restraint where mechanisms remain plausible but unverified. Relational complexity expands the causal questions worth asking; it does not lower the evidential burden for answering them.

3.10.7 Formal Inquiry

Formal inquiry constructs explicit representations of economic structures or processes in mathematical, logical, graphical, or computationally specified form. Its role in GRE is clarification. Formalization can make assumptions visible, expose inconsistencies, distinguish mechanisms that natural language leaves conflated, derive consequences, and reveal which empirical observations would discriminate among alternative accounts.

The appropriate formalism depends on the problem. Dynamical systems can represent trajectories, stability, and regime change. Networks and hypergraphs can represent relational topology and higher-order interaction. Multilayer structures can distinguish relation types. Optimization and game-theoretic models can clarify strategic constraints and incentive compatibility. Probabilistic models can represent uncertainty and conditional dependence. Field-like representations can describe dis-

tributed conditions when locality or spatial organization matters. Logical or categorical formalisms can clarify compositional structure. GRE does not designate one of these as its universal mathematics.

Formal inquiry begins by specifying what the symbols represent. A node may stand for a person, organization, legal entity, document, or technical component; an edge may encode communication, ownership, exchange, dependency, recognition, or another relation. A state variable can summarize a capacity, stock, classification, or measured condition. The model becomes meaningful only through the mapping between formal object and empirical interpretation. Two models with identical mathematics can therefore represent substantively different economic mechanisms.

Formalization also requires ontological restraint. A network representation does not prove that the economy is fundamentally a network, and a state-space model does not establish that the selected variables constitute a complete economic state. The formal representation is an analytical instrument whose adequacy depends on the question, assumptions, and empirical correspondence. GRE's ontological suspension is compatible with strong formal work precisely because it separates representational usefulness from metaphysical commitment.

One important use of formal inquiry is to distinguish levels of transformation. A model can represent change in state under fixed rules, changes in parameters, changes in topology, or transformations in the effective rule itself. These are different formal problems. GRE's concern with changing generative conditions becomes clearer when the model states which elements are permitted to vary and which remain fixed. A formalism that endogenizes network ties while fixing node identities captures one form of relational change but leaves other forms outside the model.

Formal inquiry can also produce impossibility or boundary results. Under specified assumptions, certain combinations of objectives may be incompatible; some allocation rules may generate unavoidable trade-offs; some dynamics may be unstable; some information may be insufficient for identification. Such results can be valuable even when the assumptions are idealized because they clarify where a proposed intervention requires additional structure or information.

The evidential status of a formal result must nevertheless remain explicit. A theorem establishes a consequence of assumptions. A numerical model shows behavior of a specified representation. Neither alone establishes that the assumptions hold empirically. Formal inquiry becomes empirically explanatory when the mapping, assumptions, and relevant predictions or mechanisms are supported by evidence. GRE therefore treats formalization as one rigorous mode among several, especially powerful when combined with descriptive, historical, causal, or interpretive work.

3.10.8 Computational Inquiry

Computational inquiry uses algorithmic procedures to analyze data, simulate specified systems, explore high-dimensional models, search large possibility spaces, or construct representations that would be difficult to handle analytically. It overlaps with formal inquiry but is not identical to it. A formal model can be studied without computation, while computational analysis can involve empirical pattern detection whose theoretical structure remains comparatively weak. GRE distinguishes these uses so that computational power is not mistaken for explanatory completeness.

Simulation is one major application. Agent-based models can explore how hetero-

geneous local rules generate aggregate patterns; network simulations can study diffusion, contagion, coordination, or rewiring; dynamical models can examine sensitivity and regime change; Monte Carlo methods can characterize uncertainty; optimization algorithms can explore feasible designs under constraints. Simulation is particularly useful when feedback, heterogeneity, or combinatorial complexity makes closed-form analysis difficult.

The epistemic status of simulation remains conditional. A simulated trajectory is evidence about the behavior of the model under specified assumptions. It becomes evidence about a target economic system only through an additional argument that the model represents relevant features adequately. Calibration, validation, sensitivity analysis, out-of-sample comparison, qualitative mechanism matching, and robustness checks can strengthen this bridge. The visual plausibility of a simulated pattern is insufficient on its own.

Computational inquiry also includes data-intensive empirical methods. Machine learning can classify, predict, embed, cluster, or detect patterns in large datasets. Natural-language processing can analyze documents and discourse. Network algorithms can identify structural positions or communities. Spatial computation can reveal geographical concentration and accessibility. These methods can extend observational capacity, but the resulting representations inherit the categories, sampling processes, missingness, labels, and objectives of the data-generating system.

For GRE, computational representation can itself become an object of inquiry. A credit score, recommendation model, allocation algorithm, or generative AI system does not merely describe an economic field; once used operationally, it can alter access, visibility, bargaining power, subject classification, and future data. The computational model can therefore enter the generative relation it represents. Researchers may need to study both model performance and the feedback through which deployment changes the target system.

Computation can further support exploratory work under ontological uncertainty. Researchers can test several network boundaries, alternative state representations, or competing mechanisms and examine which are robust to changes in specification. Such exploration is valuable if it is reported transparently and distinguished from confirmatory inference. Computational flexibility increases the importance of documenting choices because many plausible pipelines can yield different apparent structures.

GRE therefore welcomes computational inquiry without treating computation as a substitute for theory, meaning, causality, or normative judgment. Its contribution lies in extending what can be represented and explored while maintaining explicit links among algorithm, data, modeled object, and warranted conclusion.

3.10.9 Normative Inquiry

Normative inquiry evaluates economic arrangements, relations, processes, or interventions according to articulated standards of value, justice, participation, capability, harm, responsibility, freedom, sustainability, or other justified criteria. GRE requires this mode because generativity is not intrinsically beneficial. A relation can generate wealth and dependency, knowledge and exclusion, capability and ecological damage, trust and vulnerability, innovation and concentration. Description of generation therefore cannot settle whether the generated configuration is desirable.

Normative inquiry begins by making the evaluative standard visible. A study may evaluate distribution, procedure, recognition, participation, capability, rights, ecological integrity, intergenerational effects, or the preservation of future options. These standards can converge in some cases and conflict in others. GRE does not resolve such conflict by assuming that all values can be converted into a common metric. Monetary valuation, utility, capability, rights, and relational goods can each illuminate different dimensions while leaving remainders that resist equivalence.

The distinction between generated value and generated harm is central. An intervention that expands productive capacity can simultaneously concentrate decision authority. Infrastructure can increase mobility while displacing communities. A platform can create new forms of participation while producing surveillance or dependency. Normative inquiry therefore follows the distribution and conversion of effects across subjects, scales, and time rather than assigning the entire process a single positive or negative label from one immediate outcome.

Participation matters both instrumentally and intrinsically. Subjects affected by an intervention may hold knowledge unavailable to designers, making participation epistemically valuable. Participation can also constitute recognition and agency rather than merely improve technical outcomes. Yet participation itself varies in form and power. Consultation, veto authority, co-design, ownership, and self-governance are not equivalent. GRE can therefore examine the relational structure of participation rather than treating its nominal presence as sufficient.

Normative inquiry also addresses capability and future generativity. An arrangement can be evaluated partly by how it changes subjects' capacities to act, learn, cooperate, exit, contest, or generate further value. This future-oriented criterion does not imply that more capability is always better or that every option must be preserved. Some capabilities are harmful, and institutional commitments often require selective closure. The normative problem concerns which capacities are expanded or foreclosed, for whom, under what justification, and with what possibilities for revision.

Evaluation must remain historically and contextually responsive. Normative concepts can have general aspirations while their application depends on institutions, technologies, ecological conditions, and available alternatives. Standards themselves can also be criticized and revised through new knowledge or previously excluded perspectives. GRE therefore treats normative inquiry as reasoned and contestable rather than as a final scoring procedure appended after positive analysis.

The mode remains analytically distinct from empirical explanation even when the two interact. Evidence can show who is harmed, which capacities change, or how participation is distributed. It cannot by itself determine how conflicting claims should be weighted. Conversely, normative arguments that ignore empirical mechanisms can recommend interventions that reproduce the very harms they seek to address. GRE joins the modes through mutual constraint while preserving the distinction between what occurs and how it ought to be evaluated.

3.10.10 Intervention-Oriented Inquiry

Intervention-oriented inquiry asks how knowledge can inform deliberate attempts to alter a relational configuration, its generative conditions, or the processes through which future outcomes are produced. It is distinct from normative inquiry because deciding that a condition is undesirable does not establish how it can be changed. It

is also distinct from causal inquiry because estimating the effect of one intervention does not by itself provide a complete strategy for governance under changing conditions.

A GRE intervention begins with diagnosis. The researcher or practitioner identifies the relevant relations, subjects, constraints, capacities, value flows, representations, and scales. The intervention target may be an allocation, a rule, an infrastructure, a relation among organizations, an information environment, a participation mechanism, or a field condition that makes certain actions easier or harder. This breadth allows GRE to consider interventions that modify generative conditions rather than only redistribute final outputs.

Intervention design then requires an explicit theory of change. Which relation is expected to change? Through what mechanism? Which subjects can respond? Which enabling conditions are required? What downstream pathways are anticipated? Which unintended effects are plausible? At what time horizon should evaluation occur? These questions prevent “relational intervention” from becoming a vague label for any complex policy.

Field-oriented intervention is one important possibility. Instead of specifying a single terminal outcome, governance can alter conditions under which desirable forms of generation become more feasible. Open standards can lower barriers to entry; public infrastructure can expand capability; rights can protect participation; information systems can make harms visible; funding structures can diversify inquiry; modular regulation can preserve reversibility. Such approaches remain interventions with distributive and political consequences even when they do not centrally prescribe final behavior.

Intervention-oriented inquiry also requires feedback. Economic systems respond to policy, and subjects can adapt strategically or creatively. An initially effective rule can become ineffective after behavior changes. A subsidy can create dependence; a measurement target can be gamed; a new right can generate institutional innovation; an infrastructure can enable uses that designers did not anticipate. GRE therefore treats monitoring and revision as part of intervention rather than as post hoc maintenance.

Reversibility and repair deserve explicit attention. Some interventions are easy to modify, while others create sunk costs, legal entitlements, ecological damage, technical lock-in, or institutional dependencies. An intervention that transforms generative conditions can make later reversal difficult even if the original allocation was modest. Design can therefore consider exit, rollback, sunset, compensation, remediation, and mechanisms for affected subjects to challenge or revise the arrangement.

Intervention-oriented inquiry is necessarily ethical and political. Choosing what to change, whose capacities to expand, which risks to accept, and which alternatives to close involves normative judgment and distributions of authority. Technical sophistication cannot remove these questions. What GRE can contribute is a disciplined account of how proposed interventions enter relational fields, how their effects propagate beyond immediate recipients, how they alter future capacities and constraints, and how governance can remain responsive to evidence and contestation.

The ten modes distinguished in this section are therefore complementary ways of making GRE's research programme operational. Descriptive inquiry establishes configurations; explanatory inquiry identifies mechanisms; historical inquiry reconstructs formation; comparative inquiry tests variation and plurality; interpretive

inquiry recovers meaning and symbolic mediation; causal inquiry disciplines attribution; formal inquiry clarifies explicit structures; computational inquiry extends representation and exploration; normative inquiry evaluates consequences and arrangements; and intervention-oriented inquiry connects analysis to deliberate change. Their combination is problem-dependent rather than fixed.

Methodological plurality, however, requires epistemic discipline. Combining modes does not automatically produce stronger knowledge if their assumptions, evidential statuses, and inferential limits remain implicit. The next constitutional task is therefore to state the commitments that govern how GRE moves among these modes: ontological suspension, partial observation, distinction between relation and representation, explicit boundary and scale selection, mechanism-sensitive attribution, historical dependence, methodological pluralism, revisability, and epistemic humility.

3.11 Epistemic Commitments of GRE

The methodological plurality established in the preceding section creates a further constitutional requirement. If Generative Relational Economics permits descriptive, historical, interpretive, causal, formal, computational, normative, and intervention-oriented inquiry, it also requires standards governing how claims move across those modes and how uncertainty is represented. Methodological plurality without epistemic discipline can produce a collection of incompatible assertions whose evidential status remains unclear. The role of this section is therefore to state the principal epistemic commitments that constrain GRE inquiry across methods and domains. Its objective is neither to supply a complete philosophy of science nor to impose a single theory of knowledge. It instead specifies a working discipline for research conducted under relational complexity, historical change, partial observability, heterogeneous forms of evidence, and revisable analytical categories.

The commitments are organized around nine requirements: ontological suspension, acknowledgment of partial observation, separation of relation from representation, explicit boundary and scale selection, mechanism before unwarranted attribution, historical and contextual dependence, methodological pluralism, revisability of analytical categories, and epistemic humility. They are mutually reinforcing. Ontological suspension restrains the conversion of useful models into premature metaphysical claims. Partial observation prevents the observed record from being equated with the whole relational configuration. Distinguishing relation from representation keeps measurements, categories, graphs, narratives, and models analytically separate from the processes they represent. Explicit boundary and scale selection makes exclusions visible. Mechanism disciplines attribution. Historical dependence limits the portability of claims across contexts and periods. Methodological pluralism allows different forms of evidence to correct one another. Revisability makes the analytical vocabulary responsive to changing objects and evidence. Epistemic humility calibrates the strength of conclusions to the scope of their warrant.

These commitments do not require a researcher to remain permanently agnostic about every substantive question. GRE can make strong empirical or theoretical claims when evidence, design, and argument justify them. The commitments instead determine what must be shown before such strength is warranted. A causal estimate

obtained from a credible design can support a bounded causal claim. A historically reconstructed mechanism can support an explanation when the documentary and comparative record is sufficiently strong. A formal theorem can establish consequences within a defined model. A normative argument can defend criteria under stated premises. Epistemic restraint does not weaken inquiry; it clarifies where the force of a conclusion comes from and which transformations of the claim would exceed the evidence that supports it.

The same discipline is particularly important because GRE studies processes that may alter the categories through which they are observed. A platform can reorganize what counts as work, a legal reform can alter the recognized economic subject, an accounting standard can change what becomes economically visible, an artificial system can redistribute capacities among human and organizational actors, and a governance intervention can transform the relations that later measurements attempt to describe. In such settings, the research object and the research representation can co-evolve. GRE therefore requires epistemic commitments that are compatible with historical transformation rather than assuming a permanently fixed ontology, vocabulary, or observation regime.

3.11.1 Ontological Suspension

Ontological suspension is the first epistemic commitment because GRE deliberately works with heterogeneous representations of economic reality. An inquiry may describe persons, organizations, institutions, flows, relations, fields, trajectories, networks, states, constraints, events, capacities, or symbolic objects. Each representation can disclose features that another suppresses. GRE therefore withholds claims about the ultimate ontological status of these objects unless the local inquiry requires such a claim and adequate argument is available.

Ontological suspension does not imply that nothing exists independently of description, nor does it reduce inquiry to arbitrary perspectivism. It is a methodological restraint concerning the relation between analytical usefulness and metaphysical conclusion. Treating a firm as an entity can be economically useful because the firm has relatively stable legal, organizational, accounting, and decision-making properties. Treating the same firm as a nexus of contracts, a field of authority, a network of relations, a bundle of productive capacities, or a historical process can also be useful for other questions. The availability of several productive representations does not by itself decide which description identifies the firm's final or most fundamental mode of being.

This suspension is especially important when scientific formalisms are transferred into economic analysis. A state space can organize possible configurations without proving that the economy literally consists of points in a pre-given mathematical space. A network model can represent relations without proving that node and edge ontology is fundamental. A field representation can model distributed conditions without establishing a physical field ontology for social life. An agent-based model can operationalize actors without settling the philosophical status of agency. GRE treats such formalisms as analytical constructions whose adequacy depends on the question, assumptions, empirical correspondence, and explanatory gain.

The commitment also protects inquiry against premature reduction. Economic value need not be reduced to price because price is measurable. Institutional recogni-

tion need not be reduced to individual preference because choice data are available. Collective capacities need not be reduced to the sum of personal attributes when organizational relations contribute to what can be done. Conversely, relational language does not license the reduction of entities to relations in every context. Relational constitution and relative entityhood can coexist at different scales and for different purposes.

Ontological suspension therefore supports a layered practice of commitment. GRE can commit locally to an operational ontology for a study: it may define firms, households, algorithms, jurisdictions, or communities as analytical units and proceed rigorously within that specification. The suspension concerns the elevation of that local choice into a universal claim. A representation is adequate when it supports warranted inquiry into the relevant mechanism or phenomenon; it becomes ontologically overextended when its convenience is treated as proof that excluded dimensions are unreal or insignificant.

This commitment also preserves the possibility of theoretical correction. New evidence can reveal that an apparently stable entity is internally heterogeneous, that a presumed relation is mediated by an unobserved institution, or that a category formerly treated as natural is historically contingent. GRE should permit the analytical ontology to change with the inquiry rather than defend the initial representation merely because it was useful at an earlier stage. Ontological suspension is thus not in decision. It is a discipline of keeping the strength of ontological claims proportionate to the work they actually perform.

3.11.2 Partial Observation

GRE assumes that economic observation is structurally partial. Researchers encounter traces, measurements, classifications, documents, transactions, interviews, images, records, behavioral outputs, and other manifestations of processes rather than an exhaustive presentation of the processes themselves. This partiality is not a temporary defect that disappears once sufficiently large datasets are obtained. Even abundant observation remains conditioned by what can be recorded, which categories are used, which events become legible, which populations are included, and which temporal or relational scales are accessible.

Partial observation has several forms. Some variables are simply unobserved. Others are observed through proxies whose validity depends on context. Some relations leave weak administrative traces. Informal activity may be systematically missing from official records. Household labor can remain economically consequential while being absent from market transactions. Platform data can be highly granular while revealing little about off-platform constraints. Historical archives can preserve institutional voices more consistently than marginalized ones. A sensor system can continuously observe behavior while remaining unable to identify meaning or motive. The volume of evidence therefore does not determine its completeness.

The relational character of GRE makes this issue especially consequential. Observing an individual without observing relevant relations can produce a misleading description of capacity, constraint, or choice. A worker's income does not fully disclose bargaining power, household obligations, visa dependence, care responsibilities, access to infrastructure, or exposure to algorithmic evaluation. A firm's balance sheet can omit the public infrastructures, ecological dependencies, cultural resources, or

community relations that condition production. A policy's administrative beneficiary list can omit subjects affected through prices, labor markets, household relations, ecological effects, or institutional precedents.

Partial observation also has a temporal dimension. Data may capture a process after important generative events have already occurred. Current inequality can reflect earlier institutional selections that are no longer directly visible. An observed preference can be the result of prior adaptation, exclusion, learning, or habituation. A stable relation may have emerged from a sequence of contingencies that cross-sectional evidence cannot recover. GRE therefore distinguishes observing a current configuration from knowing the history that generated it.

The commitment to partial observation changes how evidence is reported. Missingness, measurement error, selection, proxy construction, archival survival, model dependence, and unobserved mediation should be treated as substantive features of the epistemic situation rather than technical footnotes. A study need not solve every limitation, but it should identify those that materially affect interpretation. When evidence supports only a restricted claim, the claim should remain restricted.

Partiality also motivates triangulation without turning triangulation into automatic confirmation. Different evidence sources can compensate for different blind spots. Administrative data may establish distributional patterns; interviews can identify mechanisms or meanings absent from records; archival sources can reconstruct institutional change; ethnography can reveal enactment; experiments can isolate effects under constrained conditions; computational traces can show large-scale patterns. Agreement among these sources can strengthen confidence, while disagreement can reveal that they are observing different layers of the process.

GRE therefore treats observability as part of the economic and institutional environment. What becomes observable can itself be shaped by law, technology, organizational incentives, classification systems, and power. Some actors can make their activities legible while others remain invisible; some institutions can require reporting; some platforms can monopolize data; some harms appear only after measurement categories are created. Observation is consequently both an epistemic relation and, in many settings, an object of economic analysis.

3.11.3 Distinction between Relation and Representation

GRE distinguishes the relations under study from the representations through which those relations become analytically accessible. A representation can be a variable, category, graph, matrix, equation, narrative, map, model, legal classification, accounting entry, database schema, or visual diagram. Each representation selects and organizes features of a target domain. None should be treated as identical to the relation merely because it is useful for describing it.

This distinction is fundamental to relational inquiry because representations can create an appearance of precision that exceeds their empirical warrant. A network edge can encode communication, ownership, authority, trust, exchange, co-membership, or inferred association. Two edges of identical graphical form can represent substantively different relations. A weight attached to an edge may record frequency, monetary value, probability, distance, or a model-derived score. The mathematical object is therefore interpretable only through the measurement and theoretical decisions that produced it.

The same issue appears in categorical and institutional representations. A legal category can stabilize a relation for governance without exhausting its social meaning. An accounting classification can make a form of value visible while excluding others. A survey category can facilitate comparison while compressing heterogeneous experiences. An algorithmic score can summarize observed correlates while becoming institutionally consequential through decisions made on its basis. Representation can therefore both describe relations and participate in their transformation.

GRE consequently requires researchers to specify the mapping between representation and target. If “trust” is represented by repeated cooperation, the inferential gap should be stated. If “power” is represented by network centrality, the mechanism connecting centrality to power must be argued rather than assumed. If a latent variable is used to summarize capability, the construction and interpretation of that variable should remain visible. If text embeddings represent semantic similarity, similarity in the model space should not automatically be equated with shared meaning among subjects.

This distinction also protects formal analysis from reification. A model can derive properties of a representation with complete mathematical rigor while leaving open whether the represented mechanism is empirically operative. Computational sophistication cannot bridge that gap by itself. A simulation result is a consequence of a model and its parameterization. It becomes evidence about an empirical target only through validation, calibration, comparison, and argument connecting the representation to observed processes.

Representations can nevertheless become economically real in a second sense: actors may respond to them. Credit scores, rankings, performance indicators, ratings, risk categories, forecasts, and accounting metrics can alter behavior and resource allocation. The fact that a representation becomes causally consequential does not erase the distinction between representation and relation; it creates an additional relation in which the representation enters the system it describes. GRE should then study both its descriptive adequacy and its performative effects.

Maintaining this distinction enables stronger rather than weaker modeling. It allows researchers to use abstraction aggressively while keeping track of what has been abstracted. A representation can be deliberately narrow if the local question is narrow. The epistemic requirement is transparency concerning what the representation contains, what it excludes, how it was constructed, and which claims can legitimately be inferred from it.

3.11.4 Explicit Boundary and Scale Selection

Every GRE inquiry selects a boundary and scale. The selection determines which entities, relations, periods, jurisdictions, infrastructures, ecological conditions, and forms of value enter the analysis. Because GRE often studies effects that propagate beyond administrative recipients or immediate transactions, boundary selection is an epistemic decision with direct consequences for what can be observed and explained.

A boundary is never justified merely by being available in the data. Firm-level data encourage a firm boundary; household surveys encourage a household boundary; national statistics encourage a national boundary. These sources can be appropriate, but the research question may require a different relational domain. A wage change can affect households, local demand, public revenue, migration, or subcontracting. A

technological intervention can change organizational workflows, professional identities, educational demand, and infrastructural dependence. An ecological extraction can produce effects beyond the jurisdiction in which economic value is recorded. The boundary should therefore be selected in relation to the mechanism under investigation.

Scale selection poses a related problem. The individual, organization, community, institution, ecosystem, and transnational system are not simply nested containers with fixed causal priority. A process that appears exogenous at one scale can become endogenous at another. An organizational rule can constrain an individual while being generated by industry regulation, professional norms, or platform infrastructure. A national policy can appear autonomous until cross-border capital, legal regimes, or supply chains are included. GRE requires the researcher to state which scale is analytically primary and which cross-scale effects are being omitted or modeled.

Explicit selection does not require maximal expansion. The widest possible system boundary is rarely the most useful. Expanding a model can reduce identification, tractability, interpretability, or evidential quality. A bounded inquiry can be superior when the excluded relations are unlikely to alter the conclusion materially. GRE therefore favors justified boundaries rather than maximal boundaries. The researcher should explain why the chosen domain is sufficient for the claim and identify plausible pathways through which excluded relations could matter.

Temporal boundaries require equal attention. A programme evaluated after six months may appear successful while longer-term dependency, capability formation, institutional learning, or ecological cost remains unobserved. Conversely, a long historical window can obscure short-run mechanisms by aggregating distinct institutional regimes. The relevant temporal scale depends on the generation process being studied. Some effects are immediate; others emerge through accumulation, threshold crossing, learning, reproduction, or delayed conversion.

Boundary and scale choices can themselves be politically consequential. Administrative categories define who counts as a beneficiary, employee, resident, household member, owner, victim, or stakeholder. Jurisdictional boundaries determine which costs enter public accounting. Corporate boundaries can externalize labor or ecological relations into subcontracting and supply chains. GRE therefore examines not only the researcher's boundary but also the boundaries through which economic actors and institutions organize responsibility and visibility.

The epistemic commitment is straightforward: boundary and scale should be stated, defended, and revisable. Where conclusions are sensitive to alternative boundaries, that sensitivity is part of the result. A claim that survives reasonable changes in scale has different epistemic status from one that depends on a narrow administrative frame. GRE treats this sensitivity as informative rather than embarrassing because it reveals where economic descriptions are relationally contingent.

3.11.5 Mechanism before Unwarranted Attribution

GRE is interested in generation, propagation, conversion, subject formation, power, orientation, and structural transformation. These concepts can become excessively expansive if they are used to attribute every downstream difference to an initial relation. The fifth epistemic commitment therefore requires mechanism before unwarranted attribution. A relational association or temporal sequence becomes a genera-

tive claim only when the study provides a defensible account of how the earlier configuration contributed to the later one.

Mechanism can take different forms. It may involve incentives, authority, learning, information, legal recognition, technological affordances, resource transfer, network diffusion, social interpretation, institutional reproduction, ecological feedback, or strategic adaptation. The relevant mechanism can be probabilistic rather than deterministic and can operate jointly with other causes. GRE does not require a single universal mechanism of generation. It requires the mechanism invoked in a particular explanation to be specified sufficiently that evidence could distinguish it from plausible alternatives.

This standard is especially important for relational language. A relation between two actors does not automatically explain an outcome merely because the actors are connected. Network position, for example, can matter through access to information, bargaining leverage, reputational visibility, control of brokerage, exposure to contagion, or institutional authority. Different mechanisms can produce similar network patterns. A claim about the economic significance of structure therefore requires more than descriptive topology.

The same discipline applies to power. Persistent asymmetry is relevant to power, but asymmetry alone does not establish the mechanism through which one actor constrains another's options, shapes rules, controls resources, determines classifications, or alters future generative conditions. GRE should identify how asymmetry becomes actionable. Ownership rights, legal authority, infrastructure dependence, agenda control, data access, financial leverage, or control over recognition may provide such mechanisms. Where the pathway remains uncertain, the claim should be framed as a hypothesis rather than a conclusion.

Mechanism also disciplines claims about value conversion. If educational participation is said to generate social capital, which interactions produce continuing relations? If trust is said to generate economic cooperation, what institutional or experiential processes stabilize expectations? If cultural recognition is said to improve economic capability, through which access, motivation, legitimacy, or network pathways does the conversion occur? Naming the initial and final categories is insufficient; the transformation between them is the object that requires explanation.

This commitment does not imply that every GRE study must identify a complete micro-mechanism. Some phenomena are best explained at organizational, institutional, or ecological scales. A legal rule can have a causal effect without being reduced to individual psychology. A market design can alter incentives without reconstructing every subjective deliberation. Mechanistic adequacy is scale-relative. The requirement is that the explanatory link be more specific than a retrospective association and that the proposed pathway fit the level at which the claim is made.

Mechanism before attribution also protects normative analysis. Harm should not be assigned to a particular actor or intervention merely because the harm occurred within a broader relational system. Responsibility can be distributed, mediated, historically inherited, or structurally reproduced. Normative attribution may therefore require a separate analysis of control, foreseeability, benefit, capacity, institutional role, and available alternatives. GRE's relational orientation expands the field of possible responsibility while simultaneously requiring greater care in attributing it.

3.11.6 Historical and Contextual Dependence

GRE treats economic categories, mechanisms, and regularities as potentially dependent on historical and institutional context. This commitment follows from the earlier chapters' emphasis on changing productive relations, subject forms, technologies, norms, legal categories, and value structures. A relation that operates in one institutional environment may change meaning or effect in another. Historical and contextual dependence therefore constrains generalization without eliminating the possibility of general knowledge.

Context dependence can enter through mechanisms. Credit can expand productive capacity in one institutional setting and reinforce dependence in another. Informal networks can provide resilience where formal systems are weak while reproducing exclusion where membership is restrictive. Algorithmic evaluation can reduce some forms of discretion while creating new informational asymmetries and dependencies. A cooperative structure can enable collective control under supportive legal and financial conditions yet remain marginal under a regime that withholds access to capital or procurement. The nominal form of a relation therefore does not uniquely determine its generative effects.

Historical dependence also affects categories. The economic meaning of "worker," "firm," "household," "property," "skill," "platform," or "currency" is shaped by institutional arrangements that change over time. A category can retain its name while the relations that constitute it transform. GRE should therefore avoid treating administrative continuity as proof of substantive continuity. Historical reconstruction can be necessary even when contemporary data appear precise.

The commitment does not require every proposition to be historically unique. Recurrent mechanisms can be identified across cases, and comparative analysis can reveal robust patterns. The epistemic task is to specify the domain of portability. A mechanism may generalize across institutional settings under identifiable conditions; a formal model may describe a family of processes; a causal effect may transport when relevant effect modifiers are sufficiently similar. GRE therefore distinguishes universalizing language from conditional generalization.

Context dependence also concerns meaning. Economic actors interpret rules, resources, risks, and opportunities through historically situated symbolic and normative frameworks. The same monetary transfer can signify compensation, obligation, charity, recognition, debt, or entitlement in different settings, with different relational consequences. Interpretive evidence can therefore be necessary when the mechanism depends on how actors understand the relation.

The historical commitment extends to the researcher's categories and methods. Measures calibrated in one period can lose validity as institutions change. A proxy for employment stability can fail when contractual forms transform. A model of media attention can become obsolete after a platform redesign. A measure of technological capability can change meaning as complementary infrastructures diffuse. GRE should treat measurement regimes as historically situated rather than assume that a stable variable label guarantees stable construct validity.

This commitment encourages temporal comparison and repeated evaluation. A finding can be valid for the period studied and later require revision because the object changed. Such revision does not necessarily invalidate the earlier research; it can reveal the historical conditions under which the earlier claim held. GRE therefore

regards the temporal domain of a claim as part of its specification.

3.11.7 Methodological Pluralism

Methodological pluralism is an epistemic commitment because no single method has privileged access to every aspect of a generative relational process. Quantitative estimation, qualitative interpretation, historical reconstruction, formal modeling, computational simulation, comparative analysis, experiments, ethnography, archival work, network analysis, and participatory methods each make some features more visible and others less so. GRE therefore treats methods as differentiated instruments of inquiry whose adequacy depends on the claim being made.

Pluralism differs from methodological eclecticism without standards. The presence of several methods does not strengthen a study automatically. Each method must contribute an identifiable epistemic function. A qualitative study can identify mechanisms and meanings that guide quantitative measurement. A quantitative design can estimate the distribution or magnitude of an effect suggested by qualitative evidence. Historical analysis can reveal institutional transitions that make a cross-sectional association intelligible. Formal modeling can clarify whether a proposed mechanism is internally coherent. Simulation can explore trajectories under specified assumptions. Their combination is valuable when the outputs constrain or inform one another.

Pluralism also means that methodological disagreement can be productive. If administrative data indicate improved employment while interviews reveal increased insecurity, the discrepancy may reflect different populations, time horizons, definitions, or dimensions of the outcome. GRE should investigate the divergence rather than force immediate convergence. Different methods can reveal multiple aspects of a heterogeneous value structure or relational configuration.

No hierarchy follows automatically from formal precision. Mathematical and computational methods can make assumptions explicit, derive implications, and handle complexity that prose alone cannot. Their precision concerns the representation once specified. Empirical relevance still depends on the quality of the mapping between model and target. Conversely, qualitative richness does not eliminate the need for disciplined inference. Interpretive accounts require transparent evidence, plausible alternatives, and attention to scope. Historical narratives require source criticism. Normative arguments require defensible premises. Methodological pluralism therefore expands the repertoire of rigor rather than relaxing it.

The commitment also preserves compatibility with established economics. GRE does not require replacing econometrics, experiments, equilibrium analysis, mechanism design, industrial organization, public economics, labor economics, or other established approaches when they answer the relevant question well. A GRE inquiry can incorporate these methods and add relational or generative analysis where it materially changes explanation. Pluralism includes the possibility that the best answer to a bounded question is supplied by an existing method without specifically GRE additions.

Pluralism has institutional implications for research design. Data infrastructures, publication norms, disciplinary training, and funding systems often privilege some evidence types over others. A research programme that studies heterogeneous relational processes must resist converting institutional convenience into epistemic hi-

erarchy. This does not mean every project must be interdisciplinary. It means that exclusions among methods should be justified by the question rather than inherited uncritically from disciplinary boundaries.

The strongest form of methodological pluralism in GRE is mutual corrigibility. Formal models can expose ambiguity in conceptual claims. Historical evidence can show that apparently universal categories are contingent. Qualitative evidence can reveal omitted mechanisms. Causal designs can challenge compelling narratives. Computational models can test whether proposed local rules produce the claimed system-level pattern. Normative analysis can reveal that an empirically efficient intervention depends on contested evaluative premises. Methods become part of a common research programme when they can correct one another without being forced into a single epistemology.

3.11.8 Revisability of Analytical Categories

GRE treats its analytical categories as revisable. Relation, subject, value, capacity, institution, field, constraint, trajectory, generativity, and power are working concepts whose definitions should become more precise through research. The commitment to revisability follows from ontological suspension and historical dependence: if the objects of inquiry can change and if different representations disclose different aspects of them, then the vocabulary of the research programme cannot be permanently fixed at its founding stage.

Revisability does not imply conceptual looseness. A study should define its categories precisely enough to support inference. The revision occurs when evidence, theoretical contradiction, cross-case comparison, or improved formalization shows that the existing category fails. The relevant distinction is between local precision and global finality. GRE can use a precise operational definition while remaining open to revising that definition in later research.

Category revision can take several forms. A category can be subdivided when previously hidden heterogeneity becomes important. Several categories can be combined when distinctions prove analytically unproductive. Boundaries can change when new relations become visible. A category can move from exogenous condition to endogenous object of inquiry. A variable treated as an attribute can be reconceptualized as relationally generated. A representation can be abandoned if it systematically misclassifies the phenomenon.

Economic subjecthood provides one example. A research programme built exclusively around human individuals would be strained by organizations, automated systems, collective entities, or hybrid arrangements that make economically consequential selections. Expanding the category of operational economic subject can improve analysis, but that revision need not erase distinctions concerning consciousness, personhood, legal standing, or moral status. Revisability allows the category to change while preserving distinctions that remain normatively or empirically necessary.

Value provides another example. Price can remain a central economic representation of value without exhausting the relevant evaluative or relational phenomena. Research can discover forms of value whose realization depends on access, recognition, participation, ecological capacity, institutional continuity, or future capability. Revising the analytical vocabulary to capture these forms does not require treating them as commensurable or collapsing them into a single metric.

Revisability also applies to GRE itself. Concepts introduced in this book are provisional elements of a research programme rather than protected doctrine. Later empirical work may show that some distinctions are unproductive, that other concepts are missing, or that the framework overstates the usefulness of generative analysis in particular domains. A research programme becomes cumulative not by preserving every founding category but by creating procedures through which categories can be criticized, compared, refined, and replaced.

This commitment places a burden on documentation. When categories change across studies or over time, researchers should record how definitions differ and why. Conceptual drift can otherwise appear as empirical change. GRE therefore favors transparent conceptual provenance: the history of a category's operationalization is part of the knowledge needed to compare results.

3.11.9 Epistemic Humility

Epistemic humility is the concluding commitment because it governs the relation among all the preceding ones. It requires the strength, scope, and precision of a claim to remain proportionate to the evidence and argument that support it. Humility does not require weak conclusions where strong conclusions are justified. It requires researchers to distinguish what has been observed from what has been inferred, what has been modeled from what has been validated, what is locally supported from what is generalized, and what is normatively defended from what is empirically established.

In relational economic inquiry, overstatement can arise easily because the studied systems are interconnected. Once a downstream effect is observed, it is tempting to narrate a complete chain of generation. Once a network pattern appears, it is tempting to attribute power or influence. Once a simulation reproduces a stylized fact, it is tempting to treat the mechanism as confirmed. Once an intervention succeeds locally, it is tempting to generalize it across contexts. Epistemic humility interrupts these moves by requiring an explicit account of the inferential bridge.

Humility also concerns uncertainty that cannot be reduced to a probability estimate. Researchers can face model uncertainty, category uncertainty, boundary uncertainty, interpretive disagreement, historical incompleteness, unknown unknowns, or normative pluralism. Quantification is valuable when a defensible probability model exists, but not every epistemic limitation is probabilistic. GRE therefore permits qualitative statements of uncertainty where numerical precision would be misleading.

The commitment is especially important for intervention. Application-dominant praxis often requires action before knowledge is complete. Epistemic humility does not imply inaction under uncertainty. It changes how intervention is designed: assumptions are made explicit, monitoring is built in, reversible steps are preferred where feasible, affected subjects retain opportunities for contestation, and the intervention is treated as a source of new evidence rather than the execution of a final truth. Learning and governance become coupled.

Humility also requires attention to the distribution of epistemic authority. Researchers, administrators, firms, communities, workers, users, and affected populations can possess different forms of knowledge. Expertise can be real without being total. Local experience can identify mechanisms invisible to aggregate data while

remaining limited in scope. Institutional actors can possess operational information while having incentives to frame it selectively. GRE therefore treats disagreement among knowledge holders as an object for analysis rather than assuming that one standpoint has automatic priority across all questions.

This commitment extends to artificial and computational systems. Large models, automated inference, and high-dimensional data can increase the scale and speed of analysis, but they do not eliminate uncertainty concerning data generation, representation, causal identification, normative criteria, or institutional effects. Computational confidence can be numerically precise while remaining epistemically narrow. GRE should therefore distinguish predictive performance from explanatory adequacy, statistical calibration from normative legitimacy, and representational capacity from knowledge of the target process.

Epistemic humility finally concerns the research programme's own historical position. GRE is being constituted under particular contemporary conditions: changing productive relations, computational abundance, new forms of artificial capability, ecological constraints, institutional complexity, and increasing visibility of relational and generative processes. These conditions make the programme plausible and potentially useful; they do not guarantee its enduring adequacy. Future economic forms may require different concepts. Existing theories may explain domains where GRE adds little. Evidence may contradict central hypotheses. The programme should be organized so that such correction is possible without treating revision as failure.

Taken together, the commitments of this section define a disciplined epistemic posture for Generative Relational Economics. GRE can make strong claims, employ sophisticated formalisms, combine diverse evidence, and participate in intervention, but it should do so while suspending unnecessary ontological conclusions, acknowledging partial observation, separating relations from their representations, making boundaries and scales explicit, demanding mechanisms for attribution, locating claims historically, preserving methodological pluralism, revising categories when required, and calibrating confidence to warrant. These commitments prepare the transition from inquiry to praxis. The following section turns to how GRE moves from explanation and evaluation toward relational diagnosis, generative diagnosis, and intervention under conditions where knowledge remains necessarily incomplete.

3.12 Praxis in Generative Relational Economics

The preceding sections established the objects, scales, questions, analytical perspective, modes of inquiry, and epistemic commitments of Generative Relational Economics. Those elements define how GRE can study economic relations, but a research programme concerned with generative conditions also requires an account of how inquiry can enter practice. The role of this section is to specify a preliminary praxis architecture for GRE: a disciplined way of moving from explanation toward intervention while preserving the epistemic restraints developed above. Its objective is not to provide a universal policy cycle or a general theory of governance. It identifies a recurrent sequence of practical operations through which relational and generative knowledge can inform action under conditions of incomplete knowledge, heterogeneous values, changing environments, and effects that propagate beyond the administratively designated recipient.

GRE praxis begins from a distinction between understanding a system and acting within it. Explanation can identify mechanisms, constraints, distributions, histories, and relational structures, yet intervention changes the very configuration that explanation describes. An intervention can redistribute resources, alter expectations, create or dissolve relations, redefine institutional categories, shift bargaining positions, generate new dependencies, reorganize attention, and modify later capacities for action. Praxis therefore cannot be represented as the simple application of a finished model to a passive target. It is an entry into an evolving relational domain in which the intervention, the affected subjects, the environment, and the relevant knowledge can all change through their interaction.

For that reason, the praxis architecture developed here is iterative. It moves through relational diagnosis, generative diagnosis, identification of constraints and enabling conditions, intervention design, allocation understood as relational intervention, tracing of downstream effects, feedback and revision, adaptive governance, and, where required, withdrawal, reversal, or repair. These operations can overlap, recur, or be entered from different points. They are not a mandatory sequence imposed on every practical problem. Their function is to prevent a narrow intervention logic in which resources are allocated, an immediate output is measured, and wider changes are treated as externalities unless they happen to fit the original administrative frame.

The praxis perspective also preserves the distinction between research-dominant and application-dominant activity. Research-dominant praxis principally seeks improved understanding, even when research design itself changes the studied field. Application-dominant praxis principally seeks to alter an economic or institutional situation under practical constraints. The difference concerns orientation rather than an absolute separation between knowledge and action. Research can generate interventions, and interventions can generate knowledge. GRE therefore treats praxis as a domain in which explanation, evaluation, experimentation, governance, and learning become coupled while remaining analytically distinguishable.

A further constraint is normative. Generativity is not itself a sufficient criterion of success. An intervention can generate economic activity while deepening dependence, produce capabilities for one group while foreclosing possibilities for another, increase circulation while accelerating extraction, or create institutional stability by suppressing exit and contestation. Section 3.12 therefore develops the architecture of intervention without resolving the normative standards by which generated consequences should be judged. Those standards are taken up in the following section. Here the central concern is more basic: how GRE can intervene without treating either the target of intervention or the intervention's own consequences as fixed in advance.

3.12.1 Intervention within GRE Praxis

The movement from explanation to intervention is a change in epistemic and practical burden. Explanatory inquiry asks what relations, mechanisms, histories, and conditions contributed to an observed pattern. Intervention asks what may happen if some part of that configuration is deliberately altered. The second question contains the first but adds counterfactual, organizational, ethical, and temporal demands. A mechanism that explains a past outcome may not remain invariant after actors learn

about the intervention, institutions adapt, or the distribution of resources changes. GRE therefore resists the assumption that an explanatory model can be converted directly into a policy instrument without re-examining the relations through which the intervention will operate.

A practical intervention enters a field already structured by prior relations. Subsidizing a household, financing a firm, redesigning a public service, opening access to data, changing a legal entitlement, or introducing an artificial system does more than modify one variable. It can alter who interacts with whom, which claims become enforceable, which actions become feasible, whose knowledge becomes authoritative, and which future trajectories become easier to sustain. The intervention should therefore be represented not only by its administrative action but also by the relational changes through which its consequences may be mediated.

This perspective changes the meaning of implementation. Implementation is often treated as the stage in which a previously selected intervention is executed with fidelity. GRE instead treats implementation as an epistemically productive period in which assumptions about relations, mechanisms, and capacities encounter an evolving empirical configuration. Deviations from the original design can indicate administrative failure, but they can also reveal that the initial model omitted relevant actors, constraints, interpretations, or feedback mechanisms. Praxis requires distinguishing avoidable execution error from informative evidence that the intervention theory requires revision.

The transition from explanation to intervention also introduces strategic interaction. Subjects can anticipate policy, resist classification, exploit new opportunities, reorganize coalitions, change reporting behavior, or redirect resources. Organizations can internalize an intervention into routines that differ from its stated purpose. Platforms can redesign interfaces in response to regulation. Beneficiaries can combine an allocation with household, community, or informal resources in ways that produce unanticipated effects. These responses are part of the relational system rather than noise surrounding an otherwise fixed treatment.

GRE therefore favors interventions whose theory of change states at least four elements. First, it identifies the relevant relations through which the intervention is expected to operate. Second, it specifies the generative claim: what capacities, structures, opportunities, constraints, or forms of value are expected to emerge or transform. Third, it states the anticipated temporal and scalar pathways through which effects may propagate. Fourth, it identifies observations that would count against the intervention theory. The resulting design remains provisional, but its provisionality is disciplined rather than vague.

Intervention under uncertainty does not imply paralysis. Many economic and governance problems require action before the relational system is fully known. The practical question is how to make action compatible with learning. GRE therefore gives special weight to staged implementation, monitoring, contestability, modularity, reversible components, and explicit review points where feasible. These features do not eliminate uncertainty. They reduce the cost of discovering that the intervention has altered the field in ways the initial explanation did not anticipate.

3.12.2 Relational Diagnosis

Relational diagnosis identifies the configuration within which the practical problem is constituted. Its purpose is not to produce an exhaustive map of all social relations. It asks which relations are materially relevant to the problem, how they are organized, which boundaries have been selected, and where the apparent administrative object depends on actors or conditions outside that boundary. Diagnosis therefore precedes intervention design because the same nominal problem can require different action when its relational constitution differs.

A relational diagnosis begins by identifying the subjects, organizations, institutions, infrastructures, symbolic systems, and ecological conditions that participate in the relevant economic situation. It then asks how access, authority, recognition, information, resources, obligations, and opportunities are distributed among them. The resulting map may be qualitative, quantitative, historical, network-based, institutional, or mixed. Its adequacy depends on whether it reveals relations that are necessary to understand the practical problem rather than on whether it maximizes representational complexity.

Consider a programme intended to improve employment access. An administrative diagnosis might begin with unemployed individuals and available jobs. A relational diagnosis can reveal additional mechanisms: transportation, childcare, credential recognition, social networks, disability access, hiring intermediaries, platform ranking, visa status, household obligations, employer risk practices, or regional housing costs. These are not automatically the correct variables in every case. Their relevance depends on whether they mediate the conversion of an employment opportunity into an actual capability to obtain and sustain work.

Relational diagnosis also identifies asymmetry. The relevant question is not only who possesses more resources, but which actors can define categories, set terms of exchange, control infrastructures, impose switching costs, delay decisions, externalize risk, or withdraw without comparable loss. Two actors may exchange voluntarily while facing highly unequal exit conditions. A platform and a small supplier may both be organizations, yet their capacity to redesign the interaction can differ drastically. Diagnosing these asymmetries matters because an intervention that treats formally similar actors as substantively equivalent can reproduce the mechanism that generated the problem.

The diagnosis should also be historical. Present relations can depend on prior institutional settlements, accumulated debts, inherited infrastructures, past exclusions, or sequences of investment that make current alternatives unequally costly. A cross-sectional map can show who is connected to whom while missing why the relation has its present form or why some apparently available alternatives are practically inaccessible. Historical reconstruction helps distinguish a relation that is contingent and readily modifiable from one stabilized by layered commitments and path-dependent investments.

The output of relational diagnosis is therefore a bounded working representation of the practical field. It should make its exclusions visible. No map captures every relation, and an attempt to include everything can make intervention impossible. GRE instead requires an explicit statement of which relations are treated as inside the diagnostic boundary, which are treated as environmental conditions, and which remain uncertain. The map is revisable as intervention reveals previously hidden dependen-

cies.

3.12.3 Generative Diagnosis

Relational diagnosis identifies the configuration; generative diagnosis asks what that configuration tends to produce. The distinction matters because the same relational structure can be significant for different reasons depending on the processes it sustains. A credit relation can generate productive capacity, dependency, reputational effects, data, bargaining power, future borrowing opportunities, or combinations of these. A school can distribute instruction while also generating networks, credentials, expectations, classifications, and future access. A platform can facilitate exchange while generating information asymmetries, behavioral dependence, market visibility, or new organizational capabilities.

Generative diagnosis therefore focuses on transformations rather than only states. It asks what changes because a relation persists, intensifies, weakens, or is removed. The relevant outcomes can include resources, capacities, identities, institutional routines, legal positions, expectations, symbolic categories, ecological conditions, or the ability to enter later relations. This focus is particularly important when immediate outputs are poor proxies for longer-horizon consequences. A grant may be fully disbursed while failing to produce the organizational capacity it was intended to support. A training programme may improve measured skills while weakening participation because the credential is not institutionally recognized. A subsidy may increase adoption while entrenching dependence on a proprietary infrastructure.

The generative diagnosis should distinguish several pathways. Some effects arise directly from the intervention target. Others are mediated through relations with third parties. Some emerge from feedback: an initial change alters behavior, which changes the environment faced by later participants. Some effects accumulate only after repeated interactions. Others occur through symbolic or classificatory change, where being recognized as eligible, risky, employable, innovative, or compliant modifies later treatment by institutions.

Generative diagnosis also asks what is reproduced. A relational configuration may produce no dramatic new outcome while continually regenerating a distribution of advantage, vulnerability, or access. Stable inequality can be generative in this sense because institutions repeatedly convert initial asymmetries into later opportunities. Conversely, a relation can sustain capabilities that would deteriorate if the relation disappeared. Maintenance, reproduction, and repair are therefore forms of generation when they preserve conditions that require continuing relational work.

A further question concerns foreclosure. Generation can expand possibilities for some actors while reducing the future option set for others or for the same actors at a later time. Infrastructure investment can enable activity while creating technological lock-in. Debt can finance capacity while narrowing future discretion. Standardization can reduce coordination costs while suppressing alternative forms of practice. Generative diagnosis therefore traces both enabling and constraining transformations without assuming that generation is uniformly expansive.

The practical output of generative diagnosis is a set of plausible mechanism pathways linking the relational configuration to changes that matter for the intervention. These pathways can be compared, tested, revised, or ranked by evidential support. GRE does not require every pathway to be fully identified before action. It requires

the intervention to state what it expects to generate and why, so that later observations can update rather than merely decorate the original theory.

3.12.4 Identification of Constraints and Enabling Conditions

Diagnosis becomes actionable when it identifies conditions that limit or enable transformation. GRE uses constraint in a broad but disciplined sense: a constraint changes the set, cost, probability, or viability of available transformations without necessarily making an action logically impossible. Enabling conditions operate in the opposite direction by making some transformations more feasible, durable, or accessible. The same condition can constrain one pathway while enabling another.

Constraints can be material, institutional, relational, informational, temporal, symbolic, ecological, or cognitive. A lack of capital is a material constraint, but the ability to use capital may depend on licenses, trusted partners, language access, data, infrastructure, or the timing of payments. A legal entitlement can exist while remaining practically inaccessible because procedural complexity, documentation requirements, or fear of institutional contact limits its use. An organization can possess technical capacity while lacking the authority to deploy it. A community can possess knowledge while lacking channels through which institutions recognize that knowledge as actionable.

The distinction between constraint and symptom is central. Low participation can be treated as a behavioral problem and addressed through incentives, yet the underlying constraint may be timing, distrust, inaccessible procedures, reputational risk, or exclusion from the networks through which information circulates. Raising an incentive can improve participation while leaving the deeper constraint unchanged, or it can worsen inequality if only already advantaged actors can respond. Constraint identification therefore asks which conditions actually regulate the transformation pathway relevant to the intervention.

Enabling conditions deserve equal analytical attention. Praxis often becomes overly problem-centered and maps only deficits. Existing trust relations, local organizations, informal knowledge, public infrastructure, legal protections, professional norms, ecological capacities, and mutual-aid practices can already support generation. An intervention that ignores these conditions can displace them with a formal system that appears more legible while being less generatively capable. GRE therefore asks which existing relations should be preserved, strengthened, connected, or left undisturbed.

Constraints and enabling conditions are also scale-relative. A national regulation can constrain an organization while enabling fairer competition across a sector. A household norm can constrain an individual's labor-market participation while enabling care provision that sustains other members. A standardized protocol can constrain local discretion while enabling interoperability. Praxis requires representing these tensions rather than declaring a condition simply enabling or constraining in the abstract.

The identification process should therefore produce intervention points rather than a flat inventory. Some constraints are proximal and modifiable; others are structural conditions that cannot be changed within the intervention horizon. Some enabling conditions can be activated with modest resources; others require institutional reform. Distinguishing these categories helps prevent designs that target

visible but weakly generative variables while leaving the mechanisms of exclusion or capacity formation intact.

3.12.5 Intervention Design

Intervention design translates diagnosis into a provisional configuration of actions, resources, institutions, and learning procedures. GRE does not require a distinctive policy instrument. Taxes, transfers, public investment, regulation, organizational redesign, information provision, infrastructure, standards, cooperative arrangements, educational programmes, platform rules, procurement, or combinations of these can all be compatible with GRE. What distinguishes the praxis perspective is how the intervention is specified: in relation to mechanisms, downstream generation, scale, feedback, and revisability.

A GRE intervention should first identify its operative target. The target can be a resource constraint, a relation, a conversion mechanism, an institutional rule, a boundary, a feedback loop, an information structure, or an enabling condition. Target clarity matters because interventions with the same administrative recipient can act through different mechanisms. A cash transfer and a childcare service may both support household economic participation, but they alter different constraints and relational structures. Their effects should not be inferred from the shared identity of the recipient.

Second, intervention design should distinguish the intended immediate change from the intended generative effect. Providing equipment is an immediate allocation. Developing a durable productive capacity may be the generative objective. Changing a regulation is an immediate institutional act. Increasing entry, reducing dependency, or enabling new organizational forms may be the intended downstream effect. This distinction makes it possible to observe successful implementation together with failed generation, or imperfect implementation together with unexpected generative benefits.

Third, design should state relevant temporal horizons. Some interventions seek rapid stabilization; others seek capacity formation whose effects appear slowly. A short evaluation window can misclassify a long-horizon intervention as ineffective or reward interventions that produce immediate outputs by drawing down future resources. GRE therefore encourages explicit differentiation among immediate, intermediate, and longer-horizon effects without assuming that longer is always better.

Fourth, intervention design should anticipate heterogeneity. Subjects differ in resources, vulnerabilities, interpretation, institutional status, and ability to convert an allocation into later capacity. Uniform provision can therefore generate unequal outcomes. The design question is not necessarily to individualize every intervention, which can become administratively costly or intrusive. It is to identify forms of heterogeneity that are mechanism-relevant and to determine whether adaptive, tiered, or plural pathways are needed.

Fifth, design should include learning architecture. Monitoring variables, qualitative feedback, review intervals, stop conditions, and procedures for incorporating affected participants should be established before implementation where possible. This prevents evaluation from becoming an after-the-fact search for favorable indicators. It also recognizes that some of the most important effects may be discovered only after the intervention enters the field.

Intervention design in GRE is therefore closer to constructing a revisable relational hypothesis than to selecting a fixed treatment. The design states what is being changed, through which relations, toward which generative effects, under which assumptions, across which scales and time horizons, and with what procedures for detecting error. The resulting intervention can still be administratively simple. Analytical sophistication does not require operational complexity when the mechanism is clear.

3.12.6 Allocation as Relational Intervention

Allocation is a central economic operation, but GRE treats allocation as the beginning of a relational process rather than its endpoint. Money, time, attention, infrastructure, rights, data access, institutional recognition, expertise, or productive assets enter existing relations when allocated. Their consequences depend on conversion conditions, obligations, expectations, complementary resources, and the position of the recipient within wider structures.

This perspective changes the unit of practical analysis. A transfer to an individual may affect a household, landlord, creditor, employer, local market, or platform through expenditure, bargaining, debt repayment, mobility, or information. Funding an organization can change its internal authority, external partnerships, reputational standing, and future ability to attract resources. Granting data access can create research capacity while redistributing informational advantage. Allocation therefore changes relations even when the formal instrument is directed to a discrete recipient.

Relational allocation does not mean that every allocation must be socially conditioned or collectively administered. Direct individual transfers can be valuable precisely because they reduce dependence on gatekeepers. The analytical point is that the intervention should ask what relations the allocation enters or transforms. An unconditional transfer can weaken a coercive relation by increasing exit capacity. A conditional transfer can create a new monitoring relation. A loan can expand productive capacity while strengthening a creditor's claims. The relational effects depend on design and context rather than on the category of instrument alone.

Allocation also has temporal structure. Resources can be consumed, invested, circulated, pooled, converted, or used to maintain existing capacities. Timing can determine which pathway becomes viable. A delayed payment can destroy a fragile organization even if the total allocation is adequate. A predictable stream can generate planning capacity beyond its nominal monetary value. A one-time grant can enable experimentation but fail to sustain maintenance. GRE therefore treats schedule, predictability, reversibility, and duration as properties of the allocation relation.

The recipient itself may be generated through allocation. Programmes define eligibility categories, create beneficiary identities, establish reporting obligations, and sometimes produce organizations capable of receiving funds. Public procurement can constitute firms as qualified suppliers. Credit scoring can define economically consequential categories of risk. Allocation systems therefore participate in the production of subjects and classifications, not merely in the distribution of pre-existing resources among them.

For praxis, the implication is that allocation should be evaluated through both direct transfer and relational transformation. The relevant questions include what ca-

capacity the resource creates, what dependencies accompany it, what complementary conditions are required, which actors gain authority, how value is recirculated or extracted, and what happens when the allocation stops. These questions extend ordinary allocation analysis rather than replacing it.

3.12.7 Tracing Downstream Effects

Once an intervention enters a relational field, praxis requires tracing effects beyond its immediate output. Downstream tracing follows the propagation, conversion, recirculation, dissipation, extraction, and stabilization of changes generated by the intervention. The purpose is not to attribute every later event to the intervention. It is to identify plausible pathways through which initially local changes become economically consequential elsewhere or later.

Downstream effects can be direct, mediated, recursive, or displaced. A subsidy can increase demand directly, alter supplier investment through expectation, change local prices through market response, and affect future policy through political interpretation. A new infrastructure can reduce transport costs, reorganize land values, change settlement patterns, and later alter fiscal capacity. A platform rule can affect user behavior, which changes the data used by the platform, which then changes ranking or recommendation, producing a recursive effect.

Tracing requires temporal discipline. Early indicators can differ from later effects because actors adapt and complementary investments emerge. Some harms are delayed. Some benefits require repeated interaction before they become visible. GRE therefore distinguishes outcome timing from causal distance. An effect that occurs quickly can still be relationally distant if it is mediated through several actors, while a delayed effect can arise from a simple accumulation mechanism.

Tracing also requires counterfactual restraint. Observing a later change in a connected actor does not prove that the intervention generated it. Evidence can come from experimental or quasi-experimental designs, process tracing, comparative cases, administrative sequences, qualitative testimony, network change, simulation, or combinations of these. The method should match the claim. The broader the asserted downstream attribution, the greater the burden of distinguishing intervention effects from concurrent change.

Some downstream effects concern value conversion rather than magnitude. An allocation can be converted into political influence, social recognition, technical capacity, ecological pressure, or future access. These forms may not be commensurable with the original resource. Tracing therefore cannot always be reduced to adding monetary benefits and costs. GRE can use monetary valuation where appropriate while preserving additional dimensions when conversion into a scalar measure would erase mechanism-relevant differences.

The practical function of downstream tracing is to maintain contact between intervention and evolving reality. It provides evidence for revision, identifies beneficiaries or harmed parties omitted from the original frame, and detects when an intervention's generative pathway has changed. It also prevents a programme from declaring success solely because the administratively proximate output was delivered as planned.

3.12.8 Feedback and Revision

Feedback converts intervention into learning when observations are allowed to alter the intervention theory and design. GRE distinguishes feedback from mere monitoring. Monitoring records whether specified indicators change. Feedback becomes analytically consequential when those observations can revise assumptions about relations, mechanisms, boundaries, timing, subject heterogeneity, or normative effects.

A useful feedback architecture separates implementation evidence from generative evidence. Implementation evidence asks whether the intervention occurred as intended: funds reached recipients, infrastructure was built, a rule was applied, or a service became available. Generative evidence asks whether the intended transformations followed and what additional transformations occurred. Maintaining this distinction prevents implementation fidelity from being mistaken for substantive success.

Revision can occur at several levels. Parameters can be adjusted while the intervention theory remains intact. Delivery can change because conversion conditions differ across groups. The relational target can change when a hidden intermediary becomes visible. The generative objective itself can be revised when the original aim proves infeasible, harmful, or normatively contested. In more substantial cases, the intervention can reveal that the original problem representation was wrong and requires reconstruction.

Feedback should include affected subjects where their experience provides access to mechanisms or harms not visible in aggregate indicators. Participation is not automatically epistemically superior; local actors can disagree, possess partial information, or face incentives that shape reporting. Their knowledge nevertheless belongs to the evidential field. A feedback system that listens only to administrative data can systematically miss changes in trust, dignity, informal burden, strategic adaptation, or hidden exclusion.

Revision also requires institutional capacity. An organization can collect excellent evidence yet be unable to change because budgets, legal mandates, procurement contracts, professional incentives, or political commitments lock the intervention into its original form. GRE therefore treats the ability to revise as part of intervention design. Review authority, modular contracts, contingency funds, sunset clauses, and explicit decision rules can create practical room for learning, where appropriate.

Feedback is thus not a final stage after implementation. It is a continuing relation between action and evidence. Praxis becomes adaptive when the intervention is organized so that new information can change subsequent action without abandoning accountability or making goals infinitely movable.

3.12.9 Adaptive Governance

Adaptive governance is the institutionalization of revision under changing conditions. It becomes relevant when the intervention affects a system whose relations, actors, or environment evolve on a time scale comparable to the governance process. In such settings, a one-time optimal design can become obsolete even if it was well justified when adopted. GRE therefore treats governance as an ongoing arrangement for observing, deciding, revising, coordinating, and contesting changes in a relational field.

Adaptation does not mean continuous discretionary change. Constant revision can

destroy predictability, undermine investment, and make rights dependent on administrative mood. Stable rules can themselves be enabling conditions. Adaptive governance therefore requires deciding which elements should remain stable and which should be revisable. Constitutional protections, procedural rights, or long-horizon commitments may provide a stable frame within which parameters, implementation mechanisms, or experimental components can change.

The architecture of adaptation should match the distribution of knowledge and consequence. Centralized revision can coordinate across regions and prevent local capture, while decentralized adaptation can respond to context and reveal heterogeneous mechanisms. Multi-level governance can combine these functions when authority, information, and accountability are allocated explicitly. GRE does not presume decentralization to be intrinsically more relational or generative. The relevant question is which governance structure can perceive and respond to the mechanisms that matter while preserving legitimate constraints on power.

Adaptive governance also involves threshold decisions. Some observed variation is noise; some indicates a changing mechanism. Revising too quickly can chase temporary fluctuations, while revising too slowly can entrench harm. Governance therefore needs criteria for escalation, experimentation, suspension, and review. These criteria can be quantitative, qualitative, procedural, or mixed depending on the domain.

Learning across cases is another component. Local adaptation can generate knowledge that becomes useful elsewhere, but portability requires comparison of mechanisms and boundary conditions. A successful intervention in one institutional environment may fail where trust, infrastructure, legal authority, or subject composition differs. Adaptive governance therefore builds cumulative knowledge by documenting not only whether an intervention worked, but under which relational conditions and through which pathway.

At its strongest, adaptive governance alters its own learning capacities. Monitoring systems improve, categories are revised, participation channels change, and institutional memory accumulates. Governance thereby becomes a generative process whose output includes future ability to govern. This recursive feature is central to GRE praxis: the intervention should be evaluated partly by whether it leaves the system more capable of perceiving, contesting, and responding to later problems.

3.12.10 Withdrawal, Reversal, and Repair

A praxis architecture is incomplete if it specifies how to begin and revise interventions but not how to stop them. Withdrawal, reversal, and repair are distinct practical operations. Withdrawal ends or reduces an intervention. Reversal seeks to restore a prior condition or undo a change where feasible. Repair addresses harms, dependencies, damaged relations, or lost capacities that persist after withdrawal. GRE treats these operations as part of intervention design rather than exceptional responses to obvious failure.

Withdrawal can be required for several reasons. An intervention may fail to generate its intended effect, produce unacceptable harm, become obsolete as conditions change, or create costs that exceed its continuing value. It can also succeed so thoroughly that the intervention is no longer required. A temporary guarantee, emergency subsidy, or transitional institution should not become permanent merely because its removal was never designed.

Stopping an intervention can itself be generatively consequential. Organizations may have invested around a subsidy, households may depend on a service, communities may have reorganized around infrastructure, or markets may have adapted to a regulatory regime. Abrupt withdrawal can therefore destroy capacities that the intervention helped create. Exit design should consider notice, transition periods, transfer of responsibilities, preservation of useful infrastructure, and the distribution of adjustment costs.

Reversal is more demanding because relational change is often path dependent. Restoring a prior rule does not necessarily restore the prior system. Actors have learned, investments have shifted, expectations have changed, and some capacities may have disappeared. A policy reversal can therefore create a third configuration rather than return to the first. GRE treats reversibility as a graded property: some components can be reversed mechanically, others only approximately, and some transformations are effectively irreversible within the relevant horizon.

Repair addresses the residual consequences of intervention. It can involve compensation, restoration of access, institutional reform, rebuilding trust, data deletion or correction, ecological remediation, debt restructuring, reinstatement of rights, or support for capacities weakened by the intervention. Repair is not equivalent to monetary compensation because the harmed object may be relational, institutional, ecological, symbolic, or temporal. A payment can acknowledge loss while leaving the mechanism that produced the loss intact.

The possibility of repair also changes how interventions should be designed. Systems that preserve audit trails, appeals, modularity, data provenance, and institutional responsibility are easier to correct. Interventions that diffuse responsibility across opaque chains can make harm difficult to attribute and repair. GRE therefore treats repairability as a practical design consideration alongside effectiveness and adaptability.

Withdrawal, reversal, and repair complete the preliminary praxis cycle developed in this section. GRE moves from explanation toward intervention by diagnosing the relational field, identifying what the field generates, locating constraints and enabling conditions, designing a provisional intervention, treating allocation as a relational act, tracing downstream effects, learning through feedback, adapting governance, and retaining the capacity to stop or repair what has been created. The sequence remains heuristic rather than universal. Its purpose is to organize intervention under incomplete knowledge without reducing practice to either static optimization or unconstrained experimentation.

This praxis architecture also clarifies why evaluation cannot be postponed to a single terminal outcome. Each stage creates questions about value, harm, participation, capability, dependency, future possibility, and domination. An intervention may be operationally adaptive while normatively unacceptable, or normatively attractive in intention while generatively destructive in practice. The following section therefore turns from the architecture of action to the standards by which generated consequences can be evaluated under plural and sometimes incommensurable values.

3.13 Evaluation and Normative Orientation

Generative Relational Economics requires a normative vocabulary because the processes it studies can enlarge possibility, redistribute capacity, stabilize cooperation, create dependency, intensify domination, or foreclose alternative futures. The role of this section is to specify the evaluative dimensions through which such consequences can be examined without converting generativity itself into a moral criterion. Its objective is to distinguish descriptive claims about what an economic relation generates from normative judgments about whether the generated configuration should be sustained, revised, constrained, or repaired. The discussion proceeds through ten connected dimensions: the normative status of generativity; generated value and harm; participation; capability; relational quality; future possibility; dependency and domination; generative foreclosure; plural and incommensurable values; and the division of labor between GRE and GREthic. The method is constitutive and normative. It does not attempt to derive one complete moral theory from GRE. It identifies evaluative objects and inferential disciplines that allow GRE to remain normatively explicit while preserving plurality among competing theories of justice and ethical judgment.

The need for this distinction follows directly from the analytical architecture developed above. A relation can be highly generative in the descriptive sense because it produces new organizations, knowledge, technologies, markets, habits, classifications, capabilities, and forms of value. The same relation can distribute those consequences asymmetrically, externalize harms, narrow exit options, or reorganize the field so that some future possibilities become inaccessible. An intervention can therefore succeed according to one generative objective while producing losses elsewhere in the relational domain. GRE evaluation must trace both kinds of consequence rather than allowing the presence of generation to function as evidence of desirability.

Normative evaluation also requires attention to temporal depth. Immediate welfare gains can be accompanied by long-run dependency. Short-term loss can sometimes create later capability. A stable relation can protect vulnerable participants while also becoming difficult to contest. An institution can increase aggregate opportunity while decreasing the range of trajectories available to a particular group. GRE therefore treats present outcome, relational position, future capacity, and transformation of possibility as analytically separable evaluative objects. Their relative importance cannot be fixed once for every inquiry.

Evaluation is also complicated by heterogeneous value. Economic decisions can affect income, security, care, recognition, ecological integrity, autonomy, knowledge, belonging, trust, aesthetic experience, institutional legitimacy, and many other forms of value whose relations are only partially commensurable. Monetary valuation can be useful within a defined problem while leaving significant evaluative remainders. GRE consequently distinguishes commensuration as an analytical or institutional operation from the stronger claim that the values being compared possess a common natural metric.

The resulting normative stance is neither value-neutrality nor normative closure. GRE accepts that economic inquiry frequently contains evaluative choices in the selection of outcomes, boundaries, scales, and affected subjects. It therefore seeks to make those choices explicit and contestable. At the same time, GRE does not treat its own analytical categories as sufficient to decide every ethical conflict. Participation, capability, relational quality, future possibility, dependency, domination, and foreclo-

sure provide a multidimensional evaluative field. Normative judgment still requires specification of who is affected, which values are at stake, how conflicts among values are handled, and which ethical or political principles justify intervention.

This distinction creates an interface with GREthic. GRE supplies economic analysis of generative structures, distributions, dependencies, conversion pathways, and changes in future possibility. GREthic addresses the broader ethical problem of how such findings should enter judgment, justification, institutional design, and the evolution of normative criteria. Their relation is therefore collaborative without being identical. The present section establishes that interface while keeping GRE's disciplinary center within economics.

3.13.1 Normative Status of Generativity

Generativity describes a capacity of a relation, process, institution, or configuration to produce further states, capacities, relations, values, or possibilities. That descriptive property has no fixed normative sign. Productive networks, monopolistic infrastructures, extractive regimes, scientific communities, predatory markets, mutual-aid institutions, and systems of surveillance can all generate durable consequences. The fact that a configuration generates more than its immediate output identifies an important economic property; it does not establish that the resulting trajectory should be preferred.

This distinction is foundational because GRE gives generativity an unusually prominent analytical role. Without an explicit normative separation, the vocabulary of generation could encourage a subtle bias toward expansion, novelty, proliferation, or self-reproduction. Economic history supplies many cases in which highly generative arrangements produced wealth together with coercion, ecological depletion, exclusion, or durable hierarchy. A relation can reproduce itself efficiently because the costs of exit are high. An institution can generate rapid innovation because risks are shifted toward actors with weak bargaining power. A platform can generate dense interaction while concentrating control over the infrastructure through which that interaction occurs. Descriptive generativity therefore requires an additional evaluative step.

The relevant question is not whether generation occurs, but what is generated, for whom, through which relations, under which constraints, and with what effects on later possibility. These questions prevent GRE from treating generativity as a scalar objective that can be maximized independently of content. More generation can be desirable in one dimension and damaging in another. A research system can generate knowledge while degrading working conditions. A credit system can generate entrepreneurial capacity while expanding vulnerability to debt. A welfare programme can generate security while also creating administrative classifications that constrain mobility. Evaluation therefore concerns the structure and distribution of generation.

Normative analysis must also distinguish generativity from regeneration. A system can generate novelty while eroding the material or social conditions required for continuation. Another system can maintain those conditions without producing substantial novelty. A third can restore damaged capacities while limiting some current activities. These trajectories involve different evaluative questions. GRE therefore avoids equating novelty, persistence, resilience, growth, and regeneration with one another. Each describes a different relation between current activity and future

conditions.

A similar distinction applies to self-reinforcement. Some beneficial institutions require positive feedback to remain viable. Some harmful institutions also acquire self-reproducing capacities. The presence of a stable attractor-like pattern, increasing returns, or institutional persistence does not imply normative legitimacy. Evaluation must examine whether the mechanisms of reproduction preserve contestability, participation, and the possibility of revision or whether they make domination and exclusion increasingly difficult to reverse.

The normative status of generativity is consequently conditional and relational. GRE can identify generative mechanisms and compare their consequences without assigning a universal value to generation itself. Normative evaluation begins when the analysis asks how generated consequences affect subjects, relations, capacities, values, dependencies, and future possibility. The remaining subsections specify those dimensions in greater detail.

3.13.2 Generated Value and Generated Harm

Generated value and generated harm are parallel analytical objects. Both can emerge downstream from an economic relation, both can propagate beyond the administrative recipient, and both can change form as they circulate. The evaluative task is therefore broader than measuring the immediate benefit and subtracting a directly observed cost. GRE asks how value and harm are produced, distributed, converted, accumulated, displaced, and transmitted across scales and time.

Generated value can include income, capability, knowledge, security, trust, coordination, infrastructure, recognition, institutional capacity, ecological restoration, or access to future opportunities. Some forms of value are directly appropriable by a subject; others exist only through a relation or shared condition. A public standard, a trusted institution, a functioning ecosystem, or a community of practice can generate benefits whose value cannot be represented adequately as the possession of one individual. GRE therefore evaluates value at the level at which it is generated and realized.

Generated harm has equally varied forms. An intervention can increase surveillance, dependency, stigma, ecological burden, exclusion, precarity, misinformation, or concentration of bargaining power even when the designated recipient receives a material benefit. Harm can also be displaced. A low consumer price can be sustained through labor conditions elsewhere in the supply chain. Local ecological improvement can depend on transferring waste or extraction to another region. An automated system can reduce transaction costs while increasing the exposure of a minority of users to unreviewable classification errors. Evaluation must therefore examine relational incidence rather than only administrative incidence.

Value and harm can coexist within the same generative pathway. Education can expand capability while imposing debt. Infrastructure can improve access while displacing residents. Intellectual-property protection can support some forms of investment while constraining downstream experimentation. Social protection can reduce insecurity while creating reporting burdens or intrusive eligibility regimes. Such configurations should not be forced into a premature net-value judgment when the affected values are heterogeneous and differently distributed.

Temporal ordering further complicates evaluation. Harm can be immediate while

value is delayed, or the reverse. Some effects are reversible; others create durable path dependence. A temporary subsidy may generate a lasting market or a lasting dependency. A short-lived exclusion can alter educational or professional trajectories for decades. GRE therefore records persistence and reversibility as part of the evaluative description rather than treating all consequences as contemporaneous flows.

This framework also makes attribution important. A downstream harm may be associated with an intervention without being generated by the mechanism under study. Conversely, a benefit may be credited to an intervention even though it depends mainly on pre-existing relations or complementary institutions. Normative evaluation should therefore inherit the epistemic discipline of Section 3.11: claims about generated value and harm require a stated mechanism, boundary, scale, and degree of evidential confidence.

3.13.3 Participation

Participation concerns the capacity of affected subjects to enter, influence, contest, benefit from, and withdraw from the relations through which economic life is organized. It is an evaluative object because economic systems do more than distribute resources. They distribute positions from which subjects can speak, act, create, coordinate, challenge classifications, and contribute to future generation. A configuration can therefore increase material output while narrowing meaningful participation.

Participation has several dimensions. Access concerns whether a subject can enter a relevant institution, market, infrastructure, profession, community, or decision process. Voice concerns whether the subject can make claims that receive institutional attention. Influence concerns whether participation can alter decisions rather than merely register preference. Recognition concerns whether the subject is legible within the categories through which resources and rights are allocated. Contestability concerns whether classifications, decisions, or rules can be challenged. Exit concerns whether participation remains voluntary in a meaningful sense or is sustained by dependence and prohibitive switching costs.

These dimensions need not move together. A platform can provide wide access while retaining centralized control over ranking and rule change. A formal consultation process can permit voice while leaving participants with little influence. A labor market can allow nominal exit from an employer while economic insecurity makes exit practically costly. A public service can grant rights in principle while administrative categories render some users difficult to recognize. GRE therefore avoids reducing participation to formal inclusion.

Participation also has a generative dimension. Being able to participate can develop knowledge, confidence, social ties, institutional literacy, bargaining capacity, and new forms of collective organization. Exclusion can have the opposite effect by reducing opportunities to acquire the capacities later required for participation. Present access can therefore shape future access. Evaluation should examine whether an arrangement generates broader capacities for participation or produces cumulative disadvantages that narrow future entry.

The economic significance of participation becomes especially visible under conditions of technological abundance. If productive tasks can increasingly be performed by artificial or highly automated systems, a framework that ties economic participation exclusively to productive necessity can leave human subjects with reduced ac-

cess to income, institutions, social recognition, or meaningful collective activity. GRE does not presume a particular technological outcome, but it treats the institutional organization of participation as a distinct problem from the allocation of productive tasks.

Participation should not be romanticized. More participation can impose time costs, reproduce inequalities in voice, or shift responsibility onto subjects with limited resources. Some technical decisions require specialized knowledge; some participants may prefer delegation. The normative question therefore concerns the quality and consequences of participation, including who bears its burdens, what forms of representation are available, and whether nonparticipation is compatible with protection from arbitrary decisions.

3.13.4 Capability

Capability concerns the effective ability of subjects to pursue relevant actions and ways of living within their actual relational and institutional conditions. For GRE, capability is an especially important evaluative object because economic relations can generate or destroy the conditions through which resources become usable. An allocation that appears equal at the level of resources can produce unequal capability when subjects face different conversion conditions.

Capability therefore extends evaluation beyond possession. Access to money, information, technology, or legal rights matters only partly through the quantity received. Its practical significance depends on health, time, knowledge, infrastructure, social recognition, legal status, language, care obligations, physical accessibility, institutional trust, and many other conversion conditions. GRE can analyze these conditions as part of the relational field through which a resource becomes an effective opportunity.

Capabilities can also be cumulative. Education can increase the ability to learn further skills. Secure housing can improve the ability to sustain employment or study. Access to digital infrastructure can expand the capacity to participate in markets, administration, and knowledge production. Conversely, repeated exclusion can reduce the capacities needed to take advantage of later opportunities. Evaluation should therefore trace capability trajectories rather than treating capability as a static stock.

The generative perspective adds a second question: who controls the conditions under which capability can be exercised? A subject may possess technical competence while depending on a platform, license, visa, credential, payment network, data infrastructure, or institutional recognition. Capability is then relationally enabled. If access to the enabling condition can be withdrawn unilaterally, the subject's practical freedom may be more fragile than a simple skill inventory suggests.

Capability evaluation must also preserve normative pluralism. GRE does not need to specify one universal list of valuable capabilities in order to treat capability formation as economically significant. Different inquiries can justify different evaluative sets depending on the affected population, institutional context, and normative framework. The important discipline is to state which capabilities are being evaluated, why they matter, and how their measurement relates to the actual opportunities of subjects.

The distinction between capability and performance is equally important. A subject can possess a genuine opportunity without exercising it. Economic evaluation

should not automatically infer deprivation from nonuse or success from observed functioning. Choices can reflect preference, but they can also reflect adaptation to constraint, uncertainty, social expectation, or limited information. GRE therefore treats capability as an evaluative lens that requires contextual interpretation rather than direct inference from observed behavior alone.

3.13.5 Relational Quality

Relational quality concerns the properties of the relations through which economic activity is organized. It directs evaluation toward features that can disappear when analysis looks only at individual outcomes. Two arrangements can deliver similar material distributions while differing substantially in reciprocity, transparency, recognition, reliability, contestability, vulnerability to arbitrary power, or the burdens required to sustain cooperation.

Relational quality is deliberately a plural category. A high-quality relation in one context can emphasize trust and continuity; another can require independence and easy exit; a third can require procedural transparency or protection from discrimination. GRE therefore does not assume that one relational form is universally superior. It asks which properties are normatively relevant to the local relation and how those properties affect both current experience and later generative possibility.

Trust provides one example. Trust can reduce transaction costs, support cooperation, and enable forms of joint action that formal contracting cannot fully specify. Yet trust can also create vulnerability when one party controls information or enforcement. Dense trust within a group can coexist with exclusion of outsiders. Evaluation therefore concerns the conditions under which trust is generated, whether reliance is reciprocated, and what protections exist when trust is breached.

Recognition provides another example. Economic relations can treat subjects as interchangeable units or as participants whose claims and histories matter. Recognition can affect bargaining, access, dignity, willingness to cooperate, and institutional legitimacy. At the same time, institutional recognition often depends on categories that simplify complex identities. A recognition regime can include some subjects by making others invisible. Relational quality therefore includes the revisability of the categories through which recognition is granted.

Contestability is especially important in relations involving asymmetry. A subject may accept unequal expertise, authority, or capability when decisions remain reviewable and reasons can be challenged. The same asymmetry can become more problematic when rules are opaque, appeals are impossible, or dependence makes disagreement costly. GRE therefore treats relational quality as connected to the governance of asymmetry rather than to equality in every dimension.

Relational quality also has generative consequences. Relations characterized by reliability and fair contestation can support investment, experimentation, and long-term cooperation. Relations characterized by arbitrary sanction or unstable recognition can encourage defensive behavior, information withholding, and short planning horizons. Evaluation should consequently examine both the intrinsic and generative significance of relational quality without assuming that its value can be reduced to later efficiency gains.

3.13.6 Future Possibility

Future possibility concerns the range and quality of trajectories that remain realistically available after an economic relation or intervention has taken effect. It is central to GRE because present arrangements continually reshape the conditions of later action. Evaluation therefore extends beyond current welfare to ask whether subjects and institutions retain meaningful capacity to revise, learn, exit, recombine resources, or pursue alternative forms of life and organization.

Future possibility differs from abstract logical possibility. An option can exist formally while remaining practically inaccessible because of cost, law, infrastructure, knowledge, social position, or path dependence. GRE is concerned with feasible and relationally supported possibility. The relevant question is whether subjects possess the conditions required to convert an apparent option into a credible trajectory.

Economic development can expand future possibility by generating infrastructure, education, savings, institutional competence, public knowledge, and trusted coordination. It can also narrow possibility through debt lock-in, ecological depletion, monopoly, rigid standards, irreversible investment, or loss of local capability. The same intervention can expand options for one group while constraining another. Evaluation must therefore be distributional and multiscale.

Optionality also interacts with commitment. Some valuable projects require long-term coordination, sunk investment, and stable expectations. Preserving every option can prevent the formation of institutions whose value depends on continuity. GRE therefore does not treat maximal reversibility as a universal goal. It asks whether commitments are justified, whether affected subjects understand the resulting constraints, whether revision remains possible under changing conditions, and whether the burdens of irreversibility are distributed fairly.

The temporal horizon of evaluation matters. A policy that preserves short-run choice can undermine long-run ecological or fiscal possibility. A restrictive rule can reduce present options while protecting conditions needed for future generations. GRE therefore requires explicit time horizons and rejects the assumption that present preference alone exhausts normative relevance. Intergenerational effects become part of economic evaluation when current activity alters the capability and action space available later.

Future possibility also provides a bridge between economic and political evaluation. Control over infrastructure, standards, data, property, legal categories, or knowledge systems can determine which later projects become feasible. Power can therefore operate by structuring possibility before any specific decision is made. Evaluation of future possibility helps identify such upstream effects and prepares the analysis of power in the following section.

3.13.7 Dependency and Domination

Dependency is a pervasive feature of economic life. Individuals depend on households, organizations, infrastructures, ecological systems, legal institutions, markets, and other persons. Firms depend on suppliers, finance, standards, workers, customers, and public order. Dependency therefore cannot serve as a simple indicator of injustice. The evaluative problem concerns the structure of dependence: how essential the relation is, whether alternatives exist, how burdens and benefits are

distributed, and whether one party can exercise discretionary power over another's conditions of action.

Some dependencies are reciprocal and mutually enabling. Specialization creates interdependence because actors can achieve more through coordinated reliance than through autarky. Care relations can involve deep dependence while also generating security, capability, and belonging. Public infrastructure creates dependence on collective institutions that may be normatively desirable. GRE therefore distinguishes dependency from domination rather than treating self-sufficiency as the default ideal.

Domination becomes relevant when dependency is combined with power that is difficult to contest, exit, or subject to accountable rules. A worker can depend on an employer, a seller on a platform, a tenant on a landlord, or a state on a creditor. Whether the relation becomes dominating depends on the available alternatives, procedural protections, transparency, collective organization, legal constraints, and the ability to challenge arbitrary decisions. The analysis therefore concerns relational structure rather than the mere presence of unequal capability.

Generative mechanisms can deepen dependency over time. A platform can become more indispensable as participants invest in platform-specific reputation or data. A lender can acquire increasing influence when refinancing becomes necessary. A technology ecosystem can create switching costs through proprietary standards and complementary investments. Such processes transform an initially optional relation into one that shapes the subject's future possibilities. GRE evaluates the trajectory of dependency, not only its initial contractual form.

Dependency can also be hidden by administrative boundaries. An organization may appear autonomous while relying on unpaid care, public infrastructure, ecological services, or precarious subcontracting. A wealthy region can reduce local dependence by externalizing extraction elsewhere. Evaluation should therefore trace dependency across scales and identify whose capacities sustain the apparent independence of others.

The normative task is consequently to distinguish enabling interdependence from dependency that concentrates arbitrary power or systematically transfers risk. This distinction is contextual and requires attention to alternatives, voice, exit, reciprocity, and governance. GRE can map these conditions economically while leaving broader ethical judgment open to explicit normative argument.

3.13.8 Generative Foreclosure

Generative foreclosure occurs when a present economic relation, intervention, or institutional arrangement reduces the capacity to generate relevant future alternatives. Foreclosure is stronger than an ordinary opportunity cost. Every choice excludes some alternatives because resources and time are finite. Generative foreclosure concerns changes to the conditions of future generation themselves: the loss of capabilities, relations, infrastructures, ecological conditions, institutional pluralism, or epistemic resources required to create or recognize later options.

A technological standard can produce generative foreclosure when complementary investment makes alternative architectures prohibitively costly. Concentrated ownership of research infrastructure can narrow which questions can be investigated. Educational exclusion can reduce not only present opportunity but also the later capacity to formulate and pursue new projects. Ecological degradation can re-

move future productive and cultural possibilities that current actors cannot fully specify. In each case, the loss concerns the generative field rather than one foregone transaction.

Foreclosure can be intentional or emergent. A dominant actor may deliberately raise barriers to entry. An institution may unintentionally create lock-in through cumulative coordination. A society may deplete a resource without any actor intending to eliminate later possibilities. Normative evaluation therefore cannot rely only on motive. It must examine the mechanisms through which possibility is narrowed and the distribution of the resulting loss.

The concept also requires restraint. Stable institutions necessarily reduce some degrees of freedom by creating rules, commitments, standards, and expectations. Such constraint can itself enable generation by lowering uncertainty and coordinating investment. GRE therefore distinguishes productive structuring from foreclosure by asking whether the constraint preserves meaningful routes for learning, contestation, recombination, and revision relative to the values at stake.

Irreversibility is an important but incomplete indicator. Some irreversible changes are desirable; some reversible systems can still reproduce severe domination. The evaluative question concerns which future capabilities and relations are lost, who bears the loss, whether the loss was foreseeable, whether affected subjects had meaningful participation, and whether compensating generative capacities are created elsewhere. Foreclosure is thus a relational and normative concept rather than a synonym for permanence.

Generative foreclosure gives GRE a way to evaluate economic processes whose most important harms are difficult to observe in present output measures. The absence of a future innovation, institution, community, ecological state, or life trajectory cannot be measured in the same way as an existing commodity. Evaluation therefore requires counterfactual and historical reasoning, explicit uncertainty, and humility concerning possibilities that current categories may fail to represent.

3.13.9 Plural and Incommensurable Values

GRE assumes that economic evaluation can involve several forms of value whose relations are partial, contested, or context-dependent. Income, security, autonomy, care, recognition, ecological integrity, knowledge, cultural continuity, trust, and future possibility can matter simultaneously without reducing naturally to one metric. The presence of plural value therefore creates a problem of judgment rather than a technical defect awaiting universal conversion.

Commensuration can still be useful. Budgets require numerical comparison; cost-effectiveness analysis can clarify trade-offs within a defined objective; markets generate prices that coordinate many transactions; legal and administrative systems require thresholds and categories. GRE treats these operations as institutionally situated forms of comparison. The existence of a price or index demonstrates that a conversion rule has been established for a purpose. It does not prove that every ethically relevant dimension has been captured.

Partial comparability is often sufficient for action. One option can dominate another across several relevant dimensions without requiring a common cardinal scale. Thresholds can exclude arrangements that violate minimum conditions of safety, participation, or rights. Deliberative procedures can address remaining conflicts. Sce-

nario analysis can reveal how rankings change under different value weightings. GRE therefore does not infer decision paralysis from incommensurability.

Plural value also changes the interpretation of conversion. An institution can transform cultural recognition into market demand, social trust into credit access, educational status into employment opportunity, or ecological resources into monetary revenue. Such conversions can create value while also degrading or crowding out the source relation. Evaluation should therefore examine who controls conversion interfaces, which values become legible after conversion, and which remainders disappear from institutional accounting.

Conflicts among values can also be distributional. A policy may maximize aggregate income while concentrating ecological harm in one community. A conservation programme may protect biodiversity while limiting livelihoods or customary access. An automated service may improve average efficiency while weakening procedural recognition for individuals who require exceptions. These conflicts cannot be resolved by naming all values equally important. Normative judgment must specify priority rules, procedural safeguards, compensation, thresholds, or other principles appropriate to the case.

GRE's contribution is to keep the value architecture visible. It can trace where values are generated, converted, captured, dissipated, or rendered institutionally invisible. It can identify the relations through which one value form gains priority over another. It can also expose where apparent commensurability depends on a contested institutional convention. The choice among competing normative resolutions remains an explicit ethical and political task.

3.13.10 Relation between GRE and GREthic

The normative dimensions developed in this section create a direct interface between GRE and GREthic. Their division of labor should remain explicit. GRE is an economic research programme concerned with relational constitution, generation, allocation, value transformation, capability, power, dependency, and changes in future possibility. GREthic addresses the broader ethical problem of how relational and generative consequences should be interpreted, justified, contested, and governed when several values, subjects, and temporal horizons are involved.

This division does not make GRE normatively empty. Economic research already contains evaluative choices in the definition of welfare, harm, efficiency, opportunity, risk, and admissible intervention. GRE adds explicit dimensions such as participation, relational quality, future possibility, dependency, domination, and foreclosure. These dimensions belong legitimately within economic evaluation because they describe economically generated conditions. The ethical question becomes more demanding when the inquiry asks how competing dimensions should be weighted, which constraints should function as side conditions, whose claims have priority, or what constitutes a just relation.

GREthic can therefore operate as a neighboring normative domain rather than as a final module appended after economic analysis. Ethical judgment can alter the research boundary, the choice of evaluative dimensions, the treatment of uncertainty, the design of participation, and the interpretation of evidence. Conversely, economic analysis can revise ethical judgment by revealing hidden dependencies, indirect harms, conversion mechanisms, or long-run consequences that were absent

from the initial normative description. The relation between GRE and GREthic is consequently iterative.

A generative ethical perspective also faces the problem of changing criteria. Institutions learn, social meanings evolve, new subjects become visible, and technologies create forms of action that earlier normative vocabularies did not anticipate. Ethical evaluation therefore cannot assume that a fixed list of criteria will remain sufficient under every historical condition. GREthic must be capable of examining how normative categories themselves emerge, stabilize, exclude, and require revision. This does not imply that every value is historically arbitrary. It means that the institutional expression and interpretation of values require continuing critical examination.

The interface is especially important for application-dominant praxis. An intervention can be technically effective and economically generative while raising unresolved questions of justice. In such cases GRE can provide the relational diagnosis, trace the effects, identify capability changes, map dependency, and evaluate future possibility. GREthic can help articulate the normative standards governing participation, acceptable asymmetry, protection from domination, treatment of irreversible harm, and procedures for revising the intervention when values conflict.

The distinction also protects disciplinary restraint. GRE need not become a complete moral philosophy in order to analyze normatively significant economic processes. GREthic need not replace economic explanation with ethical vocabulary. Their productive relation depends on maintaining both the empirical and normative burdens of argument. Ethical claims require justification; economic claims require evidence and mechanism; interventions require both.

The normative architecture established in Section 3.13 therefore completes an important part of Chapter 3's constitution of GRE. Generativity becomes an object of evaluation rather than a criterion of goodness. Generated value and harm, participation, capability, relational quality, future possibility, dependency, domination, foreclosure, and plural values provide a multidimensional field for judgment. The following section turns to one of the most consequential mechanisms through which these dimensions become unequally distributed: power and asymmetry within the GRE problem-space.

3.14 Power and Asymmetry within the GRE Problem-Space

Generative Relational Economics requires an explicit account of power because economic relations rarely begin from symmetric positions, and the consequences of those asymmetries can accumulate through the very processes that GRE studies. The role of this section is to identify the principal forms of asymmetry that can become economically consequential and to clarify the conditions under which asymmetry is converted into power. Its objective is to avoid two opposite reductions: treating every difference between subjects as domination, and treating power as a property possessed independently of the relations through which it becomes effective. The discussion proceeds through resource, capability, knowledge, institutional, vulnerability, and exit asymmetries; the conversion of asymmetry into power; the limits of capability equalization and counter-power; and relational governance under persistent asymmetry. The method is constitutive and analytical. It establishes a vocabulary for later

empirical, normative, and governance work without presuming that one scalar measure can represent every relevant form of power.

The starting point is a distinction between *asymmetry* and *power*. An asymmetry exists when subjects occupy different positions with respect to resources, capacities, information, institutional authority, vulnerability, or alternatives. Power arises when such differences become usable, durable, or institutionally supported means of shaping another subject's feasible actions, access to resources, interpretive environment, exposure to risk, or future conditions of generation. A highly capable subject can therefore remain weak in a particular relation when its capabilities are irrelevant to the terms of interaction. Conversely, a subject with modest resources can exercise substantial power when it controls a scarce interface, legal authorization, standard, platform, bottleneck, or exit option on which others depend.

Power is consequently relational, domain-specific, and temporally structured. The same pair of subjects can be asymmetric in opposite directions across different domains. A worker can possess knowledge essential to production while remaining institutionally subordinate in wage negotiation. A state can regulate a corporation domestically while depending on that corporation for infrastructure, tax revenue, or technological expertise. A user can choose among digital services while having little capacity to alter the standards through which data are collected and converted into commercial value. The relevant question for GRE is therefore not simply who has more, but how a difference is connected to a mechanism through which one subject can affect another subject's present options or future generative conditions.

This emphasis also distinguishes power from immediate coercion. Power can operate through direct commands, but it can also operate by shaping defaults, eligibility criteria, technical standards, access routes, classifications, expectations, and the cost of refusal. It can be episodic or structurally persistent. It can be consciously exercised or reproduced through institutions whose participants do not individually intend the resulting asymmetry. GRE therefore treats power as a family of relational mechanisms that affect the generation and distribution of possibility. Normative evaluation enters when those mechanisms are assessed in terms of domination, justice, harm, participation, capability, or foreclosure, but descriptive power analysis must first identify how the relation works.

3.14.1 Resource Asymmetry

Resource asymmetry concerns unequal access to economically consequential stocks or flows such as money, land, infrastructure, energy, data, equipment, labor time, organizational slack, credit, logistics, or legally protected assets. It is among the most visible forms of economic difference because many resources are already measured through accounting, ownership, or administrative systems. Yet possession alone does not determine relational power. What matters is the role that a resource plays within a specific relational configuration.

A resource becomes power-relevant when control over it changes another subject's feasible set or bargaining position. The owner of a scarce input can influence downstream producers when substitutes are limited and switching is costly. A lender can impose conditions when borrowers face liquidity constraints and alternative finance is unavailable. A landlord's control over housing can become consequential when residence is tied to employment, schooling, legal status, or local social networks. A plat-

form's control over computational infrastructure can matter when users, firms, or public institutions depend on that infrastructure for participation in other economic processes. The same nominal resource can therefore carry very different power consequences depending on substitutability, timing, dependence, and institutional context.

Resource asymmetry also has a generative dimension. Resources can be consumed, but they can also be converted into capacities for producing later resources. Capital can finance research, data collection, legal representation, lobbying, recruitment, or acquisition. Infrastructure can make future coordination cheaper. Land ownership can generate collateral. A large user base can generate additional data and network effects. Resource inequality can therefore reproduce or amplify itself when existing holdings enable access to mechanisms that generate further advantage.

GRE analysis should distinguish this recursive possibility from simple accumulation. A subject can possess more resources without gaining additional structural leverage if the relevant relation remains competitive and alternatives remain accessible. Conversely, a relatively small resource difference can become decisive when it controls a bottleneck or threshold. The analytical task is thus to identify the conversion mechanism: which resource matters, to which relation, over what time horizon, through which institutional or technical structure, and with what downstream effects on future capacity.

This distinction also matters for policy. Redistribution of money can reduce one resource asymmetry while leaving infrastructural, legal, informational, or organizational asymmetries intact. Access subsidies can improve current consumption without altering control over the mechanisms that generate future options. Resource equalization is therefore one possible intervention among several. GRE asks whether the relevant inequality lies in holdings, access, conversion capacity, rule-making position, or the structure through which resources become generative.

3.14.2 Capability Asymmetry

Capability asymmetry concerns differences in what subjects are able to do within a defined economic relation. Capabilities may include technical competence, organizational coordination, computational capacity, mobility, learning, bargaining skill, physical endurance, social connectivity, legal competence, linguistic access, or the ability to mobilize resources under time pressure. Capability differs from resource possession because two subjects with formally similar resources can have very different capacities to convert them into effective action.

This distinction is central in contemporary economies where productive capability can differ sharply across persons, organizations, and artificial systems. A large model can process information at scales unavailable to an individual worker. A multinational firm can coordinate legal, financial, and logistical operations across jurisdictions that a small supplier cannot match. An experienced organization can exploit a regulatory opportunity that a newly formed association does not yet understand. These differences can affect bargaining positions, speed, error tolerance, and the range of feasible strategies.

Capability asymmetry becomes power-relevant when it changes the terms under which other subjects must participate. Superior prediction can support price discrimination. Superior legal capacity can make contractual complexity costly for weaker

parties to contest. Superior computational capacity can enable rapid experimentation over markets, attention, or product design. Superior logistical coordination can make a supplier difficult to replace. In each case the capability matters because it is connected to a relation through which the more capable subject can shape conditions faced by others.

At the same time, capability differences do not by themselves establish domination, moral superiority, or ontological hierarchy. Specialized capabilities are common in cooperative systems. A surgeon and patient, pilot and passenger, engineer and user, or teacher and student occupy asymmetric capability relations that can be socially valuable when authority, accountability, consent, and institutional safeguards are appropriately organized. The relevant GRE question is whether capability asymmetry becomes a mechanism for unilateral control, extraction, dependency, or foreclosure, or whether it is embedded in reciprocal and revisable arrangements that distribute benefits and protect affected subjects.

Capability asymmetry also changes historically. Training, tools, institutional access, automation, collective organization, and technical infrastructure can expand or reduce particular capabilities. The introduction of artificial intelligence makes this especially visible because capability gaps can change quickly and unevenly across tasks. A useful GRE analysis therefore tracks the trajectory of capability differences rather than treating them as fixed attributes. It asks who gains new capabilities, who loses the economic relevance of existing ones, what new dependencies arise, and which institutions govern the conversion of capability differences into economic authority.

3.14.3 Knowledge Asymmetry

Knowledge asymmetry concerns unequal access to information, interpretive resources, expertise, explanatory models, evidence, or the capacity to recognize the significance of available information. It extends beyond the familiar problem of one party knowing more facts than another. Economic power can also arise from asymmetries in classification, prediction, interpretation, and the ability to determine which descriptions become institutionally actionable.

A seller may know more about product quality than a buyer. A financial institution may know more about pricing models and contractual risk than a client. A platform may observe aggregate behavioral patterns invisible to individual users. A government agency may hold administrative records unavailable to the public. A technical community may control specialized vocabularies required to contest a decision. These are distinct knowledge relations, and their power effects depend on how the knowledge is connected to action.

Knowledge becomes especially consequential when one subject can make decisions on the basis of information that another cannot inspect, verify, or meaningfully interpret. The weaker subject may then depend on assurances, reputation, certification, professional norms, or institutional oversight. Such dependence is not intrinsically pathological; complex economies require extensive reliance on expertise. The power problem emerges when epistemic dependence combines with weak accountability, conflicts of interest, high switching costs, or control over the channels through which claims can be challenged.

Knowledge asymmetry also includes the power to produce or stabilize representations. Economic subjects are frequently acted upon through categories: credit scores,

risk classes, performance metrics, eligibility rules, rankings, profiles, diagnoses, forecasts, and algorithmic classifications. The subject who controls the production or interpretation of a category can influence access to employment, credit, insurance, visibility, public benefits, or market participation. In such cases knowledge power does not consist only in possessing hidden information. It also consists in shaping the representational architecture through which institutions perceive other subjects.

GRE therefore distinguishes informational access, interpretive competence, model authority, and representational control. These dimensions can diverge. Data can be publicly available while computational requirements make meaningful analysis inaccessible. A model can be technically transparent while the institutional consequences of its output remain opaque. A subject can understand a classification yet lack any procedure for contesting it. Knowledge governance consequently requires more than disclosure. It may require intelligibility, auditability, contestability, alternative expertise, evidential access, and institutional routes through which interpretations can be revised.

The generative dimension of knowledge asymmetry is equally important. Knowledge can generate later knowledge, and control over data or research infrastructure can compound advantages. Organizations with larger observational fields can train better models, attract more users, and generate still more data. Institutions that define legitimate evidence can also shape which questions receive funding and which phenomena become visible. Knowledge asymmetry can therefore alter the future epistemic field itself, making it a central GRE object rather than merely a background imperfection in exchange.

3.14.4 Institutional Asymmetry

Institutional asymmetry concerns unequal positions within rule-making, authorization, recognition, enforcement, classification, and dispute-resolution structures. It is distinct from resource or capability asymmetry because an institution can grant authority to a subject whose private resources are limited. A regulator, court, standards body, professional association, university, central bank, certification agency, or platform governance unit can exercise substantial influence through the rules it is authorized to establish or interpret.

Institutional position shapes who can define admissible participation, whose claims count, which categories receive legal recognition, and which remedies are available when conflict occurs. Formal authority is one obvious form. Less visible forms include agenda-setting, control over procedure, discretionary interpretation, default-setting, accreditation, and the capacity to delay or accelerate decisions. Timing itself can become power when one party can tolerate delay and another cannot.

Institutional asymmetry is often self-reinforcing because rules influence the resources and capabilities available to participants. Licensing can protect quality and safety while also raising entry barriers. Intellectual-property rules can reward innovation while concentrating control over subsequent use. Procurement standards can improve accountability while favoring organizations with administrative capacity to comply. Corporate governance rules can distribute formal voting rights while leaving agenda formation concentrated. Institutional analysis therefore asks not only what a rule states but how it reorganizes relational possibilities.

GRE treats institutional asymmetry as especially important because institutions

mediate conversion among other forms of asymmetry. Wealth can be translated into lobbying, litigation, or organizational access. Expertise can be converted into recognized professional authority. Formal office can provide privileged information. Institutional status can determine whose vulnerability receives protection and whose losses remain externalized. Institutions are thus conversion structures through which resources, capabilities, knowledge, and recognition become power.

This does not imply that institutional asymmetry should be eliminated. Governance itself requires differentiated roles, mandates, and responsibilities. The relevant question is how authority is bounded, justified, monitored, revisable, and connected to affected subjects. An institution can exercise asymmetric authority while remaining constrained by procedure, transparency, appeal, rotation, representation, or substantive rights. GRE therefore analyzes the architecture of authority rather than treating formal symmetry as the only legitimate institutional form.

3.14.5 Vulnerability Asymmetry

Vulnerability asymmetry concerns differences in exposure to loss and differences in the capacity to absorb, recover from, or adapt to that loss. It introduces a dimension of power that is easy to miss when analysis focuses only on holdings or productive capacities. Two subjects may enter the same formal transaction while facing radically different consequences if the transaction fails.

A worker dependent on one employer can face greater loss from contract termination than the employer faces from replacing one worker. A small supplier can be more vulnerable to delayed payment than a large purchaser is to delayed delivery. A tenant can face relocation costs that exceed the landlord's costs of replacing the tenant. A household with minimal savings can be more affected by a small price shock than a wealthier household is by a larger nominal loss. These differences change bargaining relations even when contractual rights appear formally symmetric.

Vulnerability can arise from biological, social, legal, ecological, financial, or infrastructural conditions. It can also be generated by prior economic relations. Debt can increase sensitivity to income interruption. Loss of public infrastructure can increase dependence on private providers. Concentrated employment can make a region vulnerable to one firm's decisions. Data-driven personalization can expose particular groups to targeted exploitation. Vulnerability is therefore often historically produced rather than merely given.

The conversion of vulnerability into power occurs when another subject can credibly condition access to necessities, impose risks, or shift costs onto those less able to bear them. The stronger party need not intentionally threaten harm. Structural vulnerability can influence behavior because subjects anticipate the consequences of refusal. A worker may accept unfavorable terms because unemployment is costly. A state may offer concessions to a mobile investor because local employment is concentrated. A consumer may accept invasive data practices because essential services have become digitally mediated.

GRE analysis should also distinguish vulnerability from weakness in every domain. A subject can be technologically capable and financially wealthy while highly vulnerable to reputational, legal, ecological, or infrastructural disruption. Conversely, a subject with few resources can be relatively resilient when needs are modest, alternatives are available, and social support is strong. Vulnerability therefore requires explicit

specification of the relevant hazard, exposure, recovery capacity, and time horizon.

This perspective has normative implications, but the descriptive analysis comes first. Governance can reduce vulnerability by creating buffers, insurance, redundancy, public options, collective support, or guaranteed access to essentials. Yet such interventions can create new dependencies if they centralize provision without contestability. The GRE question is how vulnerability is generated, distributed, converted into leverage, and transformed by the institutions intended to manage it.

3.14.6 Exit Asymmetry

Exit asymmetry concerns differences in the cost, feasibility, and consequences of leaving a relation. It is one of the clearest mechanisms through which other asymmetries become durable. A relation can appear voluntary at entry while becoming difficult to leave once investments, identities, data, legal obligations, infrastructures, social ties, or specialized capabilities accumulate around it.

Exit costs take many forms. Financial penalties and contractual restrictions are explicit examples. Others include retraining, relocation, loss of reputation, incompatibility of technical systems, loss of accumulated data, social isolation, disruption of care arrangements, immigration consequences, or forfeiture of institution-specific benefits. Exit can also be asymmetric because one party can replace the other more easily. A large platform can lose an individual user with little consequence, while the user may lose access to a network on which professional or social activity depends.

Exit asymmetry matters because it alters the practical meaning of consent. Continued participation can reflect genuine preference, but it can also reflect high switching costs, dependence, fear of retaliation, or lack of viable alternatives. GRE therefore treats observed continuation as evidence that requires interpretation rather than as automatic proof that a relation remains mutually beneficial.

The generative dimension of exit is particularly important. Participation in a relation can produce assets that are specific to that relation: reputation scores, social connections, customized tools, accumulated knowledge, eligibility, or identity. These assets can increase productivity and value while simultaneously making exit more costly. Successful cooperation can therefore deepen dependence even without intentional lock-in. The governance problem is to preserve the benefits of relational investment while preventing accumulated specificity from becoming unilateral leverage.

Exit is also only one response to problematic relations. Voice, contestation, collective bargaining, institutional appeal, and internal reform can be preferable when relationships are valuable and exit would destroy jointly generated capacities. An exclusive focus on exit can therefore privilege subjects already able to move while leaving the most embedded or vulnerable participants unprotected. GRE analyzes exit together with voice, representation, repair, and alternative provision.

Exit asymmetry can be reduced through interoperability, portability, non-retaliation rules, social insurance, public alternatives, transferable credentials, data mobility, and limits on restrictive contracts. Such measures alter the relational field even if few subjects actually leave. The credible possibility of exit can change bargaining power. Exit governance is therefore about the structure of alternatives, not merely the observed frequency of departure.

3.14.7 Conversion of Asymmetry into Power

The preceding forms of asymmetry become analytically significant when they are connected to mechanisms of conversion. GRE treats conversion as the process through which a difference in resources, capability, knowledge, institutional position, vulnerability, or exit becomes effective influence over another subject's options or over the conditions from which future options are generated. This conversion is neither automatic nor uniform.

Several relational conditions commonly affect conversion. Scarcity matters because control over abundant and substitutable resources usually provides less leverage than control over bottlenecks. Dependence matters because the value of an asymmetry rises when other subjects rely on the advantaged subject for essential functions. Replaceability matters because subjects with many alternatives can resist conditions that dependent subjects must accept. Coordination matters because individually weak subjects can aggregate resources or voice. Institutional recognition matters because formal rules can authorize, limit, or redirect the use of an advantage. Information matters because leverage can depend on subjects understanding their alternatives and the likely consequences of refusal. Time matters because a party that can wait often has bargaining advantages over a party facing urgent costs.

Power conversion can also be recursive. A resource advantage can buy expertise; expertise can influence institutional design; institutional design can protect future resource accumulation. Superior knowledge can improve targeting; improved targeting can increase profit; profit can finance further data collection. Control over infrastructure can generate dependence; dependence can support contractual authority; contractual authority can increase exit costs. Such cycles matter to GRE because they transform temporary differences into persistent relational structures.

The concept of conversion also helps distinguish power from inequality. A wealthy subject can lack power over a regulator empowered to impose binding rules. A technically capable firm can remain dependent on a monopolistic supplier. A state with formal sovereignty can be constrained by financial, technological, or security dependencies. Power maps therefore need not reproduce wealth rankings. GRE analysis should trace conversion pathways rather than infer power from one observable variable.

Power can furthermore operate through the generation of expectations. If subjects anticipate that one party can impose costs, deny access, classify them adversely, or shape future opportunities, they may alter behavior before any explicit exercise occurs. This anticipatory effect can make power difficult to observe through events alone. Stable compliance can coexist with strong asymmetry precisely because overt conflict becomes unnecessary. Empirical inquiry may therefore need to study suppressed alternatives, unrealized options, counterfactual bargaining positions, and institutionalized expectations.

The conversion perspective also clarifies why power is domain-specific. A subject can be powerful in hiring and weak in finance, powerful in data and weak in law, powerful domestically and dependent internationally. GRE should therefore resist the temptation to compress heterogeneous power relations into one universal rank. A multidimensional mapping of asymmetries, conversion mechanisms, and affected generative conditions is often more informative than a single power score.

3.14.8 Limits of Capability Equalization

Capability enhancement is one important response to asymmetry. Education, public infrastructure, assistive technology, access to finance, legal aid, data access, computational tools, collective organization, and social protection can increase the ability of weaker subjects to participate, contest, adapt, and generate alternatives. Yet capability equalization has limits as a general theory of power reduction.

First, some asymmetries arise from differentiated roles rather than remediable deficits. Regulators and regulated entities, doctors and patients, judges and litigants, infrastructure operators and users, or specialized technical teams and general publics occupy different positions because complex systems distribute functions. Governance must then organize accountability across unequal roles rather than assume that every participant should acquire identical capabilities.

Second, capability enhancement can leave institutional conversion mechanisms untouched. Training workers may improve mobility while employers retain unilateral control over scheduling, surveillance, or termination. Financial literacy can improve decisions while contractual complexity and market concentration remain. Digital skills can expand participation while platforms retain control over standards, visibility, and data. Strengthening the weaker subject can therefore be valuable without fully altering the relation that generates the asymmetry.

Third, capabilities can themselves become positional. If all participants acquire a skill that was previously scarce, the advantage associated with that skill can move elsewhere. Credential inflation provides one familiar pattern: expanding qualifications can increase absolute competence while preserving relative competition for scarce positions. In technological domains, widespread adoption of one tool can raise the baseline expected from all participants and create a new asymmetry around access to more advanced infrastructure.

Fourth, equalization can impose burdens. Requiring vulnerable subjects to become expert negotiators, data analysts, legal specialists, or cybersecurity practitioners shifts responsibility onto those already facing structural disadvantage. Some protections are better provided through institutional design, fiduciary duties, public options, default rules, or limits on permissible extraction than through endless demands for individual capability upgrading.

GRE therefore treats capability equalization as one component of relational governance. The relevant question is which asymmetry should be reduced by expanding capability, which should be bounded through institutional rules, which should be made contestable through collective organization, and which should be accepted as functionally necessary but governed through accountability. The objective is not symmetry for its own sake. It is to prevent capability differences from becoming unjustified control over the conditions of participation and future generation.

3.14.9 Limits of Counter-Power

Counter-power refers to capacities that enable subjects to resist, negotiate, constrain, or redirect an existing concentration of power. Collective bargaining, competition, regulatory oversight, courts, professional associations, consumer organization, public alternatives, investigative journalism, open technical standards, mutual aid, and democratic participation can all function as forms of counter-power in different con-

texts. GRE treats them as relational interventions rather than as automatic restorations of balance.

Counter-power is often necessary because persistent asymmetry cannot be addressed by individual adaptation alone. Workers can negotiate more effectively through collective organization. Small firms can benefit from shared infrastructure or interoperability mandates. Consumers can rely on regulators or courts when individual monitoring is costly. Communities can build institutions that reduce dependence on a single provider. Such arrangements change the structure through which asymmetry is converted into power.

Yet counter-power has limits. It can become concentrated in its own right. A union, regulator, professional body, platform cooperative, or civic organization can develop internal hierarchies and exclusion mechanisms. Institutions created to represent weaker subjects can become difficult for those subjects to contest. Competition can constrain one monopoly while producing instability or shifting concentration to another layer of the system. Transparency can expose misconduct while advantaging actors with superior capacity to process disclosed information. Counter-power therefore requires its own governance.

Counter-power can also reproduce the ontology of the power it contests. If resistance must use the same metrics, platforms, legal categories, or technical infrastructure established by the dominant actor, alternatives may remain confined within the existing field. A community can gain representation without gaining control over the categories through which its interests are recognized. A new market entrant can challenge price while leaving data extraction practices unchanged. GRE therefore asks whether counter-power changes bargaining within a relation or transforms the generative conditions of the relation itself.

Temporal asymmetry further complicates counter-power. Concentrated actors can sometimes act quickly while collective organizations require deliberation, consent, and coordination. Conversely, public institutions can impose durable constraints that private actors cannot easily evade. The relevant balance is therefore dynamic. Effective governance must consider response speed, persistence, institutional learning, and the capacity of power holders to adapt around controls.

The limit of counter-power does not imply resignation. It indicates that balancing strategies should be evaluated recursively. A mechanism introduced to constrain power should itself be analyzed for new dependencies, exclusions, and conversion pathways. GRE's contribution is to keep that second-order question visible: what does the counter-power generate, whose capacities does it strengthen, which relations does it stabilize, and what new asymmetries emerge from its operation?

3.14.10 Relational Governance under Persistent Asymmetry

Many economic systems will continue to contain substantial asymmetries even under ambitious reforms. Subjects differ in knowledge, scale, specialization, mobility, resources, biological needs, legal mandates, technical capabilities, and exposure to risk. Relational governance therefore cannot depend on the expectation that legitimate order will emerge only after differences have been eliminated. Its task is to organize persistent asymmetry so that necessary differentiation does not become uncontrolled domination or generative foreclosure.

A GRE governance perspective begins by specifying the relevant asymmetries and

their conversion mechanisms. It asks which subjects depend on which others, what alternatives exist, which resources or capabilities function as bottlenecks, who defines the institutional categories of participation, how vulnerability is distributed, and what happens if a subject attempts to exit or contest the relation. This diagnosis identifies where safeguards are likely to matter.

Several governance principles follow from the analysis, although their concrete form remains context-dependent. Authority can be bounded by mandate and review. Essential services can be protected by continuity obligations or public alternatives. Exit can be made more credible through portability and interoperability. Knowledge asymmetry can be addressed through independent expertise, audit, contestation, and evidential access. Vulnerability can be reduced through buffers, insurance, redundancy, and guaranteed minimum capacities. Collective organization can strengthen voice. Rule-making can include affected subjects without presuming that participation alone resolves all asymmetry. Institutions can preserve appeal, revision, and sunset mechanisms so that temporary arrangements do not harden into unchallengeable structures.

Relational governance also requires attention to generative conditions. A policy can constrain abusive behavior in the present while leaving the mechanisms that reproduce future dependence untouched. Conversely, an intervention can redistribute immediate resources while weakening the organizational capacities through which a community previously governed itself. GRE therefore evaluates governance at more than one temporal layer: present protection, future capability, relational quality, structural transformation, and preservation of alternative pathways.

The concept of persistent asymmetry also changes the meaning of fairness. Formal equality of rules can coexist with radically unequal vulnerability or exit costs. Identical disclosure can be useless when interpretive capacities differ. Equal access to a market can mask unequal control over infrastructure. Governance may therefore require differentiated protections or obligations in order to make participation substantively contestable. Such differentiation must itself remain transparent and revisable because protective categories can reify the subjects they are intended to assist.

Power analysis should also remain separate from final normative judgment. A concentrated authority may sometimes be justified by coordination, safety, fiduciary responsibility, or public purpose. A decentralized arrangement can reproduce severe power through infrastructure, convention, or cumulative advantage. GRE therefore does not infer justice from decentralization, symmetry, or participation alone. It supplies a relational map of how influence is generated and sustained; normative evaluation then asks whether those mechanisms are justified under the relevant ethical, legal, and political standards.

This section therefore places power within the GRE problem-space as a dynamic relation among asymmetries, conversion mechanisms, dependencies, institutional structures, and future generative conditions. Resource, capability, knowledge, institutional position, vulnerability, and exit are analytically distinct sources of asymmetry. Their conversion into power depends on scarcity, substitutability, dependence, coordination, authorization, time, and the structure of alternatives. Capability equalization and counter-power can alter these relations, but each has limits and can generate new asymmetries. Relational governance must consequently remain adaptive, contestable, and attentive to second-order effects.

The analysis also prepares the next constitutive problem. Persistent asymmetry does not occur among identical subjects. Economic relations increasingly connect persons, organizations, states, artificial systems, ecological systems, and other heterogeneous participants whose capacities, temporalities, vulnerabilities, and value structures differ in kind as well as degree. The following section therefore turns from asymmetry within relations to the broader problem of heterogeneity and coexistence.

3.15 Heterogeneity and Coexistence

Generative Relational Economics requires an explicit account of heterogeneity because many economic relations connect subjects, systems, and processes that differ in ways that cannot be reduced to variation along a single scale. The role of this section is to establish coexistence across heterogeneous forms as a constitutive problem of GRE rather than as a residual complication added after a homogeneous model has been constructed. Its objective is to clarify how economic coordination, exchange, dependence, conflict, and joint generation remain possible when participants differ in subject form, intelligence, temporality, vulnerability, value structure, and degree of mutual intelligibility. The discussion proceeds from heterogeneous subjects and forms of intelligence through temporal and vulnerability differences, heterogeneous values, partial mutual intelligibility, economic relation under incomplete commensurability, human–AI relations, more-than-human relations, and boundary cases involving radically different subjects. The method is constitutive and analytical. It identifies conditions under which heterogeneous coexistence can be studied without presuming either complete commonality or complete incomparability.

Heterogeneity matters to GRE for a reason deeper than descriptive diversity. Difference can alter the mechanisms through which relations are formed, interpreted, stabilized, and transformed. Subjects that process information at different speeds can experience the same contract differently. Subjects with different vulnerabilities can bear the same nominal risk unequally. Subjects organized around different value structures can participate in the same economic arrangement while understanding its significance in different terms. Human and artificial systems can cooperate productively while differing sharply in embodiment, temporal horizon, memory, responsibility, and normative status. Economic coexistence therefore often depends on interfaces that enable coordination across difference rather than on the elimination of difference itself.

This perspective also changes the analytical meaning of coordination. Coordination need not imply shared ontology, identical preferences, common measures of value, or full mutual comprehension. It can arise through partial translation, rule-governed interfaces, protocols, conventions, negotiated thresholds, legal forms, institutional guarantees, or stable expectations concerning a limited domain of interaction. Such arrangements can be robust even when deeper interpretations remain divergent. They can also be fragile when the interface suppresses differences that later become economically consequential. GRE therefore asks both how heterogeneous subjects manage to relate and which differences remain unresolved beneath an apparently successful relation.

Heterogeneity should consequently be distinguished from disorder. A hetero-

geneous system can possess highly organized relations, and a homogeneous representation can conceal important differences. Likewise, coexistence should be distinguished from harmony. Subjects can coexist through cooperation, competition, dependency, conflict, indifference, mutual constraint, or asymmetric accommodation. The relevant GRE question is not whether heterogeneity produces agreement, but how different forms remain connected, how the relation distributes benefits and burdens, and how the terms of coexistence shape future generative possibilities.

3.15.1 Heterogeneous Subjects

The first dimension of heterogeneity concerns the kinds of subjects that participate in economic relations. Earlier sections treated economic subjecthood as relationally situated, institutionally recognized, temporally persistent, and historically transformable. The present section extends that argument by emphasizing that an economy can contain multiple subject forms at once. Individual persons, households, firms, states, cooperatives, communities, platforms, algorithmic systems, hybrid organizations, and other collective or artificial arrangements can all occupy economically consequential positions while remaining different in constitution and status.

These differences matter because the capacities through which subjects enter relations are not interchangeable. A natural person may possess legal rights, embodied needs, lived vulnerability, memory, social identity, and moral standing that differ categorically from the capacities of a corporation or software system. A corporation can persist across changes in personnel, accumulate assets, sign contracts, and coordinate action across large spatial scales. A public institution can exercise legally authorized powers that private actors lack. An artificial system can process or generate representations at speeds and volumes unavailable to human participants while lacking many forms of embodied participation through which human economic life is organized.

GRE therefore resists the temptation to create one abstract subject model and treat every participant as a parameterized instance of it. A unified formal representation can be useful for a local task, but the analyst must identify which dimensions of subjecthood have been suppressed. Treating a household, a company, and an automated trading system as “agents” can clarify interaction structure while obscuring differences in accountability, embodiment, temporal persistence, legal rights, or the capacity to experience harm. The representational convenience of a common agent label does not establish ontological or normative equivalence.

Heterogeneous subjecthood also means that relations can be constitutive in different ways for different participants. Employment may constitute livelihood and social identity for a worker while functioning as a cost and organizational input for a firm. Credit can appear as a portfolio exposure to a lender and as a condition of continued residence or enterprise survival to a borrower. A platform can treat a user interaction as data-generating activity while the user experiences it as communication, work, entertainment, or social participation. The same relation can therefore occupy different places in the reproduction of each subject.

This asymmetry of significance is analytically important. Economic relations cannot always be understood by assigning the same type of variable to each side. The relation may link subjects whose persistence conditions are fundamentally different. One participant can exit with limited consequence while another loses access to income, identity, infrastructure, or social connection. GRE analysis should therefore

specify what the relation does for each subject, which capacities it supports, which vulnerabilities it exposes, and how these differences affect bargaining, interpretation, and future generation.

Heterogeneous subjects can nevertheless form stable relations. Stability may arise through law, trust, standards, routines, contracts, technical interfaces, conventions, organizational design, or repeated adaptation. The existence of such stability shows that shared subject form is not a prerequisite for economic relation. What matters is whether the relation contains sufficiently compatible interfaces for action, interpretation, and expectation within the domain that must be coordinated.

3.15.2 Heterogeneous Forms of Intelligence

Economic analysis often speaks of information, knowledge, skill, and rationality as though intelligence were a single capacity that subjects possess in greater or lesser amounts. GRE treats intelligence more cautiously. Different subjects can exhibit different forms of problem solving, inference, adaptation, memory, perception, coordination, judgment, and representation. These forms may be partly comparable for a defined task without being reducible to one general economic scale.

Human economic intelligence includes dimensions that are difficult to separate cleanly: practical know-how, embodied familiarity, social interpretation, linguistic competence, moral judgment, imagination, aesthetic discrimination, memory, emotional response, and the capacity to act under incomplete and ambiguous conditions. Collective subjects can display organizational intelligence that no member possesses individually, including routines, distributed expertise, institutional memory, and coordinated response. Computational systems can display high performance in search, optimization, prediction, generation, classification, or symbolic transformation while relying on infrastructures, training processes, objectives, interfaces, and external forms of validation that structure what their outputs mean and how they are used.

Task-specific comparison is therefore often more informative than a universal ranking. One system may outperform another at high-dimensional pattern recognition while performing poorly where contextual interpretation, embodied judgment, accountability, or long-horizon institutional memory is decisive. An expert organization may coordinate a complex regulatory process effectively while responding slowly to unfamiliar technological change. A local community may possess detailed ecological knowledge that is poorly represented in standardized datasets. Heterogeneous intelligence appears as differentiated capability profiles rather than as a single ladder.

This matters economically because different forms of intelligence can become complementary. A relation can generate value precisely because participants perceive or process different features of a problem. Human-machine systems can combine computational scale with human contextual judgment. Interdisciplinary teams can connect different epistemic traditions. Firms can coordinate specialized units whose local knowledge would be insufficient in isolation. Markets themselves can sometimes coordinate dispersed information without requiring any participant to possess a complete representation of the system.

Complementarity, however, does not eliminate power. The party that controls the interface among forms of intelligence can shape which outputs count, which errors are visible, which judgments are overridden, and which forms of knowledge become

economically legible. Standardization can facilitate coordination while devaluing tacit or local knowledge. Automated decision systems can increase processing capacity while concentrating control over model design, data, thresholds, or appeals. The governance of heterogeneous intelligence is therefore partly a problem of interface design and partly a problem of institutional power.

GRE should accordingly distinguish capability difference from epistemic authority. Superior performance in one domain does not automatically justify decision authority in another. Prediction accuracy does not itself settle normative legitimacy. Computational scale does not settle interpretive authority. Human status does not guarantee technical competence. A mature analysis asks which form of intelligence is relevant to which claim, what evidence supports its reliability, how different forms are combined, and who controls the terms of combination.

3.15.3 Heterogeneous Temporalities

Economic subjects also inhabit different temporal structures. Temporal heterogeneity concerns differences in pace, horizon, persistence, delay, memory, reversibility, and the timing through which consequences become visible. These differences can be as consequential as differences in resources or capability because a relation that is sustainable at one temporal scale can be destructive at another.

Individuals often make decisions under lifetimes measured in decades, daily needs measured in hours, and contractual obligations measured in months or years. Firms may evaluate projects through reporting cycles, investment horizons, product lifecycles, or expectations concerning market entry and exit. Public institutions can operate through electoral, budgetary, legal, and infrastructural timescales. Financial systems can react within milliseconds while housing, education, ecological restoration, demographic change, and institutional trust can unfold over decades. Artificial systems can process and update representations rapidly while the social institutions required to evaluate, regulate, or contest their deployment move more slowly.

Temporal heterogeneity creates coordination problems. A rapidly adjusting actor can repeatedly change strategy before a slower institution completes review. Short-term financial incentives can conflict with long-term maintenance or ecological resilience. A policy may generate immediate benefits while degrading capacities that become visible only years later. Conversely, insisting on very long evaluation horizons can leave urgent present vulnerabilities insufficiently addressed. No single time horizon is automatically privileged across all economic questions.

GRE therefore treats temporal alignment as an analytical problem. Contracts, standards, insurance, reserves, review periods, waiting times, sunset clauses, intergenerational institutions, and adaptive governance can all be understood partly as devices for coordinating subjects whose consequences and capacities unfold at different rates. Such devices do more than schedule action. They distribute whose temporality receives priority. A deadline can privilege the actor able to mobilize quickly. A long approval process can protect against irreversible harm while disadvantaging subjects facing immediate need. A quarterly reporting regime can orient organizations toward measurable near-term outputs at the expense of slower generative effects.

Temporal heterogeneity also complicates attribution. A downstream effect may emerge long after the originating intervention, after intermediate relations have changed and after responsible institutions or personnel have disappeared. Con-

versely, a long-standing structure can condition present action without appearing in short observational windows. GRE analysis should therefore state the temporal horizon of its claims and examine whether the relevant mechanism operates faster or slower than the data used to identify it.

Coexistence across heterogeneous temporalities requires more than synchronization. Some differences should remain. Ecological regeneration cannot necessarily be accelerated to match financial expectations. Human deliberation may require time that automated processing does not. Institutional due process can be intentionally slower than market reaction. The governance question is therefore which temporal differences should be bridged, which should be protected, and how costs created by temporal mismatch are distributed.

3.15.4 Heterogeneous Vulnerabilities

Subjects differ not only in what they can do but also in what can harm them, how quickly harm occurs, how visible it is, and how readily recovery is possible. Vulnerability heterogeneity concerns these differentiated exposures and recovery conditions. It is especially important because relations that appear symmetric in formal terms can create highly asymmetric consequences when participants have different capacities to absorb loss.

The same monetary loss can be marginal for one subject and existential for another. A temporary service interruption can inconvenience a large organization while eliminating a small firm's only route to customers. Delayed payment can be a minor accounting issue for a well-capitalized buyer and a liquidity crisis for a supplier. Exposure of personal information can create embodied or social risks for an individual that have no equivalent in the experience of an automated system. Environmental degradation can affect communities whose livelihoods depend directly on local ecosystems while remaining abstract in the accounting of distant investors.

Vulnerability is therefore relational and domain-specific. A subject can be highly capable in one domain and vulnerable in another. Large firms can possess extensive resources while depending critically on specific infrastructure or regulatory permissions. States can exercise coercive authority while remaining technologically dependent. Artificial systems can be operationally powerful yet dependent on electricity, hardware, data centers, network access, maintenance, and human authorization. Vulnerability analysis should identify the failure conditions that matter for the particular relation rather than infer resilience from general size or capacity.

Recovery is as important as exposure. Two subjects exposed to the same disturbance can differ in reserves, insurance, social support, legal recourse, substitutability, repair knowledge, or access to alternative relations. These differences affect bargaining because the subject that can survive delay or failure usually possesses greater strategic freedom. Exit asymmetry, discussed in the previous section, is one expression of this wider vulnerability structure.

GRE also asks how relations generate vulnerability over time. Specialization can increase efficiency while producing dependence on narrow supply chains. Platform participation can expand market access while making future income dependent on ranking systems or account continuity. Debt can finance productive capacity while increasing sensitivity to interest rates or income interruption. An ecological intervention can raise present output while reducing resilience to later shocks. Vulnerability

is therefore often produced jointly with value.

Governance under heterogeneous vulnerability should not assume that formally equal treatment produces equivalent protection. Uniform rules can distribute risk unequally when participants have different failure thresholds. At the same time, vulnerability should not be used as a permanent identity that freezes subjects into protected categories. The analytical task is to identify specific exposure, consequence, recovery capacity, and the mechanisms through which the relation modifies them.

3.15.5 Heterogeneous Value Structures

Economic coexistence frequently connects subjects that organize value differently. Value heterogeneity includes differences in what is valued, how value is recognized, which trade-offs are acceptable, what temporal horizon matters, what forms of loss are considered substitutable, and which goods are treated as inappropriate for exchange. GRE therefore treats value structure as plural rather than assuming that all relevant evaluation can be represented through a single utility, price, welfare index, or scalar measure.

Some values are readily expressed through monetary exchange because institutions already provide stable units, markets, contracts, and accounting conventions. Others are represented through rights, duties, thresholds, rankings, narratives, professional norms, ecological indicators, cultural meanings, or qualitative judgments. A community may value continuity of place in ways poorly represented by compensation for relocation. A worker may value autonomy, recognition, security, or meaningful participation alongside income. A public institution may be bound by legality and equal treatment even where another arrangement would reduce cost. Ecological relations can involve irreversibility, species loss, or system resilience that resists straightforward substitution.

Heterogeneous value structures do not imply that coordinated decision is impossible. Institutions routinely make decisions under plural values. They use budgets together with rights constraints, technical standards, minimum thresholds, deliberation, priority rules, side constraints, multicriteria evaluation, and negotiated settlements. These devices are forms of practical ordering rather than proof that all underlying values have become commensurable.

This distinction between ordering and commensurability is central. A decision can select one option without establishing a universal measure that converts every relevant value into a common unit. A legal prohibition can exclude some options before cost comparison begins. A safety threshold can structure a feasible set without pricing every possible injury. Negotiation can produce agreement acceptable to different parties for different reasons. GRE can analyze these arrangements as relational mechanisms for coordinating value heterogeneity.

Value heterogeneity also creates power questions. The institution that chooses the metric can privilege values that fit that metric. Monetary valuation can make some losses legible while rendering others peripheral. Quantitative indicators can improve transparency while narrowing attention to what is measurable. Expert vocabularies can facilitate comparison while excluding affected participants whose reasons are expressed differently. The politics of value therefore includes the design of representation and conversion rules.

GRE evaluation should preserve this plurality where it is substantively real. Scalar

measures remain useful where a common measure is justified, but they should not acquire authority merely because they simplify optimization. When values are only partially commensurable, the analysis should record the remaining plurality rather than treating it as noise around a preferred metric.

3.15.6 Partial Mutual Intelligibility

Heterogeneous subjects rarely understand one another completely. Their categories, temporal horizons, sensory access, institutional roles, languages, models, and value structures can differ. Yet complete mutual understanding is not required for economic relation. Partial mutual intelligibility refers to the degree of shared interpretation sufficient for a defined form of coordination while leaving other aspects of the participants' worlds untranslated.

A buyer and seller can agree on quantity, quality, price, and delivery without sharing the same reasons for valuing the transaction. Organizations from different legal cultures can cooperate through contracts and technical standards while retaining different institutional assumptions. Humans can use computational systems whose internal representations they do not fully reconstruct, provided interfaces, validation procedures, and accountability arrangements make the relevant outputs sufficiently interpretable for the task. Scientific and local knowledge systems can sometimes coordinate around observable indicators while interpreting causal significance differently.

Partial intelligibility is therefore often produced by interfaces. A contract translates complex intentions into enforceable obligations. A standard reduces heterogeneous production processes to specified performance criteria. An API enables computational systems built on different internal architectures to exchange defined messages. A price compresses information relevant to exchange while leaving many reasons and consequences outside the transaction. A legal category makes different cases administratively comparable while suppressing detail. These interfaces enable relation precisely by limiting what must be mutually understood.

The reduction involved in an interface can be productive, but it can also generate misrecognition. When the interface omits a difference that later becomes consequential, coordination can fail. A metric can appear shared while participants interpret it differently. A model output can be operationally accepted without agreement on its epistemic status. A standardized category can group subjects whose vulnerabilities diverge sharply. The existence of a functioning interface therefore does not establish deep mutual understanding.

GRE analysis should ask what must be intelligible for the relation to function and what remains opaque. It should also ask who bears the risk created by opacity. If one party can demand explanation while the other cannot, interpretive asymmetry can become power. If a computational system influences access to credit, employment, or public services, the intelligibility required for legitimate use can be greater than the intelligibility required merely for technical operation.

Partial mutual intelligibility offers a middle position between two unrealistic assumptions: complete transparency and complete incommensurability. Economic life often proceeds through workable but incomplete translations. The quality of coexistence depends on whether these translations are sufficient for the stakes involved, revisable when they fail, and governed in ways that distribute interpretive risk fairly.

3.15.7 Economic Relations without Full Commensurability

Economic relation does not require every relevant object, value, subject, or consequence to be representable on one common scale. Exchange itself can involve commensuration for a limited purpose while broader aspects of the relation remain incommensurable. GRE therefore distinguishes local comparability from full commensurability.

A wage places a monetary value on labor time for the purpose of employment, but it does not establish that income exhausts the value of work, identity, health, autonomy, or social recognition. Insurance can assign compensation schedules to losses without implying that the compensated state is equivalent to the pre-loss state. Environmental markets can price particular emissions or ecosystem services while leaving cultural, ecological, and intergenerational values only partially represented. Cost-benefit analysis can support a decision under specified assumptions without becoming a complete theory of value.

Relations under incomplete commensurability often rely on layered decision rules. Some dimensions are priced. Others are protected through rights or prohibitions. Some are represented through minimum standards, negotiated conditions, or procedural safeguards. Others remain open to qualitative judgment. Such layered arrangements can be analytically messy, but the mess may reflect genuine plurality rather than methodological failure.

GRE can therefore study conversion without assuming equivalence. A value can be converted into another form through an institution even when the conversion is contested or incomplete. Time can be converted into wages; attention into advertising revenue; reputation into credit access; ecological damage into compensation obligations; research prestige into funding opportunity. The existence of a conversion mechanism shows that a relation connects the forms. It does not prove that the forms are intrinsically equivalent.

This distinction helps analyze exploitation and loss. When an institution repeatedly converts one form of value into another under asymmetric terms, the question is not only how much is transferred but which dimensions disappear during conversion. A platform can monetize social interaction while leaving users with limited claims on the resulting economic value. A development project can compensate property loss while failing to restore community networks. A labor contract can pay for output while externalizing health or care burdens. In each case, commensuration can enable exchange while concealing residual effects.

Coexistence under plural values therefore requires institutional creativity. Markets are one mechanism among several. Deliberation, commons governance, public provision, professional standards, rights, mutual aid, licensing, quotas, thresholds, and hybrid arrangements can coordinate heterogeneous values in different ways. GRE does not presume in advance which mechanism is appropriate. It asks how the chosen mechanism makes some values comparable, leaves others outside comparison, distributes authority over conversion, and alters future possibilities.

3.15.8 Human–AI Relations as a Contemporary Case

Human–AI relations provide a contemporary case in which heterogeneity of subject form, intelligence, temporality, vulnerability, and value can appear simultaneously.

GRE can analyze these relations without first resolving philosophical questions about machine consciousness or personhood. The immediate economic question is how human and artificial operational subjects become connected through production, decision, communication, ownership, infrastructure, and institutional authority.

The asymmetry is multidimensional. Artificial systems can process or generate large volumes of symbolic material rapidly, replicate outputs at low marginal cost, and operate continuously within suitable infrastructure. Humans retain forms of embodiment, lived vulnerability, social membership, legal standing, moral responsibility, contextual experience, and value formation that are not established by computational performance. Organizations often mediate between the two, determining data access, deployment goals, review procedures, liability, and the distribution of gains.

This heterogeneity creates complementary possibilities. Artificial systems can extend search, translation, drafting, prediction, pattern recognition, or simulation. Human participants can contribute contextual interpretation, problem selection, normative judgment, embodied knowledge, accountability, and decisions concerning what purposes should be pursued. The generative question is how the relation changes the capabilities of both the immediate participants and the surrounding institutions.

It also creates new dependencies. Workers can become dependent on tools they do not control. Organizations can become dependent on model providers, computational infrastructure, or proprietary interfaces. Users can rely on systems whose update cycles alter behavior faster than institutional procedures adapt. Expertise can shift from producing outputs directly to evaluating, directing, integrating, or contesting machine-generated outputs. These changes can redistribute bargaining power even when aggregate productivity rises.

Human–AI coexistence therefore should not be analyzed through replacement alone. Substitution is one possible relation. Others include complementarity, supervision, delegation, contestation, infrastructural dependence, mutual adaptation, and reorganization of occupational or institutional roles. The relevant GRE object is the evolving relational configuration: who controls the system, who defines objectives, who bears error, who receives generated value, which human capacities are strengthened or weakened, and how future alternatives are shaped.

The case also clarifies partial mutual intelligibility. Humans may use outputs without understanding every internal computational process, while artificial systems operate on representations that do not amount to human understanding in any straightforward sense. Economic coordination can nevertheless occur through interfaces, tests, standards, feedback, and institutional review. The adequacy of that partial intelligibility should depend on stakes. A low-risk drafting aid and a system affecting liberty, livelihood, healthcare, or public authority require different evidential and governance conditions.

GRE therefore treats human–AI relations as an important contemporary domain of heterogeneous coexistence, while maintaining ontological and normative caution. Operational capability does not settle personhood. Performance difference does not settle moral status. Economic usefulness does not settle legitimacy. These questions remain connected but analytically distinct.

3.15.9 More-than-Human and Ecological Relations

Economic systems also coexist with organisms, ecosystems, climatic processes, material cycles, and other more-than-human structures whose dynamics are constitutive of production and life. GRE includes these relations because economic generation depends on ecological and material conditions even when those conditions are poorly represented by conventional economic subjects.

More-than-human analysis requires ontological care. A forest, river, species, or ecosystem need not be treated as a subject in exactly the same sense as a human person or organization for its relational role to be economically consequential. Ecological systems can impose constraints, provide capacities, absorb waste, regenerate resources, transmit disturbances, and respond to interventions through dynamics that exceed the intentions of economic actors. Some legal or cultural traditions may also recognize nonhuman entities through forms of representation or standing. GRE can study these arrangements without requiring one universal theory of nonhuman subjecthood.

Ecological heterogeneity is strongly temporal. Soil formation, forest succession, hydrological cycles, species recovery, and climate processes can unfold at rates that differ from market, budgetary, and political cycles. An economic system can therefore appear productive within a short window while drawing down slower regenerative capacities. Conversely, ecological protection can impose immediate costs while preserving long-horizon generative conditions. The choice of temporal scale becomes part of evaluation rather than a neutral technical setting.

Vulnerability is likewise heterogeneous. An industrial actor may be able to relocate while a local ecosystem cannot. A community may depend on a specific river or coastal system whose loss is not replaceable by monetary compensation. Species and ecological processes can cross thresholds beyond which recovery becomes difficult or impossible on humanly relevant timescales. These differences complicate models that assume reversible substitution among resources.

Partial intelligibility appears here as well. Human institutions do not fully observe ecological systems. Models, indicators, monitoring networks, local knowledge, and scientific interpretation provide partial representations. Intervention therefore occurs under uncertainty about feedback, thresholds, and delayed effects. GRE's epistemic commitments require the distinction between ecological reality and its representation to remain explicit, especially where uncertainty interacts with potentially irreversible change.

The economic question is how relations with more-than-human systems affect present and future capacities. Extraction, cultivation, conservation, restoration, pollution control, infrastructure, and land-use rules all modify ecological conditions from which later economic possibilities emerge. More-than-human coexistence is thus central to generative analysis because the future economy is partly generated through relations with systems that exceed the boundaries of human institutions.

3.15.10 Boundary Cases of Radically Different Subjects

The most demanding cases for GRE arise when participants differ so substantially that ordinary assumptions of shared preference, common language, reciprocal recognition, or comparable vulnerability become unreliable. These boundary cases may in-

volve relations among human communities with sharply different ontologies, future artificial systems with unfamiliar forms of agency, interspecies relations, intergenerational relations in which one party is not yet present, or institutional interactions with ecological systems that cannot participate in negotiation in conventional terms. The purpose of considering such cases is not to classify every entity as a subject. It is to test which parts of GRE remain usable when mutual similarity is minimal.

The first requirement is to separate relation from reciprocity. A subject or system can be economically affected by another without being able to respond in the same channel. Future generations can bear consequences of present debt, infrastructure, ecological damage, and knowledge preservation without participating in present bargaining. Nonhuman systems can constrain or respond to economic activity without expressing preferences through markets or language. An artificial system can alter human opportunities while its own status as a bearer of interests remains unsettled. Economic relation can therefore exist under asymmetric capacities for representation and response.

The second requirement is representational humility. When one side cannot articulate its interests through the dominant institutional interface, another actor often speaks on its behalf. Guardians, regulators, scientific experts, community representatives, trustees, legal advocates, or technical proxies can perform this role. Representation may be necessary, but it creates a second-order relation in which the representative's categories can shape what becomes visible. GRE analysis should therefore examine not only the represented subject or system but also the institutions that authorize, translate, and contest representation.

The third requirement is to distinguish coordination from assimilation. Radically different subjects need not become similar in order to coexist. Governance can instead create protected distances, limited interfaces, non-interference rules, thresholds, buffer zones, rights, or protocols that make coexistence possible while preserving difference. In some cases the appropriate relation is closer integration; in others it may be separation or restriction of contact. GRE does not prescribe one universal form of coexistence because the relevant vulnerabilities, values, and generative effects differ.

Boundary cases also expose the limits of commensuration. Where interests or values cannot be credibly translated into one metric, decision may require procedural legitimacy, precaution, rights, representation, plural evaluation, or explicit acknowledgment of unresolved disagreement. A decision can still be made, but the residual disagreement remains part of the record rather than disappearing into a scalar result. This is especially important where the affected party cannot later recover from the imposed decision.

The broader constitutional implication is that GRE should be able to study economies composed of heterogeneous forms without making homogeneity a hidden precondition of analysis. Economic relation can persist through partial intelligibility, bounded interfaces, heterogeneous values, differentiated temporalities, unequal vulnerabilities, and incomplete commensurability. The task is to identify which differences matter to the relation, which interfaces make coordination possible, which conversions obscure residual losses, and how the terms of coexistence alter future generative possibilities.

Heterogeneity therefore belongs inside the GRE problem-space rather than at its margins. It prevents the economic subject from being silently standardized, prevents

intelligence from being reduced to one ranking, prevents temporality from being treated as uniform, prevents vulnerability from being inferred from formal equality, and prevents value from being collapsed into a single measure. It also provides a bridge to the next constitutional problem. Once GRE accepts heterogeneous forms as legitimate participants and objects of inquiry, it must state more precisely where its own disciplinary boundaries lie and how it relates to neighboring economic and social-scientific traditions. The following section therefore turns to the boundaries of Generative Relational Economics.

3.16 Boundaries of Generative Relational Economics

Generative Relational Economics is intended to remain intellectually permeable without becoming disciplinarily indeterminate. The role of this section is to specify the principal boundaries through which GRE relates to neighboring economic and social-scientific traditions while preserving a recognizable problem-space of its own. Its objective is neither to rank adjacent approaches nor to absorb them into a single synthesis. Instead, the section clarifies where GRE can borrow concepts, methods, evidence, and explanatory mechanisms; where genuine overlap exists; and where a distinction should be maintained because the neighboring tradition asks a different primary question, uses a different evaluative register, or makes commitments that GRE does not need to adopt. The discussion proceeds through mainstream economics, political economy, relational economics, economic sociology, complexity economics, evolutionary economics, capability approaches, ecological and regenerative economics, generative justice, and general Generative Relational Theory. The method is boundary-setting rather than genealogical. Chapter 2 reconstructed intellectual lineages; the present task is to define interfaces for an emerging research programme.

A disciplinary boundary in this sense is not a wall. GRE can use optimization, causal inference, institutional analysis, network models, historical interpretation, capability concepts, ecological accounting, or justice-oriented evaluation whenever those tools are appropriate to the claim under investigation. The boundary concerns the conditions under which such borrowing remains intelligible. A borrowed method does not make a study identical with the field from which that method came, and a shared object does not erase differences in analytical emphasis. Firms, households, technologies, institutions, ecosystems, capabilities, and power can all be studied by several traditions at once while being rendered differently by each.

This openness is necessary because many GRE questions are intrinsically composite. A study of platform labor may require conventional price and labor-market analysis, institutional and legal interpretation, network structure, computational measurement, political-economic analysis of control, and normative evaluation of capability or dependency. A study of agricultural transition may require cost and productivity analysis, ecological constraints, household reproduction, institutional history, technological coevolution, and long-horizon generative effects. GRE contributes when the inquiry asks how relations among these elements generate, distribute, stabilize, transform, or foreclose later capacities and possibilities. It does not require every neighboring perspective to be translated into GRE terminology.

Boundary maintenance therefore serves two purposes. First, it protects GRE from conceptual inflation. If every relational, dynamic, institutional, or justice-oriented

economic study were automatically classified as GRE, the programme would lose analytical content. Second, it protects neighboring fields from retrospective appropriation. GRE can inherit and recombine resources while acknowledging that those resources have their own histories, standards, and unresolved debates. The disciplinary identity developed in this chapter depends on dialogue without theoretical identity.

3.16.1 GRE and Mainstream Economics

GRE has no constitutive need to define itself through opposition to mainstream economics. Standard economic analysis contains powerful tools for studying prices, incentives, choice under constraints, equilibrium, strategic interaction, causal effects, welfare consequences, production, and allocation. Where a research problem is adequately specified by those objects, GRE gains little by redescribing the same analysis in relational vocabulary. The boundary is therefore positive: GRE becomes useful when the research question concerns how the relevant preferences, capacities, constraints, institutional positions, relations, or future opportunity sets are themselves generated and transformed through economic processes.

This distinction can be stated through analytical depth rather than disciplinary hierarchy. A conventional model may treat preferences as given over the horizon of analysis. GRE can accept that local simplification when preference formation is irrelevant to the question. A different study may need to explain how advertising, institutions, peer relations, platform design, education, or repeated participation reshape preferences or salience. In that setting, what was reasonably exogenous in the first model becomes an object of inquiry. The same logic applies to technology, endowments, legal categories, information structures, capabilities, and market boundaries.

Equilibrium analysis provides another example. GRE does not reject equilibrium as a mathematical or empirical concept. A stable or approximately stable configuration can be analytically important. The additional GRE question concerns what relations sustain the configuration, how the stability distributes capacities and vulnerabilities, whether the configuration generates new conditions that alter its own persistence, and what happens when the relevant state space or institutional rules change. Equilibrium can therefore appear within GRE without defining the whole research programme.

The relation is similarly complementary in empirical work. Econometric identification, experimental design, structural estimation, administrative data analysis, and causal inference can provide strong evidence for particular mechanisms or effects. GRE should use such evidence where available and should not substitute relational prose for identification. At the same time, an estimated local causal effect does not automatically reveal downstream institutional transformation, changing subject positions, altered exit conditions, or long-run generative consequences. Those further claims require further evidence.

The boundary can thus be summarized in terms of problem selection. Mainstream economics often provides the strongest available analysis when the relevant agents, constraints, preferences, technologies, and institutional rules can be treated as sufficiently stable. GRE becomes especially relevant when those conditions are part of what must be explained. The relationship is therefore one of selective extension and mutual correction rather than displacement.

3.16.2 GRE and Political Economy

GRE overlaps substantially with political economy because both can treat economic outcomes as inseparable from institutions, power, historical formation, distribution, and collective organization. Questions concerning ownership, labor, state capacity, financial structure, class, technological control, colonial legacies, regulation, and asymmetric dependence are naturally shared terrain. GRE does not need a separate vocabulary when political economy already provides an adequate account of the relevant mechanism.

The principal difference lies in analytical center of gravity. Political economy frequently organizes inquiry around the distribution and exercise of power among classes, states, firms, institutions, or social groups. GRE includes these objects but asks an additional family of questions concerning what those relations generate over time: capacities, subject positions, dependencies, values, institutional pathways, representational structures, ecological conditions, and the possibility of later action. Power remains central, yet GRE does not make every economic relation reducible to power.

This distinction matters because a relation can be generatively important even when domination is weak or absent. Cooperative institutions can generate capabilities and norms. Public infrastructure can create new spaces of participation. Educational systems can alter the subjects capable of entering later markets or political processes. Technological standards can coordinate activity without being explainable primarily through coercion. Political-economic analysis may already address these effects; GRE emphasizes their generative structure as a recurring cross-domain problem.

Conversely, GRE should not dilute political-economic mechanisms by translating them into neutral language of relation. Ownership, coercion, exclusion, dispossession, monopoly, dependency, and state authority possess specific institutional and historical content. When such mechanisms explain an outcome, they should be named directly. Relational vocabulary is not a substitute for analyzing who controls resources, who bears risk, who sets rules, or who can credibly exit.

GRE therefore sits near political economy while preserving a broader generative question. It can investigate how power structures generate future inequalities and institutional lock-in, but it can also study relations of learning, cooperation, care, ecological reproduction, or symbolic orientation whose economic importance is not exhausted by power. The boundary allows GRE to inherit political economy's seriousness about history and asymmetry without treating political-economic conflict as the sole grammar of economic generation.

3.16.3 GRE and Relational Economics

The strongest conceptual overlap may appear between GRE and approaches that explicitly place relations at the center of economic analysis. Relational economics, relational goods, network-based economic analysis, and other relation-sensitive traditions already challenge the assumption that economic value and behavior can always be understood through isolated individuals and possessed objects. GRE shares the view that access, interaction, recognition, coordination, dependency, and participation can be economically constitutive.

The boundary arises from the second term in the name: generative. GRE is interested not only in the existence or quality of relations but also in what relations bring into being, reproduce, transform, or foreclose. A relation can connect already-defined actors, but it can also alter their capabilities, identities, institutional positions, preferences, expectations, and future relations. The analytical question moves from the structure of a relation to the consequences of participating in and reproducing that relation.

This distinction prevents a relation-first approach from becoming static. Two networks can share similar topology while differing in what their ties generate. Two contractual arrangements can appear similar at one moment while producing different long-term capabilities or dependencies. A cooperative relation can initially create shared capacity and later become exclusionary. A market relation can transmit value while also changing the conditions under which future exchange occurs. GRE therefore requires temporal and generative specification beyond identifying relational structure.

At the same time, GRE does not claim that every relation generates deep transformation. Many relations may be transient, weak, or analytically negligible for the research question. The researcher must establish which relations matter, through which mechanisms, and over what horizon. Relation itself is not an explanatory endpoint.

The boundary with relational economics is thus narrow but meaningful. GRE belongs naturally within a wider family of relational economic approaches, while adding a systematic focus on downstream generation, recursive transformation, heterogeneous forms of value, changing subjects, and future possibility. That addition should be treated as a research orientation rather than as a claim that earlier relational work failed to recognize change or emergence.

3.16.4 GRE and Economic Sociology

Economic sociology provides many of the concepts required for GRE to avoid an overly thin account of economic action. Institutions, social networks, conventions, organizations, classifications, trust, status, embeddedness, cultural interpretation, and collective identity can all shape what economic relations are possible and how they are understood. GRE therefore shares a substantial empirical and conceptual domain with economic sociology.

The boundary is not based on a sharp separation between “economic” and “social” facts. GRE rejects such a simple partition. The distinction is better located in the organizing research problem. Economic sociology can ask how markets, firms, money, organizations, or valuation are socially constituted. GRE can use those analyses and then ask how the resulting economic relations transform later capacities, values, constraints, subject positions, and structures of possibility. The two directions can be mutually reinforcing.

GRE also retains an explicitly economic concern with allocation, production, circulation, extraction, capability, scarcity, and the organization of resources. These objects prevent the programme from dissolving into a general sociology of relations. A sociological account of trust may explain why exchange becomes possible; GRE may further analyze how the exchange redistributes capacity, creates dependency, alters future bargaining positions, or changes the institutions that sustain trust. A sociologi-

cal account of classification may explain category formation; GRE may examine how that classification changes access to credit, work, insurance, mobility, or recognition.

This interface is especially important for symbolic and representational objects. Prices, ratings, credentials, risk scores, categories, and rankings can be both social facts and economic mechanisms. GRE can study their generative effects without claiming that economic sociology is merely a precursor to GRE. The traditions differ in disciplinary history and in the questions they prioritize.

The boundary therefore remains porous. GRE depends on sociological evidence whenever economic relations are constituted by social meaning, institutional recognition, or organizational form. It remains recognizably economic when the inquiry centers on how such relations organize resources, capacities, value, scarcity, exchange, production, and future economic possibility.

3.16.5 GRE and Complexity Economics

Complexity economics and GRE share an interest in heterogeneous agents, nonlinearity, adaptation, path dependence, interaction effects, emergent macro-patterns, and systems that change outside simple equilibrium descriptions. Complexity methods can be especially valuable when aggregate outcomes arise from distributed interactions and when feedback alters the trajectory of the system.

The overlap is methodological as well as conceptual. Agent-based models, network models, simulation, nonlinear dynamics, and computational experiments can all contribute to GRE where the research problem is compatible with their assumptions. These tools allow researchers to study distributed generation, threshold effects, coordination, cascading change, and multiple possible trajectories.

GRE nevertheless remains broader than a complexity methodology. A GRE contribution need not contain a simulation, a network model, or a nonlinear formal system. Historical interpretation, institutional analysis, qualitative research, comparative case studies, legal analysis, causal inference, and participatory inquiry can all be appropriate. Complexity is one representational and explanatory family among several.

A second boundary concerns the representation of emergence. A computational model can demonstrate how a macro-pattern emerges from specified micro-rules. That result is important, but it establishes emergence within the model. GRE must still ask whether the selected agents, rules, state variables, and interactions adequately represent the empirical process. It may also need to explain how the rules themselves were historically generated, interpreted, contested, or transformed.

A third boundary concerns normativity and meaning. Complex adaptive behavior can persist without being desirable. A resilient system can stabilize exclusion, ecological harm, or domination. Actors can interpret the same rule differently, and those interpretations can alter later action. GRE therefore combines complexity-sensitive analysis with explicit attention to historical meaning, institutional authority, heterogeneous value, and normative evaluation.

The relationship is consequently close but non-identical. Complexity economics supplies powerful tools for distributed and nonlinear generation; GRE adds a wider methodological repertoire and makes the generation of rules, subjects, meanings, and evaluative conditions available as research objects where evidence permits.

3.16.6 GRE and Evolutionary Economics

Evolutionary economics offers another close interface because it treats economic systems as historically changing populations of technologies, routines, organizations, practices, and institutions. Innovation, variation, selection, retention, path dependence, learning, and coevolution provide important resources for analyzing processes that cannot be reduced to static optimization.

GRE shares the historical and processual orientation while avoiding an automatic translation of every generative process into evolutionary terms. Generation can occur through variation and selection, but it can also arise through deliberate institutional design, legal reclassification, collective interpretation, negotiated coordination, education, care, public investment, conflict, or sudden technological recombination. Evolutionary mechanisms are therefore important members of a broader generative repertoire.

The distinction is also useful for normative analysis. Persistence or selection does not demonstrate efficiency, justice, desirability, or superior adaptive value in every relevant sense. Institutions can survive because alternatives are suppressed, switching costs are high, incumbents control infrastructure, or vulnerable groups bear the costs of persistence. GRE therefore treats selection outcomes as explanatory objects that may require separate normative evaluation.

Coevolution provides particularly fertile common ground. Firms and technologies, institutions and practices, infrastructures and habits, or policies and expectations can change in mutually conditioning ways. GRE extends the question when the process changes the kinds of subjects, capacities, value forms, or relations that can exist in the next period. The interest lies not only in reciprocal adaptation but in transformation of the conditions under which later adaptation occurs.

GRE can thus use evolutionary models and concepts whenever variation, selection, retention, innovation, and coevolution explain the empirical process. Its boundary lies in refusing to make those mechanisms exhaustive. The programme remains open to generative processes whose historical logic is interpretive, institutional, juridical, ecological, political, or deliberately designed rather than primarily evolutionary.

3.16.7 GRE and Capability Approaches

Capability approaches and GRE share a concern with what people and other relevant subjects are substantively able to do and to become. This creates a natural interface between the evaluation of resources and the analysis of conversion conditions. Equal resources can produce unequal capabilities when subjects face different institutions, environments, social relations, embodied conditions, or access structures.

GRE adopts this insight without treating capability as its sole evaluative language. Capability is one dimension of generative consequence. Economic relations can generate or erode capabilities, but they can also transform dependency, recognition, institutional participation, relational quality, ecological conditions, symbolic orientation, and the possibility of collective action. Some of these effects can be translated into capability terms; others may be better preserved as distinct analytical objects.

The temporal orientation also differs in emphasis. Capability analysis can evaluate the substantive opportunities available at a given time. GRE places particular attention on how those opportunities were generated, how they are maintained, and how

present relations alter the capability-generating conditions of the future. This makes capability formation, reproduction, concentration, and erosion central dynamic questions.

Capability asymmetry further enters the analysis of power. A difference in capability does not automatically create domination, but it can become leverage when one subject controls an infrastructure, knowledge resource, legal permission, computational system, or exit option required by another. GRE therefore connects capability analysis to relational conversion mechanisms without reducing capability to power.

The boundary is normative as well as analytical. GRE can use capability-oriented evaluation without claiming to settle the philosophical questions that capability theories address concerning freedom, human flourishing, lists of central capabilities, or the justification of public priorities. Those debates remain neighboring normative resources. GRE's contribution is to investigate how economic relations generate and distribute the conditions under which capabilities become possible, durable, or foreclosed.

3.16.8 GRE and Ecological and Regenerative Economics

Ecological and regenerative economics provide essential resources for any GRE analysis in which economic generation depends on material, energetic, ecological, or more-than-human conditions. Production cannot be understood solely through monetary circulation when it depletes soils, water, biodiversity, climate stability, or other conditions required for future activity. Conversely, economic relations can sustain and regenerate ecological capacities under some institutional arrangements.

GRE shares the emphasis on stocks, flows, throughput, ecological limits, interdependence, and long-horizon reproduction. It also shares the concern that apparent short-term gain can undermine the conditions of later possibility. Generative foreclosure has a direct ecological meaning when present extraction damages the ecological capacities through which future livelihoods or social systems could otherwise be sustained.

The boundary again concerns scope and normativity. GRE uses “generative” in a broader sense than ecological regeneration. A process can generate institutions, subject positions, knowledge, technological capacities, dependencies, or symbolic values while degrading ecological conditions. Conversely, ecological regeneration can occur within social arrangements that distribute benefits or burdens unjustly. The descriptive fact of regeneration therefore requires separate social and normative evaluation.

GRE also avoids treating circularity, resilience, regeneration, and generativity as synonyms. A circular material flow can preserve an unjust labor relation. A resilient system can stabilize harmful dependence. A regenerative ecological practice can impose burdens on communities whose knowledge or land is appropriated. The relevant analysis must specify what is being regenerated, for whom, through which relations, and with what consequences elsewhere.

The relationship is therefore strongly complementary. Ecological and regenerative economics prevent GRE from treating future possibility as socially generated in isolation from biophysical conditions. GRE contributes a wider account of how ecological and economic processes interact with institutions, power, subjects, value forms, and the distribution of future generative capacity.

3.16.9 GRE and Generative Justice

Generative justice is one of the closest normative neighbors of GRE because it directs attention to the circulation and return of generative value and to the conditions under which communities retain control over the processes that produce value. Earlier in the book, this lineage was treated as an established theoretical resource rather than as a retrospective expression of GRE. That distinction remains important at the disciplinary boundary.

GRE shares the concern that evaluation should extend beyond the immediate allocation of outputs. A relation can appear distributively acceptable at one moment while extracting the capacities, knowledge, infrastructures, or ecological conditions that enable future generation. Conversely, an arrangement can strengthen future capability by returning value, knowledge, authority, or productive infrastructure to the subjects and communities involved.

The two programmes nevertheless have different scope. Generative justice is explicitly normative. GRE combines descriptive, explanatory, causal, historical, formal, computational, normative, and intervention-oriented modes. A GRE study can analyze how value recirculates or is extracted without concluding that a particular pattern is just. Normative judgment requires additional premises concerning participation, domination, capability, harm, ecological sustainability, procedural legitimacy, plural values, and future possibility.

GRE also uses a wider conception of what may be generated. Material wealth and productive capacity are central, but economic relations can also generate subject positions, representations, institutional authority, dependencies, expectations, knowledge, ecological conditions, and future option structures. Return of value is therefore one important pattern among several possible generative trajectories.

The boundary preserves attribution and conceptual clarity. GRE can learn directly from generative justice while maintaining a broader economic research programme whose normative analysis remains open to several theories of justice and to the neighboring work of GREthic. The overlap is substantive, but theoretical identity would obscure differences in purpose and scope.

3.16.10 GRE and General Generative Relational Theory

The final boundary is internal to the wider research programme. General Generative Relational Theory provides the broader conceptual space in which relations, generation, ontological emergence, epistemic mediation, historical transformation, power, normativity, and praxis can be studied across domains. GRE is the economic instantiation of that wider framework. The distinction is necessary because not every generative-relational problem is an economic problem.

GRE therefore adopts only the amount of general GR required to investigate economic objects. It studies production, allocation, circulation, exchange, extraction, capability, scarcity, institutions, economic subjecthood, value, power, ecological dependence, and the transformation of future economic possibility. General GR may address analogous structures in law, politics, education, science, aesthetics, knowledge, culture, or other domains where the primary research problem is not economic.

This distinction prevents disciplinary expansion by analogy. A relational pattern discovered in economic analysis should not automatically be generalized to every

social domain. Conversely, a concept developed in another GR domain may require translation before it becomes economically meaningful. The relevant mechanisms, evidence, units of analysis, institutions, and normative stakes can differ substantially across domains.

The relation is nevertheless recursive. GRE can contribute concepts and findings back to general GR. Economic studies may reveal new mechanisms of generative foreclosure, recursive power, value conversion, subject formation, or cross-scale transformation that later become useful outside economics. Other GR domains can likewise correct GRE by showing that an apparently economic process depends on legal, political, epistemic, cultural, or ecological structures that GRE alone cannot adequately explain.

General GR should therefore function neither as a doctrinal authority over GRE nor as a collection of metaphysical propositions that economic research is expected to confirm. It is a broader, revisable framework that can coordinate comparison among domains while remaining open to correction from domain-specific work. GRE retains disciplinary responsibility for the quality of its economic evidence and explanation.

The boundaries established across this section give GRE a position that is open without being unlimited. The programme can use mainstream economic models, political-economic accounts of power, relational and sociological analyses, complexity and evolutionary methods, capability concepts, ecological and regenerative analysis, and generative-justice insights. None of these interfaces requires GRE to become identical with the neighboring field. The criterion is whether the borrowed resource helps explain how economic relations generate, reproduce, distribute, transform, or foreclose later capacities and possibilities.

This boundary-setting also prepares the next task of disciplinary constitution. Once GRE's neighboring interfaces have been identified, a further question becomes unavoidable: what would make a particular study count as a contribution to GRE rather than merely a study that uses relational language? The following section therefore turns from external boundaries to internal research standards, specifying the criteria by which a GRE contribution can state its relational problem, generative claim, evidence, boundary conditions, normative commitments, and cumulative contribution with sufficient clarity to be evaluated and revised.

3.17 Criteria for a GRE Research Contribution

The preceding sections have defined the problem-space, analytical objects, scales, modes of inquiry, epistemic commitments, praxis orientation, normative concerns, and disciplinary boundaries of Generative Relational Economics. A research programme, however, also requires internal standards by which particular studies can be recognized, criticized, compared, and accumulated. The role of this section is to state those standards. Its objective is neither to create a rigid checklist nor to police disciplinary membership through terminology. It is to specify the minimum analytical work required for a contribution to make a recognizably GRE claim. The discussion proceeds through ten criteria: specification of the relational problem; explicit scale and boundary conditions; identification of the generative claim; evidence appropriate to that claim; distinction between representation and relational reality; attention to downstream effects; consideration of alternative generative mechanisms; nor-

mative transparency; reproducibility and interpretive traceability; and contribution to cumulative knowledge. The method is constitutional and methodological. These criteria are intended to make GRE research more contestable, revisable, and cumulative rather than more doctrinal.

A study need not satisfy every criterion with the same intensity. A conceptual paper may contribute primarily through category formation and theoretical clarification. A historical study may establish a generative mechanism through archival reconstruction. An econometric study may identify a restricted causal relation while leaving wider ontological questions open. A simulation may explore the consequences of a specified generative mechanism without claiming empirical completeness. An intervention study may generate evidence about relational change that could not be obtained through detached observation alone. The relevant standard is proportionality: the claims made should be supported by an appropriate combination of analytical specification, evidence, and methodological transparency.

GRE therefore treats disciplinary contribution as a relation between a problem, a claim, a representation, evidence, and a cumulative research context. Relational vocabulary alone does not establish that relation. A paper that describes a network, invokes emergence, or discusses downstream effects is not thereby a GRE contribution. The GRE character becomes substantive when the research shows how a specified economic relation contributes to the generation, reproduction, transformation, distribution, or foreclosure of later capacities, values, subjects, constraints, structures, or conditions of possibility, and when that claim is made in a form that other researchers can examine and revise.

3.17.1 Specification of the Relational Problem

A GRE contribution begins by specifying the relational problem under investigation. This requirement is stronger than stating that the topic is “relational.” The study should identify which subjects, entities, institutions, infrastructures, representations, ecological conditions, or other analytically relevant configurations are connected, what kind of relation is at issue, and why that relation matters to the economic problem being studied.

The relation may involve exchange, production, financing, employment, ownership, access, dependence, coordination, classification, care, information, legal recognition, infrastructure use, platform participation, resource extraction, ecological dependence, or another economically consequential connection. Its empirical form may be contractual, informal, symbolic, technical, organizational, institutional, spatial, ecological, or distributed across several of these forms. GRE does not require a single taxonomy of relations. It requires enough specification for the researcher and reader to know what is being claimed to connect what.

Relational specification should also identify the economically relevant incidence of the relation. The administrative recipient of a resource, policy, payment, model, or intervention may be only one locus within a wider relational field. A subsidy to a firm can affect workers, suppliers, competitors, financial institutions, local communities, infrastructure demand, and future investment. A credit decision can affect households, landlords, employers, insurers, and later access to other services. A platform rule can alter users, complementors, advertisers, content producers, and labor conditions. The research problem becomes relational when these connections are treated

as analytically constitutive rather than as residual externalities added after the main analysis.

The study should further clarify whether the relation is itself the principal object or whether it mediates another object of interest. A paper may examine the formation of a labor relation, the consequences generated through that relation, or the way the relation transforms its own future conditions. These are different research problems. Stating the relation precisely prevents a general language of interdependence from substituting for explanation.

Relational specification does not require exhaustive mapping. Every inquiry selects some relations and leaves others outside the active representation. The contribution lies partly in justifying why the selected relations are sufficient for the local question and in making visible which important relations have been bracketed. A study that names its relational problem clearly can later be extended, challenged, or re-scaled. A study that leaves the relation implicit is harder to evaluate because disagreement about evidence can conceal disagreement about what the object actually is.

3.17.2 Explicit Scale and Boundary Conditions

Every GRE contribution should state the scale and boundary conditions within which its claims are intended to hold. Economic relations change character across temporal, organizational, spatial, institutional, ecological, and analytical scales. An apparent entity at one scale can decompose into heterogeneous relations at another. A mechanism visible in a household, firm, or platform may operate differently at sectoral, juridical, ecological, or transnational scales. Explicit scale selection therefore belongs to the substance of the analysis rather than to a technical appendix.

Boundary conditions specify what is treated as inside the active system of analysis, what is treated as an environment or background condition, and what is excluded. These boundaries can be geographical, institutional, temporal, jurisdictional, organizational, technological, ecological, or representational. They can also be nested. A study of a labor platform may define the platform ecosystem as the primary boundary while treating labor law, payment infrastructure, and macroeconomic conditions as surrounding systems that enter through specified interfaces.

Temporal boundaries require particular care because generative effects can be delayed. An intervention that raises income over six months may reduce a productive or ecological capacity over five years. A technology that expands access in one period can create dependence on proprietary infrastructure later. A relational configuration that appears stable during one institutional regime may dissolve when law, prices, expectations, or political authority change. A GRE contribution should therefore identify the temporal horizon of the claim and, when appropriate, distinguish immediate effects from slower structural or generative transformations.

Explicit boundary conditions also constrain generalization. Evidence from one sector, jurisdiction, historical period, or technological architecture does not automatically establish the same mechanism elsewhere. A GRE study can make a narrow claim and still be theoretically important if it states the conditions under which the mechanism is expected to operate. Conversely, broad claims require correspondingly broad evidence or a carefully justified theoretical argument.

Scale and boundary transparency creates a path for cumulative research. Later

studies can test whether a mechanism persists under different institutional arrangements, whether a relation changes when the scale is expanded, or whether a boundary previously treated as external should become endogenous to the analysis. Boundary choice is therefore both a limitation and a research instrument.

3.17.3 Identification of the Generative Claim

A GRE contribution should identify its generative claim explicitly. The generative claim states what the specified relation is proposed to generate, reproduce, transform, distribute, or foreclose, through which mechanism, and over what temporal horizon. This is the criterion that most clearly distinguishes a GRE contribution from a study that merely uses relational language.

The generated object can take many forms. It may be a capability, resource, institutional position, subject identity, expectation, dependency, value form, knowledge structure, ecological condition, network topology, bargaining position, classification, infrastructure, norm, or future option. It may also be a change in the conditions under which further generation occurs. The generative claim should therefore name the analytical object rather than relying on the generic statement that a relation “creates value” or “produces effects.”

The mechanism also matters. A relation may generate later capacity through learning, investment, access, network reinforcement, institutional recognition, technological complementarity, legal stabilization, reputational accumulation, ecological regeneration, coordination, or another process. It may generate foreclosure through extraction, depletion, lock-in, exclusion, deskilling, dependency, displacement, institutional erosion, or destruction of alternatives. Different mechanisms can produce similar observed outcomes, and the same mechanism can have different consequences under different conditions.

Generative claims can vary in strength. A descriptive contribution may show that a relational configuration is systematically associated with later capacity formation. A historical contribution may reconstruct a plausible mechanism across a sequence of institutional changes. A causal contribution may identify the effect of a specified relation on a downstream outcome under defined assumptions. A formal contribution may demonstrate that a mechanism can generate a class of patterns within a model. A simulation may explore the conditions under which a proposed mechanism becomes sufficient or insufficient. These claims should be distinguished rather than compressed into one category of proof.

A strong GRE contribution also clarifies whether the mechanism concerns generation within an existing structure or transformation of the structure itself. Creating additional productive capacity under stable rules differs from changing ownership, classification, institutional authority, or the effective rules by which future capacities are generated. The distinction helps prevent ordinary output expansion from being mislabeled as deep generative transformation.

The purpose of requiring an explicit generative claim is therefore diagnostic as well as disciplinary. It enables readers to ask whether the claimed generated object actually changes, whether the proposed mechanism is observed or inferred, whether alternative mechanisms fit the evidence, and whether the effect persists beyond the immediate horizon. Generativity becomes a researchable proposition rather than an honorific description.

3.17.4 Evidence Appropriate to the Claim

Evidence in GRE should be appropriate to the epistemic form and strength of the claim. No single evidential hierarchy governs every generative question. Historical reconstruction, ethnography, interviews, administrative records, experiments, quasi-experiments, surveys, network data, financial records, ecological measurements, computational traces, legal documents, formal proofs, and simulations can each support different kinds of inference. Methodological pluralism therefore requires disciplined matching between claim and evidence.

A claim about lived dependency may require qualitative or interpretive evidence that cannot be replaced by aggregate transaction data. A claim about population-level incidence may require quantitative evidence that interviews alone cannot establish. A claim about historical institutional transformation may require archival evidence and temporal reconstruction. A causal claim about an intervention may require an identification strategy capable of distinguishing the effect from confounding processes. A formal claim requires internally valid derivation under stated assumptions. A simulation establishes consequences of modeled rules and parameters rather than direct observation of the empirical target.

The evidence should also correspond to the downstream object named in the generative claim. If a paper claims that a financing relation generates capability, it should observe or defensibly proxy the relevant capability rather than infer it solely from the initial allocation of finance. If a platform intervention is claimed to increase autonomy, measures of throughput or usage alone are insufficient unless the relation between those measures and autonomy is theoretically and empirically justified. If an ecological practice is claimed to regenerate future production conditions, evidence should reach beyond current output toward the ecological capacities that support future activity.

Mixed evidence can be especially valuable when the generative mechanism crosses representational levels. Quantitative data may reveal a distributional pattern while interviews clarify how the relation operates. Institutional documents can establish formal authority while observed practice reveals its implementation. Simulation can explore whether a proposed mechanism is sufficient to produce an observed macro-pattern while empirical data constrain the plausible parameter range. Such combinations should be integrated through a stated inferential logic rather than accumulated as decorative methodological diversity.

Evidence appropriateness also includes negative evidence and failed expectations. When a proposed generative mechanism predicts downstream change that does not occur, the absence can narrow the mechanism, reveal a missing condition, or indicate that the representation is wrong. GRE should therefore retain evidential structures that permit a generative claim to be weakened or rejected. A programme that can only reinterpret every outcome as evidence of hidden generativity would cease to be empirically corrigible.

3.17.5 Distinction between Representation and Relational Reality

A GRE contribution should distinguish the representation used in analysis from the relational reality the representation is intended to illuminate. Networks, graphs, cat-

egories, state spaces, fields, equations, indicators, taxonomies, maps, legal classifications, interview codes, and computational models are analytical constructions. They can disclose important structure while also suppressing, aggregating, or transforming aspects of the target.

The distinction is particularly important because relational analysis often makes structure visually or mathematically compelling. A network diagram can make nodes and edges appear ontologically given even when node identities, tie definitions, missing relations, and temporal aggregation are products of the data-generating process. A scalar indicator can make heterogeneous value appear commensurable. A field representation can suggest continuity where the empirical system contains discontinuities or institutionally discrete categories. A model can hold agents or rules fixed even when historical change in those objects is part of the substantive problem.

GRE does not therefore require researchers to distrust representation. Representation is unavoidable and productive. The requirement is reflexive specification. A contribution should explain what the representation makes visible, what it treats as stable, what it aggregates, what it excludes, and how those choices affect the claim. The more strongly the conclusion depends on a representational choice, the more important sensitivity to alternative representations becomes.

This criterion also applies to institutional representations. Legal categories, accounting classifications, platform metrics, credit scores, productivity measures, and administrative identities can become economically operative representations. They are not merely researcher-created descriptions. Their use can shape access, recognition, risk, resource allocation, and subject positions. A GRE study may therefore analyze a representation both as an epistemic device and as an economic mechanism.

Maintaining the distinction between representation and relational reality supports ontological suspension. Researchers can use network, field, dynamical, or computational language without claiming that the empirical economy literally possesses the complete ontology of the formalism. The analytical question is whether the representation is adequate to the local problem and generative claim. Competing representations can remain simultaneously useful when they disclose different aspects of the same economic configuration.

3.17.6 Attention to Downstream Effects

A GRE contribution should examine downstream effects far enough to evaluate the stated generative claim. This requirement does not demand infinite causal tracing. It requires the researcher to look beyond the immediate administrative output when the theoretical claim concerns later capacities, relations, values, constraints, or possibilities.

Downstream analysis begins by identifying plausible channels of propagation. A transfer to one organization may alter wages, procurement, investment, debt, market entry, local prices, or political influence. A new classification system may affect eligibility, insurance, credit, employment, or legal recognition. An AI system deployed to increase productivity may alter skill formation, supervision, bargaining power, organizational knowledge, and dependency on technical infrastructure. A conservation intervention may change ecological capacity, land access, community authority, and future livelihood options.

GRE should distinguish propagation from attribution. Observing a downstream

change after an intervention does not establish that the focal relation generated it. The contribution should specify the pathway through which the effect is expected to travel and identify evidence consistent with that pathway. Where causal identification is unavailable, the claim should remain calibrated accordingly.

Downstream attention should also include distribution. The same relation can generate gains for one subject while shifting risk, depletion, dependency, or opportunity loss to another. Aggregate improvement can therefore coexist with localized generative foreclosure. A GRE contribution should identify who receives immediate outputs, who gains later capacity, who bears costs, and whose future options become more or less available when these differences are material to the research question.

Temporal depth matters as well. Some generated effects decay quickly; others accumulate or become self-reinforcing. A short evaluation horizon can misclassify a process whose main economic significance lies in later lock-in, learning, institutionalization, ecological regeneration, or erosion. Researchers should therefore justify the chosen horizon in relation to the mechanism rather than treating the observation window as analytically neutral.

The downstream criterion ultimately protects the concept of generativity from collapsing into ordinary output measurement. GRE asks what a relation leaves behind in the capacities and conditions from which later economic processes proceed. The appropriate downstream horizon is the one required to make that question empirically meaningful.

3.17.7 Attention to Alternative Generative Mechanisms

A GRE contribution should consider plausible alternative mechanisms capable of generating the observed pattern. This criterion follows directly from epistemic humility and from the fact that similar outcomes can emerge from different relational configurations. Mechanism identification becomes stronger when the researcher explains why the preferred account fits the evidence better than important alternatives.

Alternative mechanisms can operate at the same scale or at different scales. Increased productivity within a firm may result from worker learning, capital deepening, selection of more productive workers, changes in task allocation, demand expansion, or measurement artifacts. Increased community income after an intervention may reflect genuine local capability generation, temporary transfers, migration, price effects, or extraction from another location. Institutional persistence may arise from legitimacy, coordination benefits, legal coercion, network lock-in, sunk costs, or the absence of viable alternatives.

GRE should also remain attentive to equifinality: different histories can produce similar configurations. The existence of a stable relation does not uniquely reveal how it was generated. Comparative, historical, and process evidence can help distinguish pathways. In formal or computational research, sensitivity analysis can show whether the result depends on a narrow mechanism or emerges across several model structures.

Alternative mechanisms include representational alternatives. An apparent relation can arise because of measurement, classification, selection, aggregation, or omitted variables. A network pattern can change when edge definitions change. A capability indicator can move because the proxy changes while the underlying capability does not. A historical discontinuity can reflect an archival or institutional change in

what was recorded. These possibilities do not invalidate the analysis; they specify additional hypotheses that should be considered where material.

The purpose of this criterion is not to require exhaustive refutation of every imaginable mechanism. It is to prevent a favored generative narrative from becoming insulated from competition. A GRE contribution should identify the most consequential alternatives given the domain, evidence, and claim strength, and state what additional evidence could discriminate among them. Competing mechanisms are part of cumulative research rather than threats to disciplinary coherence.

3.17.8 Normative Transparency

A GRE contribution should make its normative premises transparent whenever evaluative language enters the argument. Terms such as improvement, harm, empowerment, exclusion, justice, sustainability, resilience, capability, autonomy, participation, regeneration, and desirable generation carry normative content that should not be smuggled into a descriptive mechanism claim.

Normative transparency begins by distinguishing what the study observes from how it evaluates what is observed. A relation may generate new productive capacity while also increasing domination. A technology may expand access while weakening privacy or exit. A policy may preserve an institution while reducing the possibility of alternative forms of organization. A regenerative ecological intervention may improve biophysical conditions while distributing burdens inequitably. These cases cannot be evaluated solely by establishing that generation occurred.

The relevant evaluative principles should therefore be stated at the level needed for the claim. A study may adopt a capability perspective, a rights-based standard, a distributive criterion, a relational account of domination, a procedural standard, an ecological constraint, a plural-value framework, or another justified normative basis. GRE does not require one universal normative theory at the level of research contribution. It requires researchers to distinguish the empirical and generative analysis from the premises through which consequences are judged.

Normative transparency is equally important when a study refrains from full evaluation. Researchers may state that a mechanism increases a capability, concentrates control, or changes future options while leaving the overall justice of the arrangement unresolved. Such restraint can be more informative than forcing heterogeneous effects into a single welfare ranking.

Value plurality further requires explicit treatment of commensuration. If a study aggregates several forms of value into one index, score, monetary measure, or optimization objective, it should explain the justification and consequences of that aggregation. Practical commensuration may be necessary for decision-making without establishing that the underlying values are genuinely commensurable. A GRE contribution should preserve this distinction when it matters.

Normative transparency thus protects both positive and normative inquiry. It prevents descriptive evidence from carrying more evaluative force than it can support, while allowing ethical and political judgments to enter economic analysis openly rather than being hidden in model structure, metric selection, or outcome definition.

3.17.9 Reproducibility and Interpretive Traceability

A cumulative research programme requires other researchers to be able to reconstruct how a conclusion was produced. GRE therefore treats reproducibility and interpretive traceability as complementary standards. Their concrete form varies by method, but the underlying requirement is that the pathway from material or data to claim should remain inspectable.

For quantitative and computational work, reproducibility may involve accessible data where ethically and legally possible, documented preprocessing, variable definitions, code, model specifications, parameter choices, random seeds, robustness checks, and version information. Where data cannot be shared, the study should provide enough procedural detail to clarify what another researcher would need to reproduce the analysis under authorized access.

For qualitative, historical, and interpretive research, exact replication may be impossible or conceptually inappropriate. Interpretive traceability becomes the more suitable standard. The researcher should document source selection, coding or interpretive procedures, archival boundaries, translation choices, interview protocols, contextual assumptions, and the evidential basis for major interpretive moves. Readers should be able to distinguish the source material from the interpretation built upon it.

Formal research requires a related form of traceability. Definitions, assumptions, derivations, propositions, and the relation between formal objects and empirical interpretation should be explicit. A proof can be reproducible while its empirical meaning remains ambiguous; both layers therefore need documentation. Simulation requires the same separation between reproducibility of the computational experiment and validity of the modeled representation.

Traceability also applies to boundary and category revision. If a study changes the definition of a subject, relation, value form, or relevant system during analysis, the change should be visible. Such revision can be intellectually productive, especially in relational research where the empirical material may reveal that initial categories are inadequate. The contribution becomes stronger when readers can see why the revision occurred and how it affected the result.

These standards are not merely procedural ideals. They distribute epistemic authority. A claim whose evidential path can be inspected is easier to contest, reinterpret, update, and reuse. Reproducibility and interpretive traceability therefore support the broader GRE commitments to revisability, methodological pluralism, and re-epistemization across time.

3.17.10 Contribution to Cumulative Knowledge

A GRE contribution should clarify what becomes more knowable because of the study and how that result can enter a cumulative research programme. Novel terminology alone is insufficient. A contribution may refine a concept, establish a new typology, identify a mechanism, map a relational configuration, provide comparative evidence, develop a formal representation, test an intervention, construct a measure, document a boundary condition, falsify an earlier claim, or expose an unresolved contradiction. These are different forms of cumulative advance.

Cumulative contribution requires relation to prior work. A study should indicate

which GRE problem, concept, mechanism, or empirical domain it extends, revises, or challenges. Because GRE is an emerging programme, this relation may initially be internal to the book's preliminary constitution or to a small body of subsequent work. The standard should nevertheless be established early: later research should not repeatedly reinvent the same relational vocabulary without specifying what has changed.

Negative and limiting results are especially important. Demonstrating that a proposed generative mechanism fails under certain institutional conditions can advance the programme by specifying its scope. Showing that two indicators previously treated as proxies diverge can improve measurement. Identifying a case in which downstream generation is negligible can prevent overextension of the framework. Revealing that competing representations yield materially different conclusions can redirect theoretical development. Cumulative knowledge includes disciplined contraction as well as expansion.

A contribution should also preserve reusable analytical objects where possible. Clearly defined categories, documented datasets, mechanism diagrams, typologies, validated measures, formal models, intervention protocols, comparative cases, and explicit boundary conditions can support later synthesis. Reusability does not require standardization of every method. It requires enough conceptual and evidential continuity for results to be compared rather than remaining isolated narratives.

Cumulative knowledge in GRE is expected to remain historically revisable. Concepts adequate to one technological or institutional period may become insufficient as economic subjects, relations, infrastructures, and forms of value change. The purpose of accumulation is therefore not to build an immutable doctrinal core. It is to build a record of concepts, mechanisms, evidence, boundary conditions, disagreements, and revisions from which later inquiry can proceed with greater precision.

Taken together, the criteria in this section provide a practical threshold for recognizably GRE research. A contribution should specify the relation under study, state its scale and boundaries, articulate the generative claim, match evidence to the claim, distinguish representation from relational reality, trace relevant downstream effects, consider plausible alternative mechanisms, disclose normative premises, preserve reproducibility or interpretive traceability, and explain how the result contributes to cumulative knowledge. The criteria remain proportional to the type of inquiry, but they create a common language for criticism across heterogeneous methods.

These standards also shift Chapter 3 from disciplinary constitution toward research development. Once contributions can be evaluated individually, the next question concerns how they can accumulate across projects into a programme that develops concepts, typologies, maps, mechanisms, formal models, simulations, intervention evidence, measures, and revisions over time. The following section therefore turns from the criteria for a single GRE contribution to the architecture of a cumulative GRE research programme.

3.18 Cumulative Research Programme

The preceding section specified the standards by which an individual contribution can be recognized as part of Generative Relational Economics. A research programme, however, requires more than a sequence of individually competent studies.

It requires mechanisms through which concepts can be stabilized and revised, cases can become comparable, mechanisms can be accumulated across contexts, formal and computational representations can become reusable, interventions can generate transferable evidence, measures can be improved, and theoretical claims can contract as well as expand. The role of this section is therefore to specify how GRE can develop cumulatively without converting cumulative development into doctrinal closure. Its objective is to identify several forms of accumulation through which a still-emerging research programme can become more precise, more testable, more comparable across domains, and more corrigible over time.

Cumulative development in GRE is expected to be heterogeneous. Historical reconstruction, conceptual clarification, comparative case analysis, mechanism identification, formal modeling, simulation, intervention research, and indicator construction do not accumulate in identical ways. A concept can become more precise without becoming more universal. A mechanism can recur across cases while remaining conditional on institutional context. A formal model can improve analytical discipline without establishing empirical adequacy. An intervention can generate evidence about a relational configuration that cannot be transferred unchanged to another scale. The programme therefore needs forms of accumulation that preserve local differences while still allowing knowledge to travel.

The central commitment is that accumulation should increase the quality of future inquiry rather than merely increase the quantity of publications. A cumulative programme should make later researchers better able to distinguish objects, specify boundaries, formulate mechanisms, compare cases, identify failed expectations, construct representations, and revise earlier claims. Accumulation is therefore closely related to memory: the programme must preserve not only successful formulations but also boundary conditions, null findings, abandoned distinctions, incompatible representations, and reasons for revision. This historical record is part of the epistemic infrastructure through which GRE can remain generative without repeatedly rediscovering its own problems.

3.18.1 Conceptual Development

Conceptual development provides one of the earliest forms of cumulative work in an emerging research programme. GRE depends on terms such as relation, generativity, capacity, subject, field, orientation, propagation, conversion, foreclosure, and generative condition. These terms can guide inquiry only when their meanings become sufficiently explicit for disagreement, comparison, and revision. Conceptual development therefore concerns the progressive clarification of what a term denotes, what it excludes, how it differs from neighboring terms, which empirical indicators can bear upon it, and under what conditions the concept ceases to be useful.

Such development should proceed through distinction rather than inflation. A concept becomes stronger when researchers can identify nearby phenomena that it should not subsume. Generativity, for example, should not become a general synonym for causation, productivity, innovation, emergence, or social change. Relationality should not become a label attached to any situation containing more than one actor. Orientation should not become equivalent to intention. Power should not become interchangeable with every asymmetry. Conceptual accumulation therefore requires negative space: a concept is partly stabilized by the cases and mechanisms

that researchers agree belong elsewhere.

Conceptual development is also historical. A distinction useful in one institutional or technological period may become insufficient when the object changes. The meaning of economic subjecthood may need revision when artificial systems undertake increasingly consequential operational roles. The concept of resource may change when informational, ecological, infrastructural, or symbolic forms become central to production. The concept of value may require further differentiation when heterogeneous value forms interact without stable conversion ratios. GRE should therefore treat conceptual stabilization as provisional achievement rather than final definition.

A cumulative conceptual record should preserve successive formulations and their reasons. Later versions should make visible whether a term was broadened, narrowed, divided, or replaced. This allows conceptual disagreement to become cumulative rather than repetitive. Researchers can then ask whether a difference arises from incompatible definitions, different empirical domains, different scales, or genuinely competing theoretical commitments. Conceptual development becomes part of research infrastructure when it reduces ambiguity while preserving the possibility of revision.

3.18.2 Typology Development

Typologies allow recurrent heterogeneity to be organized without requiring reduction to a single scalar dimension. They are especially important for GRE because many objects of inquiry are structurally plural: economic subjects can differ in kind, relations can differ in direction and persistence, value can take multiple forms, generative effects can propagate through different channels, and interventions can create benefits and harms through distinct mechanisms. A typology provides a way to preserve these differences while making comparison possible.

Typology development should begin from analytically relevant distinctions rather than from the desire to populate a classificatory table. A useful typology changes what can be observed or compared. Distinguishing resource asymmetry from capability asymmetry, for example, matters because possession and effective capacity can diverge. Distinguishing relational dependence from domination matters because dependence can exist without one subject acquiring durable control over another. Distinguishing propagation, conversion, recirculation, dissipation, and extraction matters because downstream value trajectories differ even when an initial allocation is identical.

Typologies should also remain open to overlap. GRE objects are frequently multi-dimensional, and a single case can instantiate several types at once. A platform may be simultaneously an organizational actor, a field-structuring infrastructure, a representational system, and a locus of institutional power. A transfer programme can be allocative, capability-enhancing, dependency-producing, and institution-forming at different stages. Typological clarity therefore does not require exclusive membership unless exclusivity is substantively justified.

Cumulative typology development requires empirical confrontation. Categories should be revised when recurrent cases do not fit, when two categories fail to produce meaningful explanatory differences, or when one category hides internally distinct mechanisms. Cross-case work is especially important because a typology derived from one institutional context may mistake a local classification for a general

one. Typologies accumulate when their boundary conditions, empirical uses, exceptions, and revisions are recorded rather than when their labels simply proliferate.

3.18.3 Relational Mapping

Relational mapping concerns the systematic representation of economically consequential connections among subjects, institutions, resources, infrastructures, representations, capacities, and environments. The purpose is not to impose a universal network ontology. It is to make relational structure visible enough that claims about mediation, dependence, propagation, power, or generation can be examined rather than assumed.

Different research problems require different maps. A transaction map may trace flows of money or goods. An authority map may represent legal and organizational powers. A capability map may identify which relations enable access to knowledge, infrastructure, care, finance, or mobility. A representation map may show how classifications and metrics connect institutional decisions to subject positions. A temporal map may represent the order through which one relation conditions a later possibility. Ecological or supply-chain analysis may require several of these layers simultaneously.

Cumulative relational mapping depends on comparability without forced standardization. Researchers should document node definitions, relation types, temporal windows, missing-data assumptions, scale choices, and the meaning of direction or weight where these are used. When mappings from different studies cannot be directly combined, the reasons should be visible. Differences in mapping conventions can then become substantive evidence about how the object itself is differently constituted across contexts.

Relational maps can also accumulate historically. Repeated mapping can show how a configuration changes, which ties persist, which dependencies become concentrated, where new intermediaries emerge, and whether an intervention alters the topology of opportunity or control. Longitudinal mapping is particularly useful for GRE because generative claims often concern changes in the conditions from which later actions become possible. The cumulative product is not a final map of the economy, but a set of documented representations that can be compared, revised, and linked to mechanism claims.

3.18.4 Mechanism Identification

Mechanism identification provides a central bridge between relational description and generative explanation. GRE is concerned not only with whether two conditions are associated, but with how a relation contributes to the production, reproduction, transformation, or foreclosure of later capacities and possibilities. A cumulative programme therefore needs recurrent mechanism families that can be investigated across settings without assuming that the same mechanism operates universally.

Mechanisms may involve resource access, learning, coordination, institutional recognition, bargaining leverage, infrastructural dependence, feedback, expectation formation, classification, imitation, exclusion, risk transfer, ecological regeneration, or many other processes. What makes such a process a useful GRE mechanism is not its novelty of name but its role in connecting a relational configuration to a

downstream change. The mechanism should specify intermediate transformations sufficiently clearly that evidence can support, weaken, or reject the claim.

Cumulative mechanism work benefits from decomposition. A broad claim that an intervention “builds capability” may contain several distinct processes: it may increase material resources, reduce uncertainty, create social recognition, provide technical knowledge, alter institutional eligibility, or change expectations about future access. Disaggregating these processes allows later studies to test whether the same downstream effect arises through different mechanisms or whether similar interventions produce different outcomes because only some mechanism components are present.

Mechanism accumulation should therefore include enabling conditions, inhibiting conditions, competing mechanisms, and failure modes. A mechanism that appears robust in one setting may depend on trust, legal enforceability, technological infrastructure, social norms, or complementary public goods. Recording these conditions turns isolated explanations into a comparative mechanism library. Such a library remains revisable and context-sensitive, but it gives later researchers a stronger starting point than an undifferentiated appeal to relational complexity.

3.18.5 Comparative Case Accumulation

Cases become cumulative when they are documented in ways that permit meaningful comparison. GRE therefore requires comparative case accumulation rather than a collection of richly described but analytically disconnected examples. The purpose of comparison is not necessarily to produce universal laws. It can identify recurring relational configurations, clarify boundary conditions, distinguish mechanisms, reveal alternative pathways, and show how similar interventions generate different outcomes under different institutional or historical conditions.

Comparison can be organized around cases, mechanisms, trajectories, scales, or interventions. Two regions may receive similar infrastructure investments yet generate different capability effects because institutional access differs. Two platforms may use similar algorithms but create different labor dependencies because ownership and exit options differ. Two ecological restoration projects may produce comparable short-term outputs while diverging in long-run regenerative capacity. A comparative design becomes especially informative when the axis of comparison corresponds to a plausible mechanism difference.

Cumulative case repositories should therefore preserve more than outcome variables. They should record relational boundaries, subject categories, institutional context, temporal horizon, intervention history, relevant value forms, and evidential limitations. Standardized metadata can help without forcing all cases into identical theoretical categories. The aim is to make later synthesis possible while retaining the contextual features through which generative mechanisms may differ.

Negative and anomalous cases are particularly valuable. A case in which a predicted mechanism fails can identify a missing enabling condition or expose an overgeneralized concept. A case that produces an unexpected downstream effect can reveal a propagation channel absent from the original theory. A cumulative programme should therefore preserve cases that resist prevailing formulations rather than treating them as noise to be excluded from the archive.

3.18.6 Formal Model Development

Formal models can contribute cumulative value by making assumptions, relations, and implications explicit. In GRE, formalization may represent dynamics, networks, allocation processes, bargaining relations, value conversion, capability change, field-like influence, institutional rules, or recursive transformations of generative conditions. The purpose is analytical discipline rather than formalization for its own sake.

A cumulative formal programme should preserve model lineage. Later models should indicate which assumptions are inherited, relaxed, extended, or replaced. If one model treats subject identities as fixed while another allows subject formation, the difference should be explicit. If one model uses scalar value while another represents plural value dimensions, the comparison should identify what explanatory capacity is gained and what tractability is lost. Formal accumulation then becomes a sequence of interpretable modifications rather than a disconnected set of mathematical constructions.

Model families can also help identify which conclusions depend on which assumptions. Robustness across several formal representations strengthens confidence that a result reflects a structural feature rather than an artifact of one specification. Divergence across models can be equally informative when it reveals sensitivity to boundary conditions, topology, time horizon, or behavioral assumptions. GRE should therefore treat model disagreement as a source of theoretical information rather than merely as a problem to be eliminated.

Formal development remains subject to ontological suspension. A model can establish the consequences of stated relations without proving that the empirical economy possesses the model's ontology. Cumulative formal progress therefore requires empirical interpretation and clear links to the concepts or mechanisms represented. Reusable models, documented assumptions, and transparent derivations can become infrastructure for later studies even when empirical validation remains partial.

3.18.7 Simulation and Computational Exploration

Simulation and computational exploration extend formal development when analytic solutions are unavailable, when interaction structures are heterogeneous, or when researchers want to examine the consequences of alternative rules and parameter regimes. GRE can use agent-based models, network simulations, dynamical systems, optimization procedures, synthetic populations, and other computational methods to explore how local relations may generate larger-scale patterns.

Cumulative computational work requires reproducible experimental design. Code, parameter ranges, initialization procedures, random seeds, stopping rules, and output measures should be documented where possible. More importantly, the relation between computational objects and theoretical concepts should remain explicit. A simulated agent may represent a household, firm, algorithm, institution, or abstract decision unit, but that mapping is a modeling choice rather than an ontological fact.

Computational exploration can support cumulative knowledge by identifying candidate mechanisms, sensitivity regions, threshold behavior, path dependence, or unexpected interactions. It can also help discriminate among theories by showing that some verbal mechanism claims are insufficient to generate the observed pattern under plausible assumptions. Such findings remain conditional on the model, but they

can direct empirical work toward the variables and relations most likely to matter.

Simulation results should accumulate together with failed parameterizations and negative results where feasible. If a proposed mechanism produces a target pattern only under implausibly narrow conditions, that fact is theoretically relevant. Computational archives can therefore preserve the history of model development, including abandoned specifications, so that later researchers can distinguish genuine theoretical progress from repeated rediscovery of previously rejected configurations.

3.18.8 Intervention Evidence

Interventions provide a distinctive source of evidence because they modify the relational configuration under study. Policy changes, institutional reforms, experimental programmes, platform redesigns, governance mechanisms, public investments, organizational changes, and community initiatives can reveal how relations respond when constraints or enabling conditions are altered. GRE treats such evidence cautiously because intervention effects can be path-dependent, scale-specific, and entangled with adaptation.

A cumulative intervention programme should document design, implementation, context, immediate outputs, downstream effects, unintended consequences, and later structural changes. Evidence about failure is as important as evidence about success. An intervention that produces an initial benefit but creates long-term dependency contributes different knowledge from an intervention whose effects persist after external support is withdrawn. An intervention that changes institutional recognition without altering material capacity reveals a different mechanism from one that changes both.

Intervention evidence also benefits from variation in intensity, timing, sequence, and institutional setting. Comparative intervention research can identify whether an effect depends on complementary relations, threshold conditions, or prior histories. Where randomized or quasi-experimental identification is possible, it can strengthen causal claims. Where it is not, careful process tracing, comparative design, and longitudinal evidence can still contribute to mechanism understanding if the limits of attribution are explicit.

Cumulative praxis requires preserving correction histories. Researchers should record when an intervention was modified, suspended, reversed, or repaired and why. These histories provide evidence about the adaptability of both the intervention and the governing institutions. They also help later researchers understand which apparent outcomes were produced by the initial design and which emerged through iterative revision.

3.18.9 Measure and Indicator Development

Measures and indicators allow recurrent GRE concepts to become empirically tractable, but measurement should follow conceptual clarification rather than substitute for it. Possible GRE measures may concern relational dependence, capability access, exit conditions, propagation, concentration of generative control, value conversion, institutional recognition, ecological capacity, or forms of generative foreclosure. Each indicator compresses a more complex concept and therefore requires explicit justification.

Cumulative indicator development should include validity, reliability, sensitivity, and domain restrictions. An indicator useful in one institutional setting may fail elsewhere because the same observable carries a different relational meaning. A measure of platform dependence based on revenue concentration may miss infrastructural lock-in. A measure of capability based on resource possession may ignore conversion constraints. A measure of generativity based on output growth may overlook depletion of future enabling conditions. Indicator accumulation therefore depends on comparison with alternative measures and on documented cases where the proxy fails.

Composite indices require particular caution. Combining heterogeneous value dimensions into one score can aid communication or decision-making, but the weighting rule performs substantive evaluative work. GRE should distinguish between an index created for practical coordination and a claim that the underlying values are intrinsically commensurable. Sensitivity analysis can show how rankings or conclusions change under alternative weighting schemes.

A mature cumulative programme can maintain indicator families rather than seeking one universal GRE metric. Different measures may be appropriate for different objects, scales, and purposes. The cumulative goal is not metric unification but increasing clarity about what each measure captures, what it omits, and how it relates to the generative claim being tested.

3.18.10 Theory Revision

Theory revision completes the cumulative architecture because accumulation without revision would convert GRE into a repository of additions rather than a research programme. Concepts, typologies, mechanisms, models, indicators, and intervention assumptions should all remain revisable when evidence, comparison, formal analysis, or historical transformation shows that earlier formulations are inadequate.

Revision can take several forms. A concept can be narrowed because it was applied too broadly. A typology can be divided because one category contains distinct mechanisms. A mechanism can be reclassified as conditional rather than general. A formal model can replace a fixed parameter with an evolving relation. An indicator can be abandoned because it tracks a proxy rather than the target concept. A normative criterion can be separated from an empirical one when the two were previously conflated. Revision is cumulative when the reason for change is documented and the consequences for earlier findings are made visible.

GRE should also preserve superseded formulations. Historical traceability allows later researchers to understand why a theory changed and whether an earlier version may still be useful in a restricted domain. Erasing theoretical history would make apparent progress difficult to evaluate because researchers could not distinguish genuine correction from terminological replacement.

Theory revision may also be triggered by transformations in the object of inquiry. New technologies, institutional forms, ecological conditions, legal arrangements, or types of economic subject can make previously adequate categories insufficient. A research programme committed to historical dependence should expect some of its own concepts to age. Revisability is therefore not a weakness added to GRE from outside; it follows directly from the claim that economic relations and their generative conditions are historically transformable.

Taken together, the ten forms of accumulation described in this section define a research programme that can grow without equating growth with theoretical expansion. Conceptual clarification can narrow terms. Typologies can remove distinctions that fail empirically. Comparative cases can reveal boundary conditions. Mechanism research can reject attractive explanations. Formal and computational work can expose contradictions. Intervention evidence can show that a promising design generates harmful dependencies. Indicators can be retired. Theory can contract. Cumulative development is therefore the organized capacity to preserve, compare, test, reuse, and revise knowledge across heterogeneous forms of inquiry.

This cumulative architecture also prepares an important disciplinary problem. As GRE develops, researchers will not necessarily converge on one ontology, one preferred method, one formal representation, one account of value, or one definition of generativity. A cumulative programme therefore requires a way to distinguish productive internal plurality from conceptual fragmentation. The following section turns to internal pluralism and competing formulations, asking how divergent approaches can coexist, criticize one another, and become comparable without forcing premature theoretical unification.

3.19 Internal Pluralism and Competing Formulations

The preceding sections have progressively specified the identity, objects, scales, questions, epistemic commitments, praxis, normative interfaces, power problems, contribution standards, and cumulative structure of Generative Relational Economics. A cumulative research programme, however, cannot remain open merely by permitting new topics to be added. It must also preserve the possibility that several incompatible or partially incompatible formulations of the same problem coexist long enough to be compared, criticized, revised, and sometimes rejected. The role of this section is therefore to specify the place of internal pluralism within GRE. Its objective is to distinguish productive plurality from conceptual indeterminacy: GRE can sustain multiple ontologies, methods, formalisms, evidential strategies, value representations, and accounts of generativity without treating every formulation as equally adequate or every disagreement as irreducible.

Internal pluralism follows from the programme's earlier commitments. Ontological suspension limits the authority of any single representational scheme. Methodological pluralism recognizes that different research questions warrant different modes of access. Heterogeneous subjects and values make premature commensuration hazardous. Scale-relative entityhood means that the same economic configuration can be represented differently at different analytical resolutions. The cumulative programme further requires that alternative formulations remain visible so later work can determine which distinctions travel across contexts, which mechanisms recur, and which representations fail. Pluralism is therefore not an exception to GRE's constitution. It is one of the conditions under which the programme can remain corrigible.

Pluralism nevertheless requires discipline. A research programme becomes weak if incompatible claims are retained merely because they use different vocabularies. It also becomes weak if every disagreement is redescribed as a matter of perspective before empirical or conceptual comparison has occurred. GRE should therefore

distinguish plurality of representation from incompatibility of prediction, plurality of method from contradiction in evidence, plurality of value from inconsistency in stated normative commitments, and plurality of ontology from unrestricted metaphysical permissiveness. Competing formulations become productive when their objects, boundaries, assumptions, inferential claims, and failure conditions can be made sufficiently explicit for comparison.

3.19.1 Ontological Pluralism

Ontological pluralism in GRE begins from the recognition that economic inquiry can require several kinds of object-description. A firm can be represented as a legal person, an organization, a nexus of contracts, a hierarchy of authority, a network of relations, a bundle of capabilities, an institutionalized process, or a temporally persistent configuration. These descriptions do not necessarily refer to different empirical worlds. They select different features of the same or overlapping configurations for different analytical purposes.

The earlier principle of ontological suspension therefore does not prohibit ontological language. It restricts the movement from analytical usefulness to ultimate metaphysical commitment. GRE can state that a corporation is treated as an economic subject in one analysis, a relational configuration in another, and an institutional field component in a third. Each formulation must explain what distinctions it preserves, what mechanisms it makes visible, and what questions it suppresses. Ontological pluralism is legitimate when alternative object-descriptions improve inquiry without being silently conflated.

This plurality becomes especially important when objects change historically. A category that functions as a relatively stable entity during one period may later require decomposition because its internal relations become explanatory. Conversely, a dense set of relations may become sufficiently stabilized that entity-level treatment is efficient and empirically adequate. GRE therefore permits movement between entity-centered and relational descriptions as the problem changes. The choice is governed by explanatory and evidential adequacy rather than by a requirement that one level possess permanent ontological priority.

Ontological pluralism does not imply that every proposed object deserves equal standing. Some entities may be administratively convenient yet analytically misleading. Some relational categories may be too broad to identify mechanisms. Some field descriptions may erase important discontinuities. Some claims of emergence may simply rename aggregation. Competing ontological formulations should therefore be assessed by the empirical distinctions they sustain, the mechanisms they clarify, the observations they organize, and the errors they make possible to detect.

A plural programme can also contain genuine ontological disagreement. Researchers may disagree about whether a particular social fact should be treated primarily as an emergent property, an institutional rule, a represented category, a distributed relation, or a relatively autonomous object. GRE need not resolve such disagreements through constitutional fiat. It should require the competing formulations to state their consequences. If two ontologies generate indistinguishable descriptions, predictions, or interpretations for the relevant problem, the dispute may remain underdetermined. If they imply different observations, interventions, or normative diagnoses, the disagreement becomes a substantive research question.

3.19.2 Methodological Pluralism

Methodological pluralism concerns the coexistence of different strategies for producing warranted claims. GRE admits historical, interpretive, qualitative, quantitative, causal, comparative, formal, computational, and intervention-oriented inquiry because its objects can be only partially accessible through any single mode. The justification for plurality is therefore epistemic rather than diplomatic. Different methods disclose different aspects of relational and generative processes.

A historical reconstruction can identify how categories, institutions, or subject positions came to exist. Ethnographic or interpretive work can reveal meanings, tacit practices, and situated understandings that are unavailable in administrative data. Quantitative analysis can estimate distributions, associations, heterogeneity, and temporal regularities at scales difficult to observe directly. Causal designs can test specific intervention or mechanism claims under stated assumptions. Formal models can expose logical consequences and structural possibilities. Computational models can explore high-dimensional, adaptive, or path-dependent systems. None of these capacities automatically contains the others.

Methodological pluralism therefore requires claim-method matching. A computational simulation cannot by itself establish that its mechanism generated an observed historical outcome. A historical narrative cannot by itself estimate the magnitude of a population-level effect. A statistically identified average treatment effect may not explain the meanings through which the treatment was received or the institutional conditions through which it propagated. An interpretive account may clarify subject formation while leaving distributional prevalence unresolved. The value of a method depends on the claim it is used to warrant.

Pluralism also permits methodological competition. Two studies can approach the same generative claim through different designs and produce conflicting evidence. Such conflict should not be resolved automatically by a fixed hierarchy of methods. The programme should examine differences in population, scale, measurement, boundary selection, intervention timing, model specification, and inferential target. Sometimes one method will expose a limitation in another. Sometimes the disagreement will reveal that the original theoretical claim was underspecified.

The strongest form of methodological pluralism is therefore cumulative correction. Methods become mutually informative when they identify each other's blind spots and help refine the target of inquiry. GRE does not require every project to use mixed methods. It requires the programme as a whole to remain open to correction from methods capable of observing dimensions that another approach leaves unresolved.

3.19.3 Formal Pluralism

Formal pluralism extends the same principle to mathematical and computational representation. GRE has inherited resources from dynamical systems, complexity theory, network science, higher-order and multilayer representations, field formalisms, information theory, computation, and simulation. These formalisms organize different kinds of structure. A dynamical system emphasizes state, trajectory, stability, and transformation through time. A network emphasizes patterned relations among identifiable nodes. A higher-order representation can make irreducibly multi-actor interactions explicit. A field representation can describe distributed conditions that vary

across a domain. Agent-based or computational models can explore local rules, heterogeneity, and emergent aggregate behavior.

GRE therefore has no constitutional reason to privilege one formal language as the universal representation of economic relations. Formal choice should follow the structure of the research problem. A model of propagation through contractual dependencies may be naturally network-based. A problem concerning distributed accessibility or exposure may be represented more effectively through a field. A question about transition between regimes may require dynamical analysis. A question about heterogeneous adaptive actors may benefit from simulation. Several representations may be needed for the same empirical system.

Formal pluralism also protects the programme from a recurrent category error: mathematical elegance should not be mistaken for ontological authority. Two mathematically distinct representations can sometimes encode the same empirically relevant relation. Conversely, one formalism can fit several empirical situations whose mechanisms differ. Formal equivalence, approximation, simulation, or mapping therefore needs to be distinguished from substantive equivalence of the represented processes.

Competing formalisms should be compared through their assumptions, representational losses, empirical accessibility, computational tractability, and consequences for inference. A more complex formalism is not necessarily better. Additional dimensions, layers, parameters, or interacting fields can increase expressiveness while reducing identifiability. A simpler model can be preferable when its omissions are explicit and its inferential target is narrow. Formal pluralism is productive when representational choice remains accountable to evidence and purpose.

3.19.4 Quantitative and Qualitative Approaches

Quantitative and qualitative approaches often differ in data structure, inferential form, sampling logic, and the kinds of uncertainty they make visible. GRE treats these differences as analytically important rather than as a division between rigorous and non-rigorous inquiry. Quantitative work can establish patterns across large populations, estimate magnitudes, compare distributions, and model temporal or relational structures. Qualitative work can reconstruct meaning, institutional practice, local causal process, category formation, tacit knowledge, and the situated experience through which economic relations become operative.

The distinction is particularly important for generative analysis. A downstream effect can be quantitatively measurable while its mechanism remains poorly understood. Conversely, an interactional mechanism can be richly documented in a small number of cases while its prevalence, distribution, or aggregate contribution remains uncertain. GRE should therefore resist converting one form of evidence into claims warranted only by the other.

Mixed designs can be valuable when the forms of evidence address complementary parts of the same generative claim. A qualitative study can help identify mechanisms, categories, or boundary conditions that later quantitative work tests across cases. Quantitative anomalies can direct qualitative inquiry toward previously invisible heterogeneity. Administrative or network data can identify patterns of propagation, while interviews or archival evidence reveal why particular pathways existed. Such integration should be designed around a shared research problem rather than

around the ceremonial inclusion of multiple methods.

Qualitative and quantitative approaches can also disagree productively about the object itself. A variable that appears stable in a dataset may combine historically different institutional meanings. A locally salient category may have no reliable population-level measure. A statistically robust association may depend on classifications whose social production requires separate analysis. GRE's relational commitments make these disagreements substantive because measurement categories can participate in the relations they represent.

The programme therefore treats quantitative and qualitative approaches as mutually corrective without requiring symmetry in every project. The relevant question is which claims remain unsupported when only one form of evidence is available and whether the resulting limitation materially changes the argument.

3.19.5 Causal and Interpretive Approaches

Causal and interpretive approaches address different but frequently intersecting questions. Causal inquiry asks whether and through what mechanisms a change in one condition contributes to a change in another under specified assumptions. Interpretive inquiry asks how actors, institutions, representations, and practices acquire meaning within a situated historical and relational context. GRE requires both because economic relations can operate through mechanisms whose effectiveness depends on interpretation.

A legal classification, price signal, credential, ranking, or algorithmic recommendation can alter behavior partly because subjects recognize, contest, trust, misunderstand, or strategically use what the representation means. In such cases, interpretation is not merely commentary after causal analysis. It can be part of the causal mechanism. At the same time, the existence of meaning does not establish the magnitude or distribution of its effects. Interpretive adequacy and causal identification remain distinct epistemic achievements.

The same distinction applies to subject formation. Researchers may interpret how a worker, consumer, creditor, beneficiary, or platform participant is institutionally constituted and how that subject position is experienced. A causal study may then examine whether entering that position changes behavior, income, access, or later opportunities. The two analyses can support each other without collapsing into a single method.

Competing causal and interpretive accounts become especially useful when they disagree about where the mechanism lies. A causal model may attribute an effect to incentives, while interpretive evidence suggests that the intervention changed recognition, legitimacy, or perceived obligation. Rather than treating one vocabulary as necessarily deeper, GRE should ask what observable consequences follow from the alternative mechanism accounts and whether both processes operate at different stages or scales.

Causal and interpretive pluralism therefore requires translation without reduction. Researchers should state when an interpretive category enters a causal model, how it is observed, and what is lost in operationalization. Conversely, causal evidence can constrain interpretations by showing that a proposed meaning-making mechanism does not produce the expected distributional or temporal pattern. Productive integration occurs when each approach can expose conditions under which the other's

claims fail.

3.19.6 Network and Field Representations

Network and field representations provide a concrete example of formal pluralism because they organize relational structure differently. A network begins from distinguishable nodes and relations among them. It is well suited to questions concerning adjacency, centrality, brokerage, diffusion, dependence, multilayer connectivity, and evolving topology. A field representation describes conditions distributed across a domain and can be useful when influence, accessibility, exposure, salience, or constraint varies continuously or when pairwise ties provide an incomplete description.

These representations can overlap without being interchangeable. A network of financial obligations can identify who depends directly or indirectly on whom. A field representation may instead characterize how liquidity conditions, regulatory exposure, information availability, or market accessibility vary across positions. The network makes discrete relational pathways explicit; the field can make distributed background conditions visible. A system can contain both.

Choice between network and field representation should therefore follow the mechanism. If transmission occurs through identifiable connections, a network may be the natural first representation. If subjects respond to a spatially, institutionally, or symbolically distributed condition, a field can be more informative. Some problems require hybrid representations in which nodes and edges evolve within fields that also respond to network activity.

The competing representations can generate different intuitions about intervention. Network analysis may suggest altering connections, central nodes, or dependency pathways. Field analysis may suggest changing distributed conditions that shape many interactions simultaneously. GRE should not infer that one intervention is superior from the representation alone. The empirical question is which representation captures the mechanisms through which the relevant generative effects actually propagate.

The plurality also reinforces ontological suspension. Network nodes need not be ultimate entities, and fields need not be literal physical fields. Both are representational devices whose adequacy depends on what they permit researchers to observe, explain, predict, or intervene upon.

3.19.7 Scalar and Non-Scalar Value Representations

Value presents a particularly consequential case of internal pluralism. Some economic questions require scalar representation. Prices, costs, quantities, income, expected returns, or index values can support comparison, optimization, aggregation, and accounting. Other forms of value resist stable reduction to one dimension because they involve heterogeneous goods, rights, relationships, capabilities, ecological conditions, meanings, or obligations whose trade-offs are context-dependent or normatively contested.

GRE therefore permits scalar and non-scalar representations of value. The choice must be justified by the evaluative task. A scalar representation can be useful when a common unit is institutionally established, empirically meaningful, and relevant to the question. It becomes misleading when the numerical scale hides changes in what

is being valued, who has authority to define the conversion, or which losses cannot be represented adequately by the chosen unit.

Non-scalar representation can preserve plurality through vectors, partial orderings, categorical distinctions, threshold conditions, lexicographic priorities, narrative evaluation, or explicit statements of incommensurability. Such representations do not eliminate the need for decisions. Institutions frequently must act even when values cannot be reduced to a common metric. The analytical task is to distinguish practical commensuration from demonstrated commensurability and to make visible who establishes the conversion rules.

Competing value representations can lead to different judgments about the same intervention. A project may generate positive monetary returns while degrading ecological resilience, increasing dependency, or reducing future option sets. A multi-dimensional representation can reveal this divergence. Conversely, retaining every value dimension without prioritization can make decision procedures indeterminate. GRE therefore treats value representation as part of the problem rather than assuming that either scalarization or irreducible plurality is universally preferable.

Comparison among value representations should examine what each includes, excludes, weights, converts, and renders visible. It should also ask how the representation itself affects institutional action. An indicator that becomes a target can reorganize behavior; a price can alter the relation it measures; a ranking can generate new incentives and subject positions. Value representation is therefore both epistemic and potentially generative.

3.19.8 Competing Accounts of Generativity

Generativity is the organizing concept most likely to produce internal theoretical disagreement within GRE. The term can refer to several related but distinct phenomena: production of downstream capacities, emergence of new entities or relations, transformation of subject positions, expansion or contraction of future possibilities, creation of new value forms, alteration of institutional pathways, or modification of the effective rules through which later change occurs. These processes can coexist, but they should not be treated as interchangeable by definition.

One account of generativity may emphasize the creation of capacities. Another may focus on the reproduction and transformation of relational structures. A third may treat generativity primarily as alteration of future possibility spaces. A fourth may emphasize recursive change in the mechanisms that produce subsequent outcomes. GRE should allow these accounts to compete because their differences can clarify what exactly is claimed to be generated.

Competing accounts should state their unit of analysis, temporal horizon, baseline, mechanism, and observable consequences. A claim that a relation generates capability requires evidence different from a claim that it generates institutional persistence. A claim that an intervention expands future possibility requires a specification of whose possibilities, over what horizon, under which constraints, and relative to which counterfactual or historical baseline. A claim that a rule transforms its own conditions of reproduction requires evidence beyond ordinary downstream effects.

The programme should also permit the possibility that generativity is not a single natural kind. Different domains may contain several mechanisms that share a family resemblance but cannot be reduced to one formal definition. In that case, cumulative

research should develop a typology of generative mechanisms rather than force premature unification. Conversely, if apparently different mechanisms can be shown to instantiate a common structure, theory can become more parsimonious.

Internal competition around generativity is therefore desirable when it increases discriminability. A successful formulation should make it easier to determine when a process is merely productive, causal, adaptive, or reproductive and when a stronger generative claim is warranted. The concept becomes weaker when it absorbs every form of change and stronger when competing accounts specify different empirical commitments.

3.19.9 Productive Disagreement

A plural research programme depends on disagreement that can change what researchers subsequently do. Productive disagreement is therefore more demanding than the coexistence of opinions. It requires disagreement to be localized sufficiently that evidence, argument, or comparison can alter the standing of competing claims.

Researchers can disagree about concepts, boundaries, mechanisms, measurements, formal representations, empirical generalization, normative premises, or intervention implications. These forms of disagreement should be distinguished because they require different responses. A definitional disagreement may be resolved through conceptual clarification. A measurement disagreement requires validity evidence. A mechanism disagreement may require process tracing, experiments, comparative cases, or temporal data. A normative disagreement may persist even after empirical questions are settled because the disagreement concerns values or justificatory principles.

Productive disagreement also requires preserving losing formulations long enough to understand why they failed. If a model is rejected because its mechanism does not fit observed timing, that reason should become part of programme memory. If a concept is narrowed because it collapsed several distinct phenomena, the earlier broader usage should remain traceable. If two formulations apply at different scales, the outcome is not necessarily victory of one over the other but clarification of boundary conditions.

Disagreement becomes unproductive when formulations shift whenever evidence challenges them, when different vocabularies hide identical claims, when claims are insulated from possible counterevidence, or when normative and empirical disagreements are repeatedly confused. A plural programme therefore needs conventions for making commitments explicit enough that revision is possible.

The social organization of disagreement also matters. Dominant institutions, disciplines, languages, data infrastructures, or publication norms can determine which formulations are visible enough to be contested. GRE's own commitment to pluralism therefore includes attention to the conditions under which alternative formulations can enter the research programme. Inclusion of alternatives, however, does not suspend standards of evidence or argument. Productive pluralism widens the space of contestation while preserving the possibility of criticism.

3.19.10 Conditions for Theory Comparison

Internal pluralism becomes cumulative only when competing formulations can be compared under explicit conditions. Theory comparison in GRE should therefore begin by determining whether the formulations address the same object, scale, temporal horizon, and inferential target. Apparent disagreement can disappear once researchers recognize that one theory describes short-run adjustment while another describes long-run institutional transformation, or that one concerns individual behavior while another concerns field-level conditions.

Where the targets overlap, comparison should examine at least six dimensions: conceptual clarity, empirical scope, mechanism specification, evidential support, representational cost, and capacity for revision. Conceptual clarity concerns whether the theory distinguishes its principal objects and mechanisms from neighboring concepts. Empirical scope concerns the domains and boundary conditions within which the theory is expected to apply. Mechanism specification concerns what processes connect conditions to outcomes. Evidential support concerns whether available observations discriminate the theory from alternatives. Representational cost concerns the assumptions, data, computation, and abstraction required to use the formulation. Capacity for revision concerns whether failure can lead to identifiable modification rather than indefinite accommodation.

Predictive accuracy can be important but should not become the sole criterion. Some GRE problems concern historical explanation, interpretation, institutional constitution, normative evaluation, or intervention design where prediction is only one dimension of adequacy. Conversely, conceptual richness should not excuse a formulation from empirical consequences when it makes empirical claims. The criteria for comparison should therefore track the kind of contribution being evaluated.

Theories can also be compared by their generative usefulness for further research. A formulation can be valuable because it produces new measurable distinctions, suggests discriminating cases, clarifies a previously vague mechanism, or exposes a class of interventions whose consequences can be studied. Such usefulness does not establish truth, but it can justify continued investigation when direct adjudication remains incomplete.

Some competing formulations may remain partially incommensurable because they begin from different objects, values, or explanatory purposes. GRE should not manufacture a single ranking when the comparison lacks a common criterion. It should instead identify the dimensions on which comparison is possible and preserve the residual disagreement. Partial comparability is preferable to either false unification or premature declaration of complete incommensurability.

The constitutional role of internal pluralism can therefore be stated compactly. GRE should remain open to multiple formulations while requiring each formulation to expose enough of its objects, assumptions, mechanisms, evidence, values, and failure conditions to permit criticism. Pluralism protects the programme from premature closure; theory comparison protects it from indiscriminate accumulation. Together they allow disagreement to become part of cumulative inquiry.

The existence of a plural and revisable research programme also means that several difficult questions remain unresolved even after its disciplinary constitution has been specified. The following section turns from the permitted diversity of formulations to the substantive open problems that future GRE research must address.

3.20 Open Problems

The preceding sections have specified the preliminary identity, objects, scales, modes of inquiry, epistemic commitments, praxis, normative interfaces, contribution standards, cumulative structure, and internal pluralism of Generative Relational Economics. A research programme becomes more credible, however, when its unresolved problems are stated with comparable precision. The role of this section is therefore to identify several problems that remain open after the current constitution of GRE has been articulated. Its objective is neither to close those problems through definition nor to convert uncertainty into a rhetorical virtue. The aim is to distinguish questions for which GRE already has an analytical vocabulary from questions for which the mechanisms, measurements, evidential strategies, or normative criteria remain materially underdeveloped.

The open problems considered here concern identification, attribution, measurement, boundary selection, changing transformation rules, heterogeneous value, justice, symbolic reification, governance under persistent asymmetry, and long-horizon evaluation. These problems are connected, but they should not be collapsed. Better identification of a generative relation does not by itself solve downstream value attribution. A useful indicator of generativity does not establish normative desirability. A formally specified transformation rule does not guarantee that the relevant rule remains stable through the period being studied. A governance mechanism that mitigates one asymmetry can create another. The purpose of separating the problems is therefore to make future progress discriminable.

Open problems also differ in the kind of resolution they permit. Some may yield to better data, identification strategies, historical reconstruction, or formal representation. Others arise because economic relations are reflexive, boundaries are purpose-dependent, values are only partially comparable, and future possibilities cannot be observed before they are realized. GRE should therefore allow for the possibility that some uncertainty can be reduced while other uncertainty remains structural to the object of inquiry. A mature research programme needs both ambitions: to improve what can be known and to specify what remains underdetermined.

3.20.1 Identification of Generative Relations

The first open problem concerns the identification of generative relations. GRE frequently asks whether a relation contributes to the production of later capacities, institutions, subject positions, value forms, or conditions of possibility. Such claims are stronger than statements that two variables covary or that one event precedes another. They also exceed the observation that a relation participates in ordinary causal production. A relation becomes generatively relevant when its operation changes what can subsequently be produced, sustained, accessed, recognized, or transformed. The empirical difficulty lies in demonstrating that stronger claim.

Identification requires a specification of the relation, the object said to be generated, the time horizon over which generation occurs, and the mechanism that connects them. These elements can be difficult to observe simultaneously. Some relations operate through repeated interaction rather than singular events. Some produce latent capacities that become visible only when later conditions activate them. Some operate through institutional recognition or symbolic classification rather than

directly observable material transfer. Some are distributed across several actors or infrastructures, making bilateral attribution misleading.

A further difficulty is that generative relations may be constitutive rather than merely productive. A worker's access to a professional network, for example, can affect opportunities while also contributing to the formation of recognized expertise, identity, or standing. A credit relation can transfer purchasing capacity while simultaneously generating dependency, reputational records, or future exclusion. In such cases the relation changes properties of the participating subjects and the environment in which later action occurs. Identification must therefore distinguish immediate output from transformation of later possibility.

Progress on this problem will require multiple forms of evidence. Longitudinal observation can reveal whether capacities persist beyond the originating relation. Comparative cases can test whether similar relational configurations produce similar downstream structures under different contexts. Process tracing can identify intermediate mechanisms. Experiments or quasi-experiments can help isolate particular pathways when intervention is possible. Formal or computational models can clarify what observations would discriminate generative mechanisms from ordinary transmission. Interpretive evidence can be necessary when generation operates through meaning, recognition, or institutional classification.

No single identification strategy is likely to cover the full range of GRE objects. The open task is therefore to develop a disciplined family of identification standards. Such standards should make it possible to distinguish a plausible generative hypothesis from a demonstrated mechanism, and a demonstrated local mechanism from a general claim about generativity across contexts.

3.20.2 Attribution of Downstream Value

A second open problem concerns attribution once value has propagated beyond an initial relation or intervention. Economic processes commonly produce effects through chains of mediation. Training can alter later employment, organizational practice, peer learning, and household security. Infrastructure can generate uses that were not anticipated by its designers. Knowledge can be recombined by actors distant from its original producer. Institutional reforms can change incentives, expectations, classifications, and later policy capacities. GRE needs ways to analyze such downstream value without converting every remote benefit into a claim of credit for the initial source.

Attribution becomes difficult because downstream effects are usually co-produced. Later value can depend on complementary resources, independent decisions, institutional environments, accumulated knowledge, ecological conditions, and subsequent interventions. A generative relation can be necessary without being sufficient. It can raise the probability of an outcome without determining it. It can create an enabling condition whose significance varies strongly across contexts. A later actor can transform an inherited resource so substantially that simple origin-based attribution becomes conceptually misleading.

The problem therefore has at least three dimensions. Causal attribution asks whether the earlier relation materially contributed to the later outcome. generative attribution asks whether it altered the conditions from which later value could emerge. Distributive attribution asks how recognition, return, responsibility, or

claims on value should be allocated among contributors. These dimensions should remain distinct because evidence for causal contribution does not settle the distributive question, and normative entitlement cannot be inferred directly from causal ancestry.

Future GRE work requires methods for tracing contribution without assuming additive decomposition. In some domains, contribution analysis may be approximately scalar. In others, interaction effects, complementarities, threshold behavior, or non-substitutable roles make scalar shares unstable or arbitrary. Network and process representations may help locate pathways without requiring a single attribution percentage. Counterfactual analysis can identify whether a contribution changed the set of feasible trajectories. Historical reconstruction can reveal how later actors transformed inherited conditions.

The objective should therefore be calibrated attribution. GRE should become better at saying that an upstream relation enabled, constrained, amplified, redirected, or conditioned later value while preserving uncertainty about the exact share attributable to that relation. Such calibrated language is important both for explanation and for later questions of return, compensation, responsibility, and justice.

3.20.3 Measurement of Generativity

The measurement of generativity presents a related but distinct problem. The concept is attractive because it directs attention toward effects on later productive and transformative possibilities. Yet the concept can become analytically weak if every beneficial downstream effect is redescribed as generativity. Measurement therefore requires a more discriminating account of what is being measured and at which scale.

Several candidate dimensions are possible. One study may measure new capabilities acquired by participants. Another may measure the diversity of subsequent activities enabled by an intervention. A third may examine persistence of effects after direct support ends. A fourth may study whether new actors can enter a domain, whether dependence on a central provider declines, or whether local reproduction becomes possible. A fifth may examine changes in the range of feasible future states. These measures capture different aspects of generativity and should not automatically be aggregated.

The temporal horizon also changes the result. An intervention can generate high short-run activity while degrading future ecological or institutional capacity. Another can impose substantial near-term cost while creating durable infrastructure or knowledge. A third can generate options that remain unused for years. Measurement therefore requires explicit time horizons and, where possible, sensitivity to delayed activation and depreciation.

Baseline selection is equally important. Generativity can be expressed relative to a prior state, a plausible counterfactual, an alternative intervention, or a historically available possibility set. These baselines answer different questions. A project can be generative relative to local past conditions while remaining less generative than another feasible arrangement. A technology can expand one actor's possibilities while narrowing those of another. A scalar score that suppresses these distinctions can obscure more than it reveals.

GRE should therefore resist the premature construction of a universal generativity index. The more promising direction is a family of measures tied to explicit objects:

capability generation, institutional reproduction, option expansion, relational diversification, knowledge recombination, ecological regeneration, or transformation of future constraints. Some domains may support quantitative indicators; others may require ordinal, categorical, historical, or qualitative evidence.

The open problem is to determine when these heterogeneous measures can be compared and when they should remain separate. Measurement should increase discriminability while preserving the multidimensional character of generation. A measure becomes useful when it makes a claim more testable or comparable, not merely when it assigns a number to a concept.

3.20.4 Relational Boundary Selection

Every relational analysis requires a boundary, yet the boundary can materially determine the result. A firm can be analyzed through internal employment relations, supply chains, financial dependencies, legal institutions, ecological inputs, community effects, or global infrastructures. A household can be treated as a unit or decomposed into members with different resources, vulnerabilities, and bargaining positions. A platform can be bounded by formal ownership or expanded to include complementors, users, data providers, moderators, advertisers, and regulatory institutions. Each choice creates a different relational object.

Boundary selection is therefore more than a technical preprocessing decision. It affects which mechanisms are visible, which costs are externalized, which subjects count as participants, and which downstream effects are attributed to the focal process. A narrow boundary can produce apparent efficiency by excluding displaced burdens. An excessively broad boundary can make explanation indeterminate by treating nearly everything as part of the system.

GRE currently has principles that help discipline boundary choice: explicit scale selection, ontological suspension, claim-relative objecthood, and attention to downstream effects. These principles do not yet provide a general procedure for deciding how far a relational analysis should extend. The appropriate boundary depends on the claim. A study of contractual propagation may require one boundary; a study of ecological regeneration may require another; a study of institutional recognition may require several overlapping boundaries.

One direction for future work is sensitivity analysis across relational boundaries. Researchers can ask whether the principal inference changes when adjacent actors, longer time horizons, or additional infrastructures are included. Another direction is boundary justification through mechanism: include relations that participate materially in the mechanism under investigation and distinguish them from contextual conditions whose role is secondary. A third is normative boundary review, especially where exclusion from the analytical boundary also removes affected populations from evaluation.

The deeper problem is that boundaries can themselves be generated and contested. Legal categories, accounting rules, administrative jurisdictions, platform architectures, and disciplinary conventions determine what appears internal or external. GRE therefore needs methods for studying boundary formation while still selecting workable boundaries for empirical research. This is an inherently reflexive task: the researcher must construct a boundary without mistaking that construction for a natural edge of the economic world.

3.20.5 Dynamics of Changing Transformation Rules

GRE places particular emphasis on situations in which the effective mechanisms of change are themselves transformed. This possibility is analytically important because many models assume that states change under a rule that remains sufficiently stable for the period of analysis. Economic history repeatedly presents harder cases: technologies alter feasible production processes, institutions modify incentives and classifications, learning changes decision procedures, political settlements alter property and authority, and adaptive systems modify the relations through which later adaptation occurs.

The open problem is empirical representation of these changing transformation rules. It is relatively straightforward to estimate changing states under a fixed model. It is harder to determine whether parameter drift is sufficient, whether the structure of interaction has changed, whether new variables have become relevant, or whether the model class itself must be revised. A sudden forecasting failure can indicate structural transformation, measurement change, omitted context, or ordinary stochastic variation. The observation alone does not identify rule change.

Different forms of rule transformation should therefore be distinguished. Parameters can change while the functional structure remains stable. Network topology can evolve while node types remain fixed. Agents can learn and alter local decision rules. Institutions can redefine available actions or recognized categories. New technologies can introduce previously unavailable operations. Symbolic changes can alter how subjects interpret the same formal option. More radical transformation can make earlier state variables inadequate because the kinds of economically relevant entities have changed.

Future GRE work requires diagnostics for these levels. Change-point methods, time-varying parameter models, adaptive networks, institutional process tracing, computational learning models, and historical comparison can each contribute. None should be treated as a universal representation. The important question is what evidence warrants movement from a claim of state change to a claim of structural change, and from structural change to transformation of the effective rule of change.

This problem also concerns anticipation. If governance relies on models whose rules can change in response to the intervention itself, policy evaluation becomes recursively difficult. Agents can adapt to incentives, classifications, metrics, and regulatory thresholds. Institutions can learn from being measured. Artificial systems can modify decision environments at high speed. GRE therefore needs forms of intervention design that monitor the stability of the assumed transformation rule rather than merely updating parameter estimates within it.

3.20.6 Heterogeneous Value Comparison

GRE's commitment to heterogeneous value creates an unresolved problem of comparison. Economic decisions frequently require choices among outcomes expressed through different value languages: income, time, health, dignity, ecological integrity, autonomy, knowledge, cultural continuity, security, care, or future option value. Practical governance cannot always defer choice until a complete theory of commensurability is available. Yet forcing these values into a single metric can erase the distinctions that motivated plural evaluation in the first place.

The problem is therefore to determine which forms of comparison are legitimate under partial commensurability. Some values may be monetizable for a specific administrative purpose while retaining dimensions not captured by price. Some can be ordered ordinally without meaningful cardinal distances. Some can be compared only within a domain. Some are subject to thresholds or rights that constrain trade-offs. Some are held by different subjects whose evaluative frameworks do not share a common scale.

GRE needs a vocabulary for these cases because generative effects often cross value domains. A policy can increase income while reducing ecological resilience. A technology can increase productivity while weakening autonomy or interpretive control. An institution can expand access for one population while eroding cultural continuity for another. The analytical challenge is to preserve these transformations without treating every trade-off as either fully aggregable or completely incomparable.

Several approaches are available for future development: vector-valued representation, partial ordering, threshold constraints, lexicographic priorities, multi-criteria analysis, deliberative comparison, qualitative matrices, and domain-specific indicators. Each imposes assumptions. The important task is to state those assumptions and to distinguish practical decision procedures from claims about underlying value equivalence.

Comparison also has a political dimension. Institutions that control the conversion interface between value forms can determine which values become legible enough to enter allocation decisions. Measurement systems, accounting rules, markets, legal standards, and algorithmic ranking can all privilege particular value representations. GRE should therefore study value comparison both as an analytical problem and as an object of economic power.

The open problem is not to eliminate heterogeneity. It is to make decision-relevant comparison possible while preserving residual differences that remain normatively or empirically meaningful.

3.20.7 Generativity and Justice

Generativity and justice intersect without being identical. An arrangement can generate substantial new capacity while distributing access, control, risk, or return unjustly. A restrictive intervention can reduce some forms of generation while protecting vulnerable subjects or preserving future ecological conditions. A relation can be locally reciprocal while depending on historical structures that shape who possesses the capacity to participate. GRE therefore needs a more developed account of how generative analysis and theories of justice constrain, inform, and revise one another.

One unresolved issue concerns the object of justice. Evaluation can focus on resources, capabilities, recognition, participation, relations, procedures, generated opportunities, or future conditions of generation. These objects can point in different directions. Equal resource distribution can coexist with unequal conversion capacities. Broad participation can coexist with domination inside the participatory process. Expansion of future possibilities for one group can depend on ecological or social foreclosure for another.

A second issue concerns temporal distribution. Generative interventions often move value across time. Present actors can bear costs that create future capacities, while future actors can inherit both benefits and constraints without having partic-

ipated in the original decision. Justice therefore requires attention to who pays for generation, who controls the generated capacity, who receives later return, and who inherits the risks of failure or lock-in.

A third issue concerns agency and authorship. When value is co-produced through distributed relations, justice cannot rely only on a simple producer-recipient distinction. Contributors can include maintainers, caregivers, communities, infrastructures, knowledge traditions, ecosystems, and future institutions. Attribution uncertainty makes distributive claims more difficult but does not remove the normative problem.

GREthic provides a neighboring domain for deeper normative theory, while GRE retains responsibility for describing the economic relations through which capacities, dependencies, returns, and foreclosures are produced. The open problem is to build interfaces between these domains without allowing normative vocabulary to substitute for economic mechanism or economic description to settle normative judgment automatically.

Progress will likely require multiple justice criteria rather than a single principle centered on generativity. Generativity can become one object of justice—especially where institutions systematically capture others' capacity to generate—but justice also constrains which forms of generation are permissible and how risks, participation, recognition, and future possibilities should be distributed.

3.20.8 Symbolic Reification

GRE relies heavily on analytical concepts such as relation, field, subject, capability, generativity, value, constraint, and possibility. These concepts are necessary for inquiry, yet repeated use can create symbolic reification: a representation introduced to organize observation begins to be treated as if it were the stable object itself. This problem is especially significant for a programme that explicitly distinguishes relations from their representations.

Reification can occur through ordinary scholarly language. A network diagram can encourage researchers to treat nodes as naturally bounded entities even when the nodes are administrative constructions. A capability measure can become identified with capability itself. A field representation can be spoken of as if the measured scalar were literally the distributed social condition. A generativity score can transform a multidimensional hypothesis into an apparently objective property. Institutional categories can become research variables and then return to practice with the authority of scientific classification.

The danger increases when representations become operational. Metrics influence funding, rankings, eligibility, regulation, and organizational behavior. Models can therefore participate in generating the reality they purport to describe. Subjects adapt to categories, optimize against indicators, and reorganize behavior around algorithmic classifications. A representation can acquire causal power through institutional uptake without becoming ontologically complete.

GRE needs practices that keep this reflexive relation visible. Researchers can document category construction, preserve alternative representations, test sensitivity to operational definitions, distinguish latent constructs from measured proxies, and monitor how measures alter behavior after institutional adoption. Historical work can show how categories change. Interpretive inquiry can reveal meanings lost in standardized representation. Formal work can state which properties are assumed

rather than observed.

The open problem extends beyond avoiding conceptual error. Symbolic reification can become a mechanism of power when institutions control the categories through which subjects are recognized, evaluated, funded, or excluded. The study of representations therefore belongs within the economic analysis of generative conditions. GRE must remain capable of using symbols and models decisively while keeping open the possibility that its own categories become objects of later revision.

3.20.9 Governance under Persistent Asymmetry

Section 81 treated asymmetry as a durable feature of many economic relations and distinguished it from power. The open governance problem begins where complete equalization is unavailable, undesirable, or itself generative of new dependencies. Differences in expertise, capital, institutional authority, computational capability, ecological exposure, time horizon, or exit capacity can persist even under well-designed institutions. Governance must therefore operate in conditions where symmetry cannot be treated as the endpoint.

One challenge is preventing asymmetry from becoming unreviewable domination. Transparency, contestability, exit, representation, auditing, countervailing institutions, liability, redistribution, and public infrastructure can each constrain conversion of asymmetry into power. Their effectiveness depends on context. Transparency is weak where subjects lack capacity to interpret information. Exit is weak where alternatives are costly or unavailable. Counter-power can create another concentration. Redistribution can reduce resource asymmetry while leaving institutional or epistemic asymmetry intact.

A second challenge concerns dynamic asymmetry. Capabilities change at different speeds. Artificial systems, financial institutions, states, and large platforms can update or coordinate more rapidly than individuals or local communities. Governance mechanisms designed for a slower environment can become ineffective before formal rules change. Persistent asymmetry is therefore partly temporal: the ability to learn, respond, litigate, coordinate, or revise can itself be unequally distributed.

A third challenge concerns productive asymmetry. Some differentiation enables specialization, expertise, delegation, and coordination. Governance that attempts to eliminate every asymmetry can destroy useful capacities or impose high administrative cost. GRE therefore requires criteria for distinguishing asymmetries that are functionally productive from asymmetries that generate dependency, exclusion, capture, or foreclosure. The distinction is empirical and normative rather than definitional.

Future work should compare governance architectures by how they affect conversion mechanisms. Which institutions prevent expertise from becoming unaccountable authority? Which infrastructures reduce dependence without eliminating specialization? Which rights preserve contestability when exit is impossible? Which forms of public or cooperative capacity alter bargaining structure? Which monitoring systems remain revisable when the powerful actors being monitored can adapt strategically?

The open problem is governance that remains effective under durable difference. GRE should study how relations can remain productive and heterogeneous while limiting the recursive accumulation of asymmetry into structures that remove others' capacity to participate, contest, exit, or generate alternatives.

3.20.10 Long-Horizon and Intergenerational Evaluation

The final open problem concerns effects that extend beyond ordinary observational and political horizons. Generative analysis often directs attention toward future capacities, institutional trajectories, ecological conditions, knowledge infrastructures, and path-dependent constraints. These objects can persist for decades or generations. Evaluation therefore faces a fundamental difficulty: the most important consequences may occur after the period in which evidence can be directly collected or the relevant decision-makers remain accountable.

Long-horizon evaluation raises familiar forecasting problems and additional generative-relational problems. Future subjects may possess different preferences, technologies, institutions, vulnerabilities, and value languages. Interventions can change the categories through which later outcomes are evaluated. The relevant counterfactual can also evolve. A policy that appears option-expanding under present technology can become restrictive under a later technological regime, while an apparently conservative intervention can preserve ecological or institutional capacities whose future uses are presently unknown.

Discounting provides one way to compare temporally separated effects, but discount rates encode substantive assumptions and cannot resolve all intergenerational questions. Some future losses concern irreversible ecological damage, destroyed knowledge, institutional lock-in, or loss of option-generating capacity. These may be poorly represented as ordinary delayed consumption effects. GRE therefore needs temporal representations that distinguish delayed value from changes in the capacity to generate future value.

Uncertainty compounds the problem. Forecast distributions may widen with horizon; structural transformation can invalidate the model generating those distributions; unknown future innovations can alter feasible trajectories; and future actors cannot participate directly in present deliberation. Evaluation must therefore combine prediction with robustness, precaution, reversibility, preservation of options, and explicit treatment of model uncertainty. Different domains will justify different combinations.

Intergenerational analysis also requires attention to inheritance. Future subjects inherit infrastructure, institutions, debts, ecological conditions, knowledge, classifications, and unresolved conflicts. These inheritances shape both their opportunities and the costs of changing course. A generative intervention should therefore be evaluated partly by what kinds of revision it leaves possible for those who come later.

This problem may retain irreducible uncertainty. Future possibility spaces cannot be observed in full, and the values through which future actors judge inherited conditions cannot be completely known. GRE should not treat this uncertainty as a reason to ignore long horizons. It should instead make the uncertainty explicit and examine which interventions preserve enough diversity, reversibility, capacity, and institutional corrigibility to support later adaptation and re-evaluation.

The ten problems in this section define a research frontier rather than a list of defects awaiting simple repair. Some require better measurement and identification; some require new formal or empirical methods; some concern interfaces with normative theory; and some arise from reflexivity, historical change, and the openness of future possibility. Progress in one area can also alter another. Better generativity measures can intensify symbolic reification if their institutional use is poorly gov-

erned. Broader relational boundaries can improve downstream attribution while increasing uncertainty. Stronger governance of asymmetry can change the mechanisms whose effects were initially being measured.

GRE should therefore preserve open problems as active components of its cumulative research programme. An unresolved question becomes productive when competing formulations, evidence, failed approaches, and revisions remain traceable. The next section turns from these substantive open problems to the architecture through which the wider GRE programme can organize their investigation across epistemology, methodology, praxis, formalization, governance, knowledge, artificial intelligence, and domain-specific applications.

3.21 Architecture of the GRE Research Programme

The preceding sections have specified the provisional identity, problem-space, objects, scales, modes of inquiry, epistemic commitments, praxis, normative interfaces, contribution criteria, internal pluralism, and open problems of Generative Relational Economics. The role of the present section is different. It organizes those commitments into a research architecture that can support the remainder of the book and, more importantly, a cumulative programme extending beyond this book. Its objective is to identify the principal domains of work that GRE requires, clarify their relations, and show how movement among them can remain coordinated without collapsing them into one method, one ontology, or one normative theory. The architecture is therefore neither a linear sequence nor a departmental division of labor. It is a set of connected research components whose outputs can constrain, revise, or redirect one another.

The programme can be understood as having several recurrent movements. Epistemological work asks what kinds of relational and generative claims can be warranted. Methodological work develops procedures for observing, reconstructing, comparing, and testing those claims. Praxis links explanation to intervention under incomplete knowledge. Substantive economic work specifies economic objects, allocation processes, value trajectories, temporal organization, power, knowledge, artificial intelligence, and domain-specific mechanisms. Formal work provides representations that can clarify structure or generate implications without acquiring automatic ontological priority. Normative and governance work evaluates how generated capacities, dependencies, harms, and possibilities should be judged and governed. None of these components is sufficient by itself. Their interaction is what gives GRE the possibility of becoming a research programme rather than a vocabulary.

This architecture also gives the later chapters a disciplined relation to Chapter 3. The chapters that follow do not merely expand terms introduced here. They test whether the constitutional claims made in Part I can survive more demanding epistemic, methodological, formal, substantive, and applied development. A concept that proves unusable under empirical inquiry should be revised. A formal representation that cannot preserve relevant historical or interpretive distinctions should be limited. A normative framework that obscures economic mechanisms should not replace explanation. An intervention methodology that generates unanticipated dependency should feed back into the theory of power and praxis. The architecture is therefore recursive: later work is expected to modify the preliminary constitution from which

it begins.

3.21.1 Epistemology of Relations

A GRE research programme requires an epistemology capable of supporting claims about relations without assuming that relations are directly given to observation. Economic inquiry usually encounters traces: transactions, documents, prices, classifications, narratives, institutional records, behavioral responses, network data, legal categories, measurements, and model outputs. From such traces, researchers infer relations of dependence, recognition, exchange, authority, mediation, constraint, influence, and generation. The first architectural component therefore concerns the conditions under which these inferences are warranted.

The epistemology of relations must keep at least four layers distinguishable. There is the relation or relational process posited as part of the target situation; there are the observations through which researchers gain partial access to it; there are the categories and representations used to organize those observations; and there are the claims made on the basis of those representations. Confusion among these layers produces many characteristic errors. A network edge can be mistaken for the relation itself. A legal category can be treated as a complete description of social participation. A repeated correlation can be interpreted as a stable generative relation even where the mechanism changes historically. GRE therefore requires explicit accounts of how observations become relational claims.

This epistemic component also has to accommodate different kinds of relational evidence. Some relations are materially instantiated through contracts, infrastructures, ownership, payment, or legal authority. Others are reconstructed from repeated interaction, dependence, interpretation, or institutional practice. Still others concern counterfactual or generative effects that cannot be observed directly because they refer to capacities, alternatives, or future conditions. Evidence sufficient for one kind of relation may be inadequate for another. The programme should therefore resist a single criterion of relational observability.

Epistemology of relations also includes reflexivity. Economic categories can alter the relations they represent. Credit scores change access to credit; rankings alter institutional behavior; classifications determine eligibility; models influence expectations; and public descriptions can reshape coordination. The object of knowledge can therefore respond to the means of knowing. This makes epistemology an economic problem as well as a philosophical one. The programme must study how knowledge practices participate in the relational field whose properties they attempt to establish.

The output of this component is not a final theory of knowledge. It is a set of standards for relational claims: how objects are identified, how boundaries are selected, how observations are linked to relations, how representations are validated, how uncertainty is expressed, and how claims remain open to correction. Those standards provide the epistemic ground on which the methodological components of the programme operate.

3.21.2 Methodology of Relational Inquiry

Relational methodology concerns procedures for studying configurations in which the properties or effects of an object depend materially on its relations with other ob-

jects, institutions, environments, or representations. Its central task is to move analysis beyond isolated-unit description without treating every connection as equally significant. A relational study must identify which relations matter, how they are evidenced, what scale they operate at, and which consequences follow from their organization.

The methodological repertoire is necessarily plural. Historical reconstruction can identify how a relation formed and changed. Comparative inquiry can examine why similar entities occupy different relational positions. Network analysis can represent patterned connectivity. Institutional analysis can identify rules that stabilize or authorize relations. Ethnographic and interpretive work can reconstruct how participants understand obligations, identities, and meanings. Econometric and causal designs can estimate effects generated through specified relational exposures. Qualitative process tracing can examine mechanisms that are difficult to reduce to stable variables. None of these methods is intrinsically more relational merely because of its technique. Relationality enters through the structure of the research question and the specification of the object.

A developed relational methodology should make boundary construction explicit. Researchers need criteria for deciding which actors, institutions, ecological conditions, infrastructures, classifications, and temporal histories belong inside the analysis. Because boundaries are analytical choices with substantive consequences, sensitivity to alternative boundaries should become part of methodological practice where feasible. The same transaction can look efficient within a firm boundary and extractive within a regional labor system; a technological intervention can look productive over one year and capability-destroying over a decade.

Relational inquiry also needs procedures for distinguishing direct from mediated effects. Economic outcomes often travel through chains of institutions, expectations, infrastructures, and social recognition. A transfer to one subject can alter bargaining conditions for another; a platform rule can change incentives through ranking systems; a legal reform can transform behavior through expectations before enforcement occurs. Methodological work must therefore support the reconstruction of mediation rather than stopping at the administrative point of intervention.

The programme should accumulate relational methods through reusable design patterns rather than prescribe one canonical protocol. Useful patterns may concern boundary selection, multi-source evidence, relation typing, temporal reconstruction, counterfactual comparison, cross-scale mapping, or identification of institutional mediation. These patterns become a methodological library that later studies can adapt while preserving transparent assumptions and limits.

3.21.3 Methodology of Generative Relational Inquiry

Generative relational inquiry adds a further question to relational analysis: what later capacities, structures, values, subjects, constraints, or possibilities are produced through a relation, and through what mechanism? This shift changes both the temporal horizon and the object of explanation. The researcher is no longer concerned only with what a relation currently connects or distributes. The inquiry follows how participation in the relation changes the conditions from which subsequent economic processes can occur.

This methodological component therefore requires explicit generative claims. A

study should state what is alleged to be generated, over what period, for which subjects or systems, and through which mediating process. Generation may concern skills, trust, dependency, infrastructure, market access, organizational capacity, knowledge, subject positions, ecological resilience, future options, institutional lock-in, or the capacity to generate further value. These are heterogeneous objects, so no single metric can stand in for generativity across domains.

Generative inquiry also requires attention to counterfactual trajectories. The relevant comparison is frequently not simply between treated and untreated units at one time. It may concern how different relational configurations alter later pathways. This creates methodological difficulty because the treatment can change the variables, categories, or institutional environment through which later outcomes are measured. Longitudinal designs, historical comparison, mechanism-based simulation, qualitative reconstruction, and adaptive experimentation may therefore complement conventional causal identification.

A further methodological problem concerns recursion. Generated capacities can alter the relation that generated them. New knowledge changes bargaining power; institutional learning changes governance; accumulated infrastructure shifts future allocation; successful coordination changes expectations; artificial systems can alter the speed and scale of subsequent production. Generative relational methodology must be capable of tracing such feedback without assuming that the original mechanism remains fixed.

The programme should therefore develop a family of generative research designs rather than one universal method. Their common requirement is disciplined movement from relation to mechanism to generated consequence to altered future condition. Where the chain cannot be established, the study should say so. Where several mechanisms remain plausible, competing explanations should remain visible. This methodological restraint protects generativity from becoming an all-purpose label for any downstream change.

3.21.4 Praxis and Intervention

Praxis connects GRE's explanatory programme to purposive attempts to alter economic relations. The architectural function of praxis is to prevent theory from ending at diagnosis while also preventing intervention from outrunning knowledge. GRE therefore treats intervention as an iterative research and governance process in which action generates new evidence, changes the relational field, and may require revision of both the intervention and the theory that justified it.

A GRE praxis architecture begins with relational and generative diagnosis. The analyst identifies the relevant subjects, institutions, dependencies, constraints, capacities, value trajectories, and asymmetries. Intervention design then specifies which relation or enabling condition is to be changed, what effects are expected, which subjects may bear risks, and what indicators or qualitative observations can reveal downstream consequences. Implementation becomes part of inquiry because it tests assumptions under conditions that may differ from those represented in the initial model.

Adaptive feedback is therefore central. Interventions should include monitoring capable of detecting effects beyond the intended recipient, changes in dependency, emergent exclusion, shifts in power, unexpected conversions of value, and damage to

future options. Revision can concern intensity, targeting, institutional design, representation, or even the original diagnosis. Where harm or failure becomes sufficiently probable, withdrawal, reversal, and repair need to remain available.

Praxis also requires institutional design for learning. Organizations often collect data for accountability but not for theoretical correction. GRE would instead treat intervention records, failed mechanisms, participant interpretations, unexpected effects, and reversal attempts as cumulative research materials. This creates a bridge between application-dominant work and research-dominant work. Interventions become sites in which the adequacy of relational and generative hypotheses can be examined.

The praxis component does not imply that every GRE project must intervene. It specifies the architecture required when explanation is translated into action. Its standards are proportional to stakes and uncertainty. The more irreversible, asymmetric, or long-horizon the intervention, the stronger the need for monitoring, contestability, staged implementation, reversibility, and repair capacity.

3.21.5 Economic Objects and Relational Architecture

Substantive GRE begins by reconstructing the architecture of economic objects. Firms, households, platforms, markets, contracts, currencies, technologies, infrastructures, public agencies, communities, and ecological systems can all function as economic objects, but their economic significance depends on relations that constitute access, authority, dependence, recognition, exchange, coordination, and reproduction. The programme therefore needs systematic accounts of how economic objects are stabilized and connected.

Relational architecture concerns more than mapping connections. It asks which relations are constitutive, which are enabling, which are extractive, which are substitutable, and which create dependence or future capacity. It also examines how objects change when their relational architecture changes. A firm can retain a legal identity while its productive relations, knowledge base, ownership, labor dependence, and technological infrastructure transform substantially. An apparently stable object can therefore contain changing generative conditions.

This component also organizes scale. Economic architecture can be reconstructed within organizations, across supply chains, among institutions, between human and artificial subjects, or across economic and ecological systems. At one scale a platform is an entity; at another it is a field of relations among users, advertisers, workers, algorithms, legal authorities, and infrastructures. GRE should be able to move between these representations without presuming that one scale is ontologically final.

A mature programme would accumulate relational architectures comparatively. Which configurations support distributed capability? Which concentrate dependency? Which are resilient to shocks? Which permit exit and revision? Which externalize ecological or social costs? Which generate durable learning? Comparative architectural work can provide intermediate theory between highly local case description and universal claims about markets or institutions.

This substantive component prepares several later programme domains. Allocation changes relational architecture; value moves through it; generative spacetime records its historical and temporal organization; formal models represent selected features of it; governance attempts to alter its asymmetries. Economic architecture

therefore functions as a central integrative object without becoming the sole object of GRE.

3.21.6 Relational Allocation

Allocation is conventionally concerned with who receives which resources under specified constraints. GRE retains that question but expands the analytical unit. An allocation also enters a relational configuration and can change bargaining positions, dependencies, recognition, coordination capacity, expectations, and future productive possibilities. Relational allocation is the programme component that studies these mediated effects systematically.

The relevant object is therefore not merely the resource transferred. It includes the route, institutional conditions, attached obligations, timing, visibility, substitutability, and relations through which the allocation is received and used. The same monetary amount can produce different consequences depending on whether it arrives as wage, grant, debt, benefit, prize, investment, family transfer, or platform payment. The relational form can influence autonomy, stigma, risk, reciprocity, and future access even when nominal quantity is identical.

Relational allocation also widens incidence analysis. Effects can propagate beyond the administrative recipient through households, markets, organizations, networks, and institutions. A subsidy can change prices, a training programme can alter labor-market competition, a public infrastructure investment can change land values, and access to computation can reshape research capacity. GRE therefore asks which relations mediate the allocation and how those relations redistribute later opportunities or constraints.

The programme should develop both descriptive and intervention-oriented allocation research. Descriptive work can reconstruct relational incidence and downstream transformation. Formal work can model how allocation changes network positions or dynamic constraints. Comparative work can examine alternative institutional forms for delivering similar resources. Normative work can evaluate whether an allocation expands capability while generating dependency elsewhere. Application-dominant praxis can use these findings to redesign allocation mechanisms.

Relational allocation is thus a bridge between conventional economic analysis and the generative programme. It retains scarcity, incentives, incidence, and trade-offs while extending attention to how allocation changes the relational conditions under which later value and capability are generated.

3.21.7 Generative Value

Generative value concerns value that arises through the capacity of a relation, resource, institution, or process to enable further valuable activity. The concept does not replace exchange value, use value, welfare, capability, social value, ecological value, or other established categories. Its programme function is to make the production of future value-generating capacity an explicit economic object.

Generative value may appear through learning, infrastructure, trust, institutional competence, scientific knowledge, ecological restoration, network access, organizational routines, or the creation of new possibilities for participation. Its effects can be

delayed, distributed, and difficult to attribute to one original intervention. The same process can generate several forms of value while also producing harm, dependence, or exclusion. The programme therefore requires plural representations rather than assuming that generative value is one scalar quantity.

Research in this component should address propagation and conversion. Value generated in one domain can move into another: knowledge can become productive capability, social recognition can become market access, infrastructure can become bargaining power, ecological conditions can enable future production, and data can become organizational advantage. Conversion can also be blocked or asymmetrical. Subjects may contribute to a generative process without capturing the value that later emerges from it.

This creates questions of return and distribution. Who receives the benefits of generated capacity? Which relations permit value to recirculate to those who sustained its emergence? Which institutional arrangements enable extraction by actors positioned downstream? How should delayed or diffuse contributions be recognized? These questions connect generative value to political economy and justice without making one normative rule part of the definition of value itself.

A cumulative research programme should develop typologies of generative mechanisms, methods for tracing value trajectories, domain-specific indicators, and comparative institutional studies. It should also preserve cases in which apparently generative investments fail to create durable capacity or create capacity that later becomes harmful. Generative value becomes analytically useful only if it remains distinguishable from the general fact that economic processes have consequences.

3.21.8 Generative Spacetime

Generative spacetime provides the programme's architecture for analyzing how economic relations are organized across heterogeneous spatial and temporal conditions. The term does not imply that social reality literally possesses the geometry of physical spacetime. It identifies a research problem: economic processes unfold through histories, delays, path dependencies, spatial distributions, institutional boundaries, and differently paced subsystems whose relations shape what can be generated later.

Time in GRE cannot be reduced to a neutral index. The order of events can matter. Early access to capital can alter later bargaining power; institutional sequencing can determine which reforms become feasible; technical standards can lock in infrastructure; educational investments can affect capabilities years later; ecological degradation can create long recovery periods. Identical quantities introduced at different moments can therefore have different generative effects.

Spatial organization is similarly relational. Geographic distance interacts with infrastructure, jurisdiction, logistics, language, data access, mobility, and ecological conditions. Digital mediation can reduce some distances while creating new forms of concentration in computation, platforms, standards, or data centers. A generative-spacetime analysis asks how locations become connected or separated through these economic relations rather than treating space as a passive container.

The programme also needs to study heterogeneous temporalities. Humans, firms, financial markets, states, ecosystems, infrastructures, and artificial systems can operate at very different speeds. Their coupling can generate asymmetry. A platform can change an algorithm faster than workers can reorganize; financial capital can exit

faster than communities can replace employment; ecological recovery can be slower than investment cycles. Temporal mismatch therefore becomes an economic mechanism rather than merely a descriptive feature.

Generative spacetime should support historical reconstruction, dynamic modeling, spatial analysis, and long-horizon evaluation. Its contribution is to preserve the ordering, location, duration, and temporal coupling of generative processes. It thereby links historical analysis to formal dynamics without reducing one to the other.

3.21.9 Formal Models

Formal modeling provides GRE with tools for making assumptions explicit, deriving implications, comparing mechanisms, and exploring trajectories that are difficult to reason about verbally. The programme can draw on dynamical systems, networks, multilayer structures, agent-based models, optimization, game theory, probabilistic models, field-like representations, simulation, and other mathematical or computational techniques where they are appropriate to the object.

The architectural principle is representational pluralism under ontological restraint. A network model emphasizes connectivity; a dynamical model emphasizes state evolution; a game-theoretic model emphasizes strategic interaction; an agent-based model emphasizes local rules and emergent aggregate patterns; a field representation emphasizes distributed conditions. These models need not be translated into one universal formal language. Their adequacy depends on which features of the economic problem they preserve and which they suppress.

Formal work in GRE should state the status of each construction. Some models are descriptive summaries. Some identify structural possibilities. Some generate comparative statics or trajectories. Some serve as counterfactual laboratories. Some are fitted to empirical data; others are heuristic. A mathematically precise model can remain empirically weak if its variables or mechanisms lack adequate correspondence to the target system. Formal rigor therefore complements rather than substitutes for evidential warrant.

Generativity creates particular formal challenges. The variables, interaction structures, or effective rules may themselves change. Models can represent some forms of adaptation, network rewiring, rule learning, or changing parameters, but the programme should distinguish represented transformation from genuinely unforeseen category change. Where the formal state space excludes relevant novelty, model revision may be more appropriate than adding complexity to preserve a fixed representation.

The cumulative aim is a library of transparent formal models tied to clearly stated empirical and conceptual problems. Comparability should depend on assumptions, mechanisms, observables, and failure conditions, not on adherence to one mathematical paradigm. Formal models should remain instruments through which GRE sharpens explanation, tests implications, and explores possibilities.

3.21.10 Justice, Power, and Governance

Power and justice form a programme component because generative economic relations distribute more than current resources. They shape who can participate, who

can exit, whose knowledge counts, who bears vulnerability, which alternatives remain feasible, and who captures value generated through collective processes. Governance concerns the institutional organization of these relations under persistent asymmetry and uncertainty.

Power research in GRE studies conversion mechanisms. Resource, capability, knowledge, institutional, vulnerability, and exit asymmetries become economically consequential when they can be converted into durable influence over others' options or future conditions. The programme should identify the institutional arrangements that enable or constrain these conversions. Ownership, standards, law, infrastructure, platform design, intellectual property, credit, public authority, and organizational hierarchy can all mediate conversion.

Justice enters as a neighboring evaluative problem rather than a property automatically inferred from generativity. A highly generative arrangement can still distribute participation unequally, impose dependency, externalize harm, or foreclose alternatives. GRE therefore needs interfaces with distributive, procedural, relational, capability-oriented, ecological, and generative approaches to justice while remaining explicit about which normative principles are being used.

Governance research then asks how institutions can organize relations under conditions in which asymmetry cannot simply be eliminated. Relevant mechanisms include contestability, transparency, rights, public capacity, collective organization, auditing, representation, interoperability, liability, redistribution, and preservation of exit or voice. Each can itself generate new dependencies or concentrations. Governance must therefore be evaluated recursively.

This component connects explanation, normativity, and praxis. Its success should be judged not by whether it yields one constitutional ideal but by whether it improves the ability to diagnose power, compare governance architectures, evaluate their generated consequences, and revise institutions as relational conditions change.

3.21.11 Knowledge and Epistemic Economy

Knowledge is simultaneously an input, output, resource, relation, institution, and source of asymmetry. A GRE research programme therefore requires a substantive epistemic economy concerned with how knowledge is generated, validated, stored, circulated, priced, restricted, translated, forgotten, and converted into other forms of value or power.

The economic organization of knowledge affects who can generate further knowledge. Access to education, archives, computation, laboratories, data, journals, languages, expert communities, and institutional recognition shapes future epistemic capability. Knowledge production can therefore exhibit cumulative advantage and generative inequality even when individual information goods are non-rival. Ownership, paywalls, classification, secrecy, data governance, and platform control can influence the relational conditions of inquiry.

Epistemic economy also concerns recognition. Some observations become evidence, some questions become fundable, some methods acquire authority, and some speakers become credible. These processes are partly scientific and partly institutional. They can generate epistemic injustice when subjects are systematically excluded from contributing, being understood, or influencing the categories through which their situations are represented. At the same time, standards of evidence

remain necessary; inclusion cannot mean suspension of criticism.

Artificial intelligence intensifies these questions by reducing some costs of synthesis, drafting, search, modeling, and content generation while increasing dependence on data, computation, model access, evaluation infrastructure, and epistemic filtering. Abundance of generated text can make provenance, attention, verification, and question formation scarcer. The economic object is therefore not knowledge alone but the relational infrastructure through which epistemic capability is distributed.

The programme should study knowledge capital, epistemic labor, archive power, verification, provenance, scientific institutions, open infrastructure, education, and the generative conditions of inquiry. It should also examine how its own research practices distribute epistemic participation and authority.

3.21.12 Artificial Intelligence and Radical Asymmetry

Artificial intelligence provides a contemporary domain in which several GRE problems become unusually visible at once: heterogeneous subjecthood, rapid capability change, concentration of infrastructure, epistemic abundance, organizational transformation, power conversion, temporal mismatch, and uncertainty about future generative trajectories. The programme should therefore treat AI neither as a peripheral application nor as an all-explanatory paradigm. It is a demanding empirical case for testing GRE's concepts.

The central economic problem is not simply automation or substitution. AI systems can alter the cost and speed of cognition-like tasks, reorganize knowledge work, modify decision processes, enable new forms of coordination, and change who can produce valuable outputs. The consequences depend on ownership, access, interface design, labor relations, education, regulation, data, compute, and organizational capacity. Similar model capabilities can therefore produce different economic structures under different relational architectures.

Radical asymmetry refers to cases in which capability differences become large enough to transform bargaining, monitoring, production, or institutional response. Such asymmetry can occur among firms, states, workers, consumers, or human and artificial operational subjects. It does not establish moral or ontological equality among those subjects. The research problem concerns how capabilities are converted into economic power and how other subjects retain participation, contestability, learning, and exit under rapidly changing conditions.

AI also complicates the generative horizon. Systems that participate in research, design, education, administration, or cultural production can alter the rate at which new possibilities are generated. They can also narrow possibility through standardization, dependence, concentrated infrastructure, or recursive optimization around existing metrics. Evaluation must therefore attend to both capability expansion and generative foreclosure.

This component should integrate empirical labor economics, industrial organization, innovation studies, political economy, governance, epistemic economy, and technical understanding of AI systems. GRE contributes by coordinating these perspectives around relational and generative mechanisms rather than by replacing their specialized expertise.

3.21.13 Domain-Specific Applications

The final architectural component concerns domain-specific application. A research programme becomes substantive only when its concepts survive contact with cases in which institutions, evidence, values, scales, and mechanisms differ. GRE should therefore be tested across domains rather than developed indefinitely at the level of general vocabulary.

Candidate domains include labor, education, scientific research, health, finance, development, migration, humanitarian systems, urban infrastructure, digital platforms, ecological transition, public administration, innovation, culture, and international economic relations. Each domain brings specialized literatures and methods that GRE must respect. Domain application should begin from the empirical problem and available knowledge, then ask whether relational and generative analysis adds explanatory or practical value.

Applications serve several programme functions. They test concepts against heterogeneous evidence. They expose hidden assumptions imported from one domain into another. They identify mechanisms that may travel across cases and mechanisms that remain local. They provide intervention evidence. They reveal where value categories differ and where normative conflict becomes unavoidable. They can also demonstrate that GRE adds little to an already adequate established analysis, which is itself useful boundary knowledge.

Cross-domain comparison should therefore be careful. Similar labels can conceal different mechanisms. Dependency in finance, caregiving, digital infrastructure, and ecology need not be structurally identical. Generativity in education may concern capabilities and inquiry; in ecological restoration it may concern system resilience and future option spaces; in science it may concern knowledge and question formation. Comparative GRE should look for structural correspondence without presuming equivalence.

Domain-specific work also provides the main route through which the architecture remains corrigible. If concepts repeatedly fail in applied settings, they should be narrowed or abandoned. If new objects or mechanisms recur across domains, the programme can revise its typologies. If governance approaches generate predictable secondary harms, praxis should change. Application is therefore not the terminal stage of the programme. It is one of the principal sources through which the architecture itself evolves.

Taken together, these thirteen components define a preliminary architecture for GRE research. They do not form a pipeline in which epistemology is completed before methodology, methodology before substantive economics, and substantive economics before application. Work can begin in any component and move among several. An empirical anomaly can force epistemic revision; an intervention can reveal a new mechanism; a formal model can expose an ambiguous concept; a domain-specific case can require new governance categories; a normative conflict can reveal that a value representation is too coarse.

The architecture therefore functions as a coordination device. It indicates where a research question sits, which neighboring components are likely to constrain it, what forms of evidence or representation may be required, and how results can return to the wider programme. It also gives the remaining parts of the book a common orientation: ontology and epistemology, research praxis and methodology, application-

dominant intervention, substantive economic foundations, power and knowledge, artificial intelligence, domain applications, and the later disciplinary return are connected components of one revisable research programme rather than independent theoretical excursions.

The following section condenses this architecture into a preliminary constitution of GRE. That constitution does not close the field. It states, in compact form, what GRE studies, what it does not need to presume, what it attempts to explain and change, what can count as evidence and contribution, and which questions remain deliberately open to historical and theoretical revision.

3.22 A Preliminary Constitution of GRE

The preceding sections have developed Generative Relational Economics from a provisional disciplinary identity into a structured research programme. They have specified its problem-space, methodological primitives, objects and scales of inquiry, characteristic questions, analytical sequence, account of economic subjecthood, orientation of generation, modes of inquiry, epistemic commitments, praxis, normative interfaces, analysis of power and heterogeneity, disciplinary boundaries, contribution criteria, cumulative programme, internal pluralism, open problems, and wider research architecture. The role of the present section is to condense those commitments into a preliminary constitution. The term *constitution* is used here in a limited methodological sense. It denotes a compact statement of the conditions under which GRE can presently recognize its own objects, claims, evidence, interventions, contributions, and limits. It does not denote a final doctrine, a metaphysical settlement, or a fixed disciplinary code.

The objective of the section is therefore both consolidating and restrictive. Consolidation is needed because a research programme can become diffuse when its concepts expand faster than the criteria governing their use. Restriction is needed because GRE should remain distinguishable from any study that happens to mention relations, emergence, complexity, value, or future possibility. A preliminary constitution states what kinds of questions GRE takes responsibility for, which assumptions it withholds, what forms of explanation it seeks, how intervention enters the programme, what can count as evidence and contribution, and which questions remain deliberately unsettled. The method is synthetic rather than genealogical. No new lineage is introduced here. The section reorganizes the commitments already established in Chapters 1–3 into eight constitutional dimensions: domain, restraint, explanation, praxis, evidence, contribution, openness, and historical revisability.

The constitution is preliminary for a substantive reason. GRE studies processes in which relations, subjects, capacities, value structures, institutions, and conditions of generation can themselves change. A research programme directed toward such objects would contradict its own subject matter if it treated its present categories as permanently settled. Constitutional stability is therefore functional rather than absolute. The programme needs enough continuity for researchers to disagree about the same problems, compare findings, and accumulate knowledge, while retaining enough revisability to alter its categories when empirical, historical, formal, or normative work reveals that they have become inadequate. The constitution presented below should be read in that spirit.

3.22.1 Domain and Objects of Study

GRE studies economic relations insofar as those relations help generate, reproduce, distribute, transform, or foreclose later capacities, constraints, values, subjects, institutions, trajectories, and fields of possibility. This domain statement is intentionally broader than the study of transactions and intentionally narrower than a general theory of social reality. GRE remains economic because its questions concern allocation, production, circulation, valuation, work, capability, institutional organization, economic power, dependence, resources, infrastructures, knowledge, and the conditions through which subjects participate in material and symbolic economies. It becomes generative-relational when those objects are examined through the consequences of their relational organization for what can subsequently exist, act, acquire value, coordinate, persist, or change.

The programme therefore treats the immediate recipient of an allocation or intervention as only one possible locus of effect. A subsidy may alter supplier capacity, household bargaining, regional infrastructure, expectations, or political legitimacy. An educational resource may change knowledge, confidence, social connection, question formation, institutional recognition, or later opportunity. A platform rule may change not only prices or matching efficiency but also visibility, dependence, subject formation, and the viability of alternative organizational forms. GRE asks which of these downstream effects are materially connected to the original relation and through which mechanisms they are generated. The downstream horizon is empirical and selective rather than indefinitely expansive: a GRE analysis is responsible for tracing consequences where plausible generative pathways and evidential access make them analytically relevant.

The objects admitted to this domain are correspondingly plural. Relatively stabilized entities, subjects, relations, resources, capacities, values, constraints, fields, processes, events, trajectories, institutions, social facts, and symbolic representations can each become objects of GRE inquiry. Their analytical status depends on the local problem. A firm may be treated as an entity in one study, as a field of internal relations in another, as an institutional rule complex in a third, and as a node within a wider production ecology in a fourth. GRE does not require one of these descriptions to exhaust the firm's reality. It requires the researcher to state which object construction is being used, at what scale, for which explanatory purpose, and with what evidential consequences.

The domain also includes heterogeneous subjects. Human persons, households, organizations, public bodies, communities, ecological systems, hybrid arrangements, and artificial operational agents may participate in economically consequential relations under different descriptions and with different normative statuses. Their inclusion within a common analytical field does not establish ontological or moral equivalence. It means only that their interactions can affect allocation, value, capability, dependence, coordination, and future possibility in ways that economic inquiry may need to represent. The constitution therefore permits heterogeneous participation while reserving questions of personhood, consciousness, legal personality, moral status, and ecological standing for the appropriate neighboring domains and normative arguments.

A GRE study is consequently identified less by a proprietary object than by a characteristic relation between object and question. The same labor market, school, AI

system, household, ecological project, financial institution, or humanitarian intervention can be studied through many legitimate economic approaches. It becomes a GRE problem when the inquiry asks how relational organization changes the capacities and conditions from which later economic and social possibilities are generated. This criterion preserves disciplinary openness while preventing the label GRE from becoming synonymous with any broad interest in complexity or interdependence.

3.22.2 Constitutive Restraints

GRE proceeds under several restraints that are constitutive rather than merely cautious. The first is ontological suspension. The programme can use entities, relations, processes, fields, networks, trajectories, categories, and generative structures without declaring any one of them the final metaphysical furniture of reality. Analytical usefulness establishes neither ontological priority nor completeness. A network representation may clarify connectivity; a field representation may clarify distributed conditions; a process description may clarify temporal transformation. Their value depends on the problem and the evidence. GRE therefore permits ontological commitment at the level required for a particular inquiry while withholding stronger closure.

The second restraint concerns explanatory universality. GRE does not presume that every economically relevant outcome requires a generative-relational explanation. Standard price theory, causal estimation, accounting, institutional description, optimization, historical narrative, or domain-specific expertise may already explain the relevant problem adequately. The programme earns analytical relevance where relational mediation, downstream generation, changing capabilities, path dependence, heterogeneous value, shifting subjecthood, power conversion, or transformation of future possibility materially improve understanding. The GRE label should therefore be unnecessary when a narrower account is sufficient.

A third restraint concerns generativity itself. Generation is not presumed to be beneficial, innovative, progressive, emancipatory, or just. Relations can generate dependency, exclusion, vulnerability, ecological degradation, epistemic closure, concentrated power, or the destruction of alternative futures. A highly generative system can reproduce harm more effectively than a weakly generative one. Evaluation must therefore remain separable from description. GRE can identify that a relation generates new capacities or reorganizes a field while leaving open whether that transformation should be encouraged, governed, limited, repaired, or reversed.

A fourth restraint concerns representation. Variables, categories, network edges, model states, indicators, simulations, legal classifications, and textual interpretations mediate access to the object; they are not automatically identical with it. GRE therefore distinguishes relational reality from its representation and treats boundary choice, measurement, coding, scale selection, and model specification as substantive parts of inquiry. This restraint is especially important where categories can become performative. Rankings, credit scores, eligibility classifications, productivity metrics, and AI-generated representations may alter the relations they purport to describe. The research instrument can become part of the generative field.

A fifth restraint concerns scalar and historical invariance. GRE does not assume that an object retains the same analytical identity across scale or historical transformation. A configuration that is stable enough to be treated as an entity at one level may decompose into changing relations at another. Categories such as worker, house-

hold, capital, platform, intelligence, capability, value, or market can change their institutional content over time. The constitution therefore requires explicit scale, boundary, and historical conditions whenever they materially affect the claim.

These restraints make the programme deliberately non-totalizing. They protect methodological pluralism, disciplinary interfaces, and corrigibility. They also impose costs: GRE must often carry more uncertainty, specify more boundaries, and resist attractive universal formulations. Those costs are accepted because a programme concerned with changing relations and future possibility requires a disciplined distinction between useful analytical commitment and premature closure.

3.22.3 Explanatory Commitments

GRE attempts to explain how economic outcomes and future possibilities arise through relations that mediate allocation, interaction, interpretation, institutional recognition, capability, and value. Its characteristic explanatory move is from a local intervention or observed configuration toward the mechanisms through which effects propagate and reorganize later conditions. This move does not replace causal inference. It expands the range of causal and generative questions that may need to be asked when the object cannot be understood adequately as an isolated unit responding to fixed incentives or constraints.

A generative explanation should identify more than temporal succession. It should specify a plausible mechanism connecting relational conditions to later changes. The mechanism may involve resource transfer, learning, coordination, reinforcement, institutional authorization, recognition, imitation, network exposure, expectation formation, technological complementarity, legal change, ecological feedback, symbolic classification, or another documented process. Claims of generation should remain proportionate to the degree to which such mechanisms can be evidenced. Where mechanism is uncertain, GRE should state the uncertainty rather than substituting the vocabulary of emergence for explanation.

The programme is especially interested in recursive transformation. Economic processes can change the conditions under which later processes operate. A policy can alter not only behavior but institutional trust; a technology can alter not only productivity but the skills and infrastructures required for participation; a market can alter not only allocation but the kinds of actors able to survive within it; an AI system can alter not only task performance but the organization of expertise, attention, and decision authority. In such cases, the effective rule governing later change may differ from the rule that characterized the earlier system. GRE therefore treats transformation of generative conditions, and where warranted transformation of effective rules, as explanatory objects in their own right.

Explanation also requires attention to propagation, conversion, recirculation, dissipation, and extraction. Generated value can move among subjects and institutions, change form, accumulate, decay, or be captured. Knowledge can become capability; capability can become bargaining power; symbolic recognition can become access; ecological capacity can become economic resilience; public infrastructure can become private rent; care can sustain labor capacity without appearing in market price. GRE does not presume that these conversions are complete or commensurable. It seeks to identify the relations through which they occur and the losses, exclusions, and asymmetries that accompany them.

Power enters this explanatory programme as the conversion of asymmetry into durable influence over others' options, vulnerabilities, representations, exit conditions, or future generative possibilities. Resource asymmetry, capability asymmetry, knowledge asymmetry, institutional authority, vulnerability, and exit conditions can each contribute to power when relational conditions allow them to be converted into leverage. This formulation avoids treating all difference as domination while making the reproduction of asymmetry economically analyzable.

GRE also attempts to explain orientation. Economic systems do not only produce outputs; they distribute attention, visibility, curiosity, legitimacy, funding, search capacity, and institutional recognition. These processes influence which possibilities receive the conditions required for further development. An account of generation is therefore incomplete when it describes capacity while ignoring the mechanisms that direct capacity toward some questions, designs, values, or futures rather than others. Orientation can be intentional, institutional, market-mediated, algorithmic, cultural, or emergent. Its explanation belongs within the economic problem-space when it affects resource allocation and future generative capacity.

The constitutional explanatory commitment can therefore be summarized without reducing it to one model: GRE seeks mechanisms linking relational organization to the emergence, persistence, transformation, distribution, or foreclosure of later economic possibilities. Different studies may instantiate that commitment through historical reconstruction, causal inference, formal modeling, computational exploration, qualitative mechanism tracing, comparative inquiry, or combinations of these modes. The explanatory standard lies in the clarity of the claim and its warrant, not in adherence to one technique.

3.22.4 Praxis and Transformative Orientation

GRE is not constituted only as a descriptive programme. It also includes praxis: the disciplined movement from explanation toward intervention under incomplete knowledge. This practical orientation follows from the object of inquiry. If economic relations shape later capacities, dependencies, values, and possibilities, then allocation and governance decisions participate in the generation of future conditions. The research programme should therefore be capable of informing intervention while remaining explicit about the uncertainty and normative judgment that intervention introduces.

Praxis begins with diagnosis rather than prescription. A relational diagnosis identifies the relevant subjects, institutions, infrastructures, dependencies, boundaries, and scales. A generative diagnosis asks which of those relations reproduce present conditions and which enable or foreclose change. Intervention design then specifies what is being altered: resources, constraints, access, recognition, information, rights, infrastructure, incentives, coordination mechanisms, or other conditions. This sequence prevents the language of generativity from becoming a license for indiscriminate experimentation.

Allocation is treated within this praxis as a relational intervention. The economic significance of allocating money, rights, infrastructure, education, information, or computational capacity depends on the relations into which the allocation enters. Identical resources can produce different effects under different conversion factors, institutional rules, recognition structures, ecological conditions, and power relations.

GRE therefore asks how an intervention changes the field through which resources become capabilities and how those new capabilities affect other subjects and future options.

Intervention generates evidence as well as effects. Feedback, implementation failure, unanticipated dependence, unequal uptake, symbolic reinterpretation, ecological response, and strategic adaptation can reveal relations that were poorly represented in the initial model. GRE praxis should therefore preserve mechanisms for revision during and after intervention. Adaptive governance is valuable where it institutionalizes learning without turning affected populations into uncontrolled experiments. The practical requirement is not endless flexibility but explicit conditions under which evidence triggers continuation, modification, scaling, suspension, or termination.

Withdrawal, reversal, and repair form part of this constitutional praxis. Interventions can become harmful, obsolete, captured, or self-reinforcing in ways that diverge from their original aims. A programme concerned with generative effects must ask whether the conditions produced by an intervention can be undone and what restoration would actually mean after the system has changed. Repealing a rule may fail to recreate the earlier state because capabilities, expectations, infrastructures, relationships, and subject positions have already been transformed. Reversibility is therefore an empirical property, not an administrative assumption.

The transformative orientation of GRE remains normatively open in a specific sense. The programme can analyze which interventions expand participation, capability, resilience, plurality, or future possibility, but it does not derive a complete moral ordering from generativity alone. Normative appraisal can draw on justice theory, ethics, law, democratic processes, domain-specific standards, and the neighboring GREthic programme. Praxis is thus constituted by an obligation to connect explanation with action where useful, paired with an obligation to keep empirical mechanism and normative justification distinguishable.

3.22.5 Evidential Admissibility

GRE adopts evidential pluralism constrained by claim-specific standards. Evidence is admissible when it bears materially on the claim being made and when the path from observation or representation to inference is sufficiently explicit for criticism. The constitution therefore does not privilege one evidential form in advance. Administrative records, prices, transactions, experiments, quasi-experiments, surveys, interviews, ethnography, archives, legal materials, organizational documents, ecological measurements, network data, computational traces, comparative cases, formal implications, simulations, and intervention records can all contribute, but they warrant different kinds and strengths of claims.

Descriptive evidence can establish patterns without identifying mechanisms. Causal designs can estimate specified effects without exhausting interpretation or historical formation. Historical evidence can reconstruct sequence, contingency, and institutional development without producing a universal parameter estimate. Interpretive evidence can establish how categories, meanings, or obligations are understood by participants without by itself identifying every material consequence. Formal models can show what follows from specified assumptions without demonstrating that the target system satisfies those assumptions. Simulations can explore

implications, sensitivity, and possible dynamics without becoming observations of the world merely through computational complexity. These distinctions are constitutional because GRE depends on combining modes without conflating their warrants.

Evidence for generative claims requires particular care. A downstream change occurring after an intervention is insufficient by itself to establish generation. Researchers should specify a mechanism, consider alternative pathways, examine temporal ordering, identify relevant mediators, and state the boundary over which the claim is intended to hold. Where direct identification is impossible, triangulation among historical, qualitative, quantitative, formal, or comparative evidence can strengthen the claim while preserving residual uncertainty. The programme accepts graded evidence; it does not require false certainty before relational mechanisms can be studied.

Counterfactual reasoning is often unavoidable. Claims about capability, foreclosure, resilience, opportunity, or future possibility concern alternatives that may never be fully observed. Evidence can include comparison across cases, natural experiments, historical alternatives, participant knowledge, structural models, simulation, sensitivity analysis, or explicit scenario construction. The relevant standard is transparency about which counterfactual is being invoked and why it is credible enough for the intended claim. Counterfactual richness should not be confused with evidential freedom.

Negative and disconfirming evidence also belongs within GRE. Failed interventions, absent downstream effects, unstable mechanisms, measurement failure, non-transportable cases, and situations in which a simpler established theory outperforms a GRE formulation should be retained as programme knowledge. Such evidence narrows the field's domain and improves theory comparison. A research programme that records only successful generative narratives would systematically exaggerate its own explanatory scope.

Finally, evidence is historically situated. Data availability, categories, archives, measurement systems, institutional visibility, and computational capacity change over time. Some subjects leave extensive traces while others remain under-recorded; some value forms are priced while others are rendered administratively invisible. GRE therefore treats the evidential environment itself as potentially structured by power and institutions. Evidential admissibility includes attention to whose relations can be observed, which histories can be reconstructed, and which absences may reflect the organization of recording rather than the absence of the phenomenon.

3.22.6 Criteria of Contribution

A contribution to GRE is constituted by the structure of its research claim rather than by the presence of GRE terminology. At minimum, a recognizable contribution should specify the relational problem, the relevant scale and boundary, the generative or relational claim being advanced, and the evidence or representation that bears that claim. It should distinguish the modeled or represented relation from the target relation, calibrate its inference to the available warrant, and identify material alternative mechanisms where they are plausible.

A contribution may be conceptual. It can clarify a category, distinguish previously conflated mechanisms, develop a typology, or revise the programme's ontology under

suspension. It may be empirical, identifying a generative relation or demonstrating a boundary condition. It may be historical, reconstructing how an economic subject, institution, value form, or generative condition emerged. It may be formal, providing a model that clarifies a mechanism or reveals implications. It may be computational, exploring dynamics inaccessible to analytic derivation. It may be normative, identifying evaluative conflicts or consequences that existing frameworks obscure. It may be practical, producing intervention evidence or governance procedures. No one form is constitutively superior.

GRE contribution also requires downstream discipline. A study need not trace every consequence of an intervention or relation, but it should explain why the chosen horizon is adequate to the research problem and acknowledge plausible effects excluded by that boundary. Where a claim concerns generativity, the analysis should identify what is being generated, for whom or for what system, through which mechanism, over what time horizon, and under what conditions. The term *generative* should carry analytical content rather than function as a general synonym for productive, innovative, or beneficial.

Normative transparency is another criterion. Researchers should distinguish descriptive claims, explanatory claims, forecasts, evaluations, and recommendations. If a contribution favors participation, capability, equality, resilience, pluralism, ecological integrity, autonomy, or another normative objective, the evaluative premise should be stated rather than embedded invisibly in the language of system improvement. GRE can support normatively engaged research while preserving the difference between evidence about consequences and judgment about their desirability.

Contribution further requires reproducibility or interpretive traceability appropriate to the method. Quantitative and computational work should expose data construction, assumptions, code, parameters, and sensitivity where feasible. Historical and qualitative work should make source selection, interpretive steps, category construction, and evidential tensions sufficiently visible for another researcher to understand how the conclusion was reached. Formal work should state assumptions and domains of applicability. Traceability is the general constitutional requirement; exact replication is one method-specific realization.

The final criterion is cumulative relevance. A GRE contribution should leave the programme better able to inquire afterward. It may supply a reusable concept, map, dataset, mechanism, comparative case, formal model, indicator, intervention record, negative result, or theory revision. Cumulative relevance includes contraction. Demonstrating that a concept is too broad, a mechanism fails outside a narrow domain, an indicator systematically distorts value, or an intervention generates recurrent harm is a positive research contribution because it improves the programme's capacity to avoid error.

3.22.7 Open Constitutional Questions

The preliminary constitution deliberately leaves major questions open. The first concerns identification. Generative relations are often distributed, mediated, and historically formed, making it difficult to determine which relation produced which downstream capacity or constraint. Better causal designs, process tracing, comparison, formalization, and computational methods may improve identification, but some relations remain reflexive or multiply realized. The programme does not assume that

every generative effect can eventually be assigned to a single source.

A second open question concerns measurement. Generativity can refer to capability formation, relation formation, value propagation, diversification of future possibilities, resilience, subject formation, institutional transformation, or changes in the effective rules of change. These may require different measures and may resist reduction to one scalar index. Measurement research should therefore explore domain-specific indicators, multidimensional representations, and comparative procedures without presuming a universal generativity metric.

A third concerns value. Economic relations can generate several forms of value simultaneously and can convert value across domains imperfectly. Monetary price, capability, symbolic recognition, ecological capacity, care, knowledge, institutional trust, public infrastructure, and future option value cannot be presumed fully commensurable. GRE requires practical ways to compare and govern heterogeneous values while preserving information about what is lost through commensuration. The relation between such comparisons and normative justification remains open.

A fourth concerns boundaries and scale. Relational systems rarely arrive with uniquely given analytical borders. Expanding a boundary can reveal hidden dependencies while making causal identification harder; narrowing it can improve tractability while externalizing relevant effects. Scale changes can also alter what counts as an entity, mechanism, or outcome. GRE therefore needs stronger procedures for boundary sensitivity, multiscale inference, and the comparison of explanations constructed at different resolutions.

A fifth concerns changing transformation rules. When institutions, technologies, categories, expectations, or subject capacities evolve, the model adequate to an earlier period may cease to describe the later system. Some of this can be handled through time-varying or adaptive models; some may require changes in variables and model classes themselves. Distinguishing parameter change from structural change, and structural change from the emergence of new relevant categories, remains a central theoretical and empirical problem.

A sixth concerns justice and governance under persistent asymmetry. Economic relations often depend on differences in capability, information, authority, vulnerability, and exit. Equalization can be desirable in some dimensions while infeasible or counterproductive in others. Counter-power can reduce domination while creating new gatekeepers. Governance must therefore organize asymmetry while preserving participation, contestability, learning, and repair. The programme leaves open which institutional forms achieve those aims under different material and cultural conditions.

A seventh concerns heterogeneous subjects and artificial intelligence. Operational agency, legal personality, moral status, consciousness, accountability, and economic capability can diverge. AI systems can become economically consequential without resolving philosophical questions about machine subjecthood. GRE needs analytical conventions that allow such systems to be studied as participants or mediators where appropriate while preventing capability measures from silently determining ontological or normative status.

An eighth concerns long horizons. Generative effects can unfold across careers, institutions, ecosystems, and generations. Evidence weakens as horizons extend, while path dependence and rule change make extrapolation increasingly uncertain. Yet short-horizon evaluation can systematically favor interventions that consume the

conditions of future possibility. Developing responsible long-horizon analysis without manufacturing spurious precision remains one of GRE's most important open problems.

These questions are constitutional because their unresolved status shapes how the programme should behave. Openness does not imply that anything is permitted. It means that GRE should preserve competing formulations, record uncertainty, compare methods, and allow evidence from later chapters and future research to revise the present constitution. A preliminary constitution identifies the space of legitimate disagreement as much as it identifies present commitments.

3.22.8 Historical Revisability of the Programme

GRE is constituted as a historically situated research programme. Its emergence is connected to changes described in Chapter 1: expanded relational production, globalization, digital mediation, artificial intelligence, ecological constraint, changing scarcity, capability asymmetry, new scientific and computational capacities, and altered conditions of evidence and governance. These conditions make certain relational and generative questions more visible and more tractable. They do not make GRE historically inevitable, universally necessary, or permanently adequate.

Historical situatedness has two implications. First, GRE concepts should be expected to change as the economy changes. Categories useful for contemporary platform economies, AI-mediated production, or ecological transition may require revision under future institutional and technological arrangements. New forms of subjecthood, coordination, property, value, or infrastructure may emerge. Existing distinctions may lose relevance. A theory of historically changing economic reality should preserve the capacity to revise the categories through which it recognizes that reality.

Second, standards of inquiry can also evolve. New measurement technologies, archives, computational methods, legal institutions, participatory procedures, and epistemic practices can change what relations are observable and what interventions are ethically or practically possible. Methods and evaluative procedures therefore possess histories of their own. GRE should record those histories and remain capable of re-evaluating earlier findings when the epistemic resources available to later inquiry change. Revisability applies to methods and standards as well as to substantive theory.

Revision should nevertheless remain disciplined by programme memory. The replacement of one concept by another should preserve the reasons for the change; abandoned indicators, failed models, negative cases, and superseded mechanisms should remain accessible where possible. Otherwise a field can mistake forgetting for innovation. Cumulative knowledge requires both inheritance and correction. A historically revisable constitution therefore needs archives of its own revisions.

The present constitution can be revised through several routes. Empirical anomalies can show that a proposed relation does not operate as expected. Comparative work can reveal that a mechanism is culturally or institutionally specific. Formal work can expose inconsistency or hidden assumptions. Intervention can reveal unanticipated dependence or harm. Normative inquiry can show that an apparently desirable generative process rests on unjust relations. Historical analysis can demonstrate that a category treated as natural is institutionally recent. Domain applications

can reveal objects that the existing typology cannot adequately represent. Each route provides a legitimate basis for constitutional amendment when the evidence is strong enough.

Revisability also protects GRE from disciplinary self-insulation. The programme should remain in dialogue with mainstream economics, political economy, economic sociology, complexity and evolutionary economics, capability approaches, ecological economics, legal and institutional analysis, philosophy, computer science, and other relevant fields. GRE has no constitutional entitlement to retain a concept merely because it originated within the programme. Where neighboring theories explain a problem better, GRE should borrow, narrow its own claim, or withdraw it. The integrity of the programme depends more on its capacity for correction than on the preservation of a proprietary vocabulary.

A preliminary constitution therefore combines continuity with amendability. GRE presently studies economic relations through their role in generating, distributing, transforming, and foreclosing later capacities and possibilities. It proceeds under ontological suspension, evidential pluralism, boundary and scale transparency, methodological pluralism, normative separability, and explicit attention to power, heterogeneity, historical dependence, and recursive change. It seeks explanations that identify mechanisms, praxis that remains revisable under feedback, contributions that are traceable and cumulative, and a programme architecture capable of learning from failure as well as success. These commitments are strong enough to coordinate inquiry while remaining open to revision.

Chapter 3 thereby completes the preliminary constitution of Generative Relational Economics and closes Part I. Chapter 1 reconstructed the historical conditions under which the programme becomes intelligible; Chapter 2 reconstructed the intellectual lineages that make its conceptual vocabulary possible; Chapter 3 has stated the provisional research programme that follows from those conditions and inheritances. Part II now turns from constitution to deeper theoretical development. Chapter 4 examines the ontological view of Generative Relational Theory, beginning with the degree and form of ontological commitment that relational and generative inquiry requires. The constitution established here should therefore be treated neither as an endpoint nor as a summary detached from what follows. It is the provisional compact against which the later ontology, epistemology, methodology, formalization, political economy, governance, and applications of the book can be tested and revised.

Chapter 4

The Ontological View of Generative Relational Theory

Chapter 4 begins Part II by making explicit the ontological view that underlies Generative Relational Theory (GR) and, through it, Generative Relational Economics (GRE). Part I established the historical conditions under which GRE becomes salient, reconstructed the intellectual lineages from which it draws, and formulated its preliminary disciplinary constitution. Those tasks repeatedly relied on distinctions among objects, relations, processes, representations, subjects, values, institutions, and emergent forms of reality. The present chapter develops the ontological architecture required to use those distinctions with greater precision. Its purpose is neither to establish a final metaphysics nor to reduce heterogeneous domains to a single relational vocabulary. It is to clarify what kinds of reality GR and GRE can speak about, under what commitments, and with what degree of ontological restraint.

The central architecture developed in this chapter distinguishes three registers: *ontological reality*, *relational reality*, and *manifestational reality*. The distinction is analytical rather than a division of the world into three independent substances or three successive stages. Ontological reality concerns the question of what obtains or occurs at the level of reality whose ultimate constitution may remain partly or wholly outside the commitments required by a particular inquiry. Relational reality concerns objects that emerge within generative-relational systems and acquire sufficient persistence and stability over some region or interval of spacetime to exercise causal efficacy within those systems. Manifestational reality concerns the conditions under which something becomes available in a mode of appearance, experience, articulation, measurement, classification, symbolization, or other manifestation. These registers identify different questions concerning reality and thereby allow existence, relational efficacy, manifestation, knowledge, and representation to remain analytically distinguishable.

Relational reality occupies a particularly important position in GR. An object can become relationally real without the framework first establishing that it possesses an independent or fundamental ontological existence. Money, legal status, institutional authority, socially sustained identities, forms of trust, experienced continuity of self, and objects embedded in religious or cultural relations may acquire persistence, stability, and causal efficacy through the systems in which they emerge. Their relational

reality concerns how they are generated and sustained within those systems and how, once stabilized, they participate in the generation of subsequent relations. This claim leaves their ultimate ontological status open where stronger commitment is unnecessary. Relational reality is therefore neither weakened reality nor a synonym for collective belief. It names a distinct analytical status grounded in generative emergence, persistence, stability, and causal participation.

Relational reality also need not await perception. A relational-generative structure may already persist and exercise causal efficacy before a subject becomes aware of it, before it acquires perceptual salience, or before a symbolic vocabulary has been developed through which it can be articulated. This feature becomes important for later GR inquiries into contingency, aesthetic judgment, subjectivity, historical emergence, and the formation of meaning. A contingent configuration, for example, may possess a relational and historical structure before its contingency becomes manifest to a subject and before an aesthetic judgment concerning it occurs. Manifestation can therefore disclose something whose relevant generative conditions precede the event of disclosure. Neither conscious recognition nor symbolization is a general precondition for relational reality.

The distinction between relational and manifestational reality nevertheless does not establish a one-directional sequence. Manifestations can themselves enter generative-relational systems. Once an appearance, judgment, classification, measurement, declaration, image, symbol, institutional record, or other manifestation becomes operative within a system, it may alter expectations, practices, classifications, capacities, constraints, and subsequent relations. Manifestation may thereby contribute to the stabilization, transformation, or dissolution of relational realities. A declaration of trust can alter the relation through which trust continues to develop; a monetary inscription can participate in reproducing monetary relations; a legal classification can reorganize the institutional relations to which it refers; and a manifested self-description can affect later recognition, conduct, and self-formation. Manifestational reality therefore participates in generation rather than occupying only an observational surface outside it.

For this reason, the three registers are better understood through a graph of heterogeneous relations than through a chain of successive layers. Ontological conditions may participate in the emergence of relational structures. Relational structures may condition what can become manifest. Manifestations may reorganize relational structures and, through historically accumulated effects, alter the conditions encountered by later processes. Relations between the registers can be recursive, many-to-many, temporally extended, and partly non-invertible. No universal sequence from ontology to relation to manifestation is presupposed. Particular trajectories may exhibit such an ordering locally, but the architecture itself permits feedback, mediation, historical transformation, and multiple paths among the registers.

A limited heuristic analogy can be drawn with the three-register architecture associated with Lacanian thought. Ontological reality can recall some of the problems posed through the Real, relational reality some functions associated with the Imaginary, and manifestational reality some aspects of the Symbolic. The correspondence is deliberately incomplete. GR's ontological reality is not equivalent to the Lacanian Real; relational reality extends beyond image and identification; and manifestational reality includes perceptual, affective, bodily, material, institutional, statistical, and technological manifestations that cannot be reduced to symbolic inscription. The use-

ful analogy lies principally in refusing a linear hierarchy among registers and in attending to their mutual mediation. The relation among the registers matters more here than any attempted one-to-one identification among their names.

A further consequence concerns comparison. The fact that two objects satisfy the conditions for relational reality does not establish that their generative structures are commensurable. They may occupy a common metric space, different metric spaces connected through an explicitly constructed mapping, non-metric spaces admitting another form of structural comparison, or relational domains for which no warranted common comparison structure has yet been established. Shared reality-status therefore does not imply shared structure. A perceptual object generated under conditions ordinarily described as hallucinatory and a perceptual object associated with an independently physical object may both become relationally real within relevant systems while differing substantially in their generative organization. The ontological, relational, and manifestational questions concerning them remain distinguishable, and comparison between their structures requires additional justification.

This point becomes consequential when the chapter turns to manifestation mappings and their possible non-invertibility. Similar manifestations may arise from different relational configurations, while similar relational configurations may yield different manifestations under changing bodily, historical, institutional, cultural, technological, or symbolic conditions. Reverse inference from manifestation to relational structure therefore requires explicit epistemic assumptions. Manifestational similarity alone provides insufficient grounds for relational identity, just as relational comparability does not by itself establish ontological identity. These distinctions provide part of the ontological basis for the epistemological problems developed in Chapter 5.

The chapter proceeds by stages. Section 90 states the ontological position of GR and develops the principle of methodological restraint. The subsequent sections introduce the three registers of reality and clarify ontological suspension before returning to change, structure, constraint, and difference as minimal primitives through which stable configurations can be analyzed. The chapter then develops relational reality and manifestational reality in greater detail, examines the generative emergence of manifestation, and studies the mappings through which relational configurations become manifest. Later sections address non-invertibility, symbolization, recursive relations among manifestation and subsequent relational formation, subjecthood, value, meaning, social facts, institutions, process, events, and becoming. Category-theoretic and scale-relative views are introduced where they offer useful formal or structural clarification, while their ontological interpretation remains deliberately limited. The final movement historicizes ontological categories, clarifies the methodological status of relational-generative analysis, considers compatibility with alternative ontological commitments, and states the boundaries of the chapter's claims.

The resulting ontology is intentionally open. GR requires enough ontological articulation to distinguish kinds of reality, analyze their relations, and prevent epistemic or representational categories from silently replacing the realities under study. It does not require those distinctions to culminate in a closed metaphysical system. The three-register architecture instead provides a disciplined space within which heterogeneous realities can emerge, persist, act, manifest, mediate one another, and transform historically while questions of ultimate ontology remain open where the inquiry

does not require their resolution. This ontological view prepares the transition from the reality of generative-relational systems to the epistemic problem of how such realities can be known through necessarily situated manifestations, traces, representations, and interventions.

4.1 Ontological Position

This section establishes the ontological position from which the remainder of Chapter 4 proceeds. Its role is preparatory: before GR distinguishes ontological, relational, and manifestational reality, it must clarify what kind of ontological commitment an open generative-relational research programme actually requires. The argument proceeds in five steps. It first specifies the function of an ontological position in GR, then examines why economic analysis cannot avoid ontological commitments simply by leaving them implicit. It next distinguishes commitments made for a local explanatory task from stronger claims about the ultimate constitution of reality. The final two subsections formulate methodological restraint and explain how GR can make substantive ontological commitments without converting those commitments into a closed metaphysical system. The mode of argument is conceptual and methodological. The aim is to establish conditions for disciplined inquiry rather than to settle the ultimate furniture of reality.

4.1.1 Ontological Position in Generative-Relational Inquiry

Every inquiry presupposes some account of what kinds of objects, processes, relations, differences, events, or structures can enter explanation. A study of prices presupposes that prices can be identified with sufficient stability for the purposes of the analysis. A study of institutions presupposes that institutions can persist through changes in personnel and individual acts. A study of subjects presupposes some basis on which actions, memories, capacities, or recognitions can be attributed to a subject over an analytically relevant interval. A study of causal effects presupposes that differences in the world can be related to subsequent differences under stated conditions. These presuppositions need not constitute a complete metaphysics, yet they carry ontological content because they determine what the inquiry treats as sufficiently real, persistent, and efficacious to bear explanatory weight. (Quine 1948; Fraassen 1980)

GR makes this background explicit because its principal objects are often emergent, historically variable, multiply realized, reflexive, or only partially accessible through observation. The framework studies how objects and capacities arise through generative relations, how stabilized forms participate in later generation, how manifestations mediate subsequent relations, and how the relevant units of analysis can change with scale and history. Such questions become confused when the status of an analytical object is left unspecified. A relation represented in a model, a relation inferred from evidence, a relation stabilized in a social system, and a relation posited as part of ultimate reality are different claims even when the same word is used for each of them.

Definition 4.1 (Ontological position). An *ontological position* is the explicit set of commitments through which an inquiry specifies what kinds of entities, relations, pro-

cesses, differences, structures, or events it treats as real enough to enter explanation, together with the scope and strength assigned to those commitments.

Definition 4.1 treats an ontological position as more than a list of objects. Scope and strength matter equally. A claim that money is real for the analysis of exchange, obligation, accounting, and institutional action differs from a claim that money is a fundamental constituent of reality. A claim that a relational configuration has causal efficacy within a particular generative-relational system differs from a claim that relation is the ultimate substance from which all reality is composed. A claim that a self persists with enough stability to organize action differs from a claim that the self possesses an invariant metaphysical essence. GR therefore requires an ontological vocabulary capable of supporting local explanatory commitments while preserving distinctions among different strengths of claim.

This position also separates ontology from immediate observability. Some structures relevant to explanation may be indirectly inferred, historically reconstructed, experimentally perturbed, or manifested only through partial traces. Their ontological status cannot be reduced to whether a subject currently perceives them. Conversely, something may be vividly perceived or symbolically articulated while its underlying ontological status remains unsettled. Chapter 4 will later formalize this distinction through the three registers of reality. At this stage, the important point is methodological: a theory of reality must distinguish the conditions under which something becomes available to inquiry from the conditions under which it becomes causally or structurally relevant to the system being studied.

GR consequently adopts an ontological position because generative explanation needs objects that can persist, interact, constrain, enable, transform, and become historically consequential. At the same time, the framework resists extending each local explanatory success into a general metaphysical conclusion. This combination provides the starting orientation for the chapter: explicit commitment where explanation requires it, explicit suspension where the evidence and analytical task do not warrant further closure.

4.1.2 Ontology and Economic Analysis

Economic analysis makes ontological selections whenever it decides what counts as an economic object, a relevant relation, a unit of action, a form of value, a resource, an institution, a constraint, or a consequence. These selections can remain implicit because many categories are inherited from established practice. Households, firms, states, markets, prices, contracts, preferences, assets, skills, debts, and technologies can appear sufficiently familiar that their status as analytical constructions receives little attention. Yet each category compresses a field of heterogeneous relations into an object that can be compared, measured, modeled, regulated, or acted upon. (Giere 2004)

The ontological significance becomes clearer when categories change. A platform can function simultaneously as a firm, infrastructure, market organizer, data environment, contractual authority, and technological mediator. An artificial system can participate in production, recommendation, bargaining, classification, and coordination while questions of agency, subjecthood, legal personality, and responsibility remain separately unsettled. Knowledge can appear as a private asset, a shared capacity, an institutional memory, a public resource, or a relation embodied in practices

and networks. Care can be treated as labor, relation, capability formation, social reproduction, or a mixture whose relevant ontology varies with the research question. Such cases reveal that economic analysis does not merely observe a world already partitioned into self-identifying economic units. It also selects and stabilizes objects for inquiry.

GRE requires particular care because its central questions concern generation across time. An economic relation can alter the capacities of subjects, the availability of future actions, the structure of institutions, the distribution of recognition, the meaning of categories, and the conditions under which later value can be generated. The object relevant at the beginning of a process may therefore differ from the object relevant at its end. A training relation can alter the capabilities through which a worker later participates in production. A credit relation can change both material capacity and future bargaining conditions. An institutional classification can reorganize eligibility and thereby reshape the population to which the classification is subsequently applied. The ontology of the analysis must accommodate objects that are partly constituted through the histories in which they participate.

This historical mutability does not imply that economic objects are analytically arbitrary. An object can be historically generated and still become stable enough to constrain action, coordinate expectations, carry obligations, or produce measurable consequences. The relevant question is therefore not whether an object is timeless, but how its stability is generated, over what interval it persists, through which relations it is reproduced, and what causal difference its presence makes. This is one reason relational reality becomes important later in the chapter: many economically consequential objects derive their practical reality from sustained generative relations without requiring an immediate claim about their ultimate metaphysical status.

Economic representations also participate in the realities they describe. Prices, rankings, credit scores, accounting categories, legal forms, forecasts, and classifications can become inputs into later action. Once institutionalized, a representation may influence resource allocation, access, expectations, strategy, or identity. The economic analyst therefore encounters a reflexive environment in which manifestational and representational forms can become causal components of subsequent relational organization. This feature gives ontology a practical significance. Treating a category as merely descriptive can obscure the process through which its use contributes to reproducing or transforming the object under analysis.

Claim 4.2 (Ontological relevance of economic categories). *An economic category acquires ontological relevance for GRE when its stabilization, transformation, or disappearance makes a causal or structural difference to the generative-relational processes under study.*

Claim 4.2 does not require every economic category to possess the same mode of reality. A legal corporation, a price, a bodily capacity, an ecosystem, a debt, and an expectation can enter economic explanation through different generative histories and different forms of persistence. Their inclusion in one inquiry does not imply that they share a common substance or a common metric. It establishes only that the analysis has reasons to treat them as causally or structurally relevant within its stated domain.

This pluralism is especially important for GRE because heterogeneous objects can interact without becoming ontologically homogeneous. A legal rule can affect material production; an aesthetic judgment can redirect research attention; a symbolic

classification can change access to finance; a bodily limitation can alter bargaining relations; an imagined future can influence present investment. The causal field of economic action therefore crosses domains that may require different descriptive vocabularies. A useful ontology must permit interaction across heterogeneous forms of reality while resisting the inference that interaction proves reducibility to one underlying analytical language.

4.1.3 Locality and Scope of Ontological Commitment

Ontological commitment in GR is local to an explanatory task unless a stronger scope is independently established. Locality here refers to the domain within which a commitment is warranted: a generative-relational system, a historical interval, an analytical scale, a class of mechanisms, or a specified research problem. This principle allows GR to say that an object is real enough to explain a process without requiring the same statement to settle its status across every possible domain of inquiry.

Definition 4.3 (Ontological commitment). An *ontological commitment* is a commitment to treat some object, relation, process, difference, structure, or event as possessing sufficient reality, within a specified domain and for a specified explanatory purpose, that claims about its persistence, efficacy, interaction, or transformation can bear argumentative weight.

Definition 4.3 makes ontological commitment purpose-sensitive without making it arbitrary. The commitment remains answerable to evidence, coherence, explanatory performance, and the consequences of intervention. Its purpose specifies the burden of proof. An analysis of currency circulation may require a robust account of money as an institutionally and relationally stabilized object while remaining neutral about whether monetary value possesses any reality outside such systems. An analysis of subjective continuity may require a stable operational subject over a given interval while leaving open deeper claims about the metaphysics of selfhood. An analysis of religiously organized economic life may need to treat a deity as a relationally real object within the relevant system if the deity organizes obligations, trust, sacrifice, authority, or allocation; that analytical commitment does not itself adjudicate theological claims concerning independent divine existence.

Locality also matters for scale. An object stable at one scale may dissolve into changing components at another. A firm can be treated as a persistent organization in an industry-level analysis while appearing as a changing field of contracts, routines, persons, technologies, and authority relations in an organizational study. A market can function as an analytical object at one scale while a microstructural analysis resolves it into order books, protocols, matching rules, information flows, and strategic interactions. Neither description automatically invalidates the other. Their adequacy depends on the generative processes each inquiry seeks to explain.

Temporal scope produces a similar effect. Persistence is always persistence over some interval. An institution can be highly stable relative to daily transactions and historically transient relative to centuries. A subject's identity can remain sufficiently continuous for contractual responsibility while changing substantially over a life course. A convention may stabilize coordination for a generation and later disappear. GR therefore avoids treating stability as timeless identity. Stability is a relation between a pattern and an analytical timescale, together with the mechanisms that reproduce the pattern across change.

Proposition 4.4 (Local sufficiency of ontological commitment). *For a generative-relational explanation, the ontological commitment required to support the explanation need extend only as far as the persistence, efficacy, and relations necessary for that explanation, unless additional evidence or argument justifies a stronger claim.*

Proposition 4.4 provides a rule of economy for ontological reasoning. If an account of institutional trust depends on a stabilized relation that changes later action, the inquiry can study that relation without deciding whether trust is reducible to neural states, symbolic structures, expectations, embodied dispositions, or some combination of them at an ultimate level. If a model of knowledge production depends on a research community, shared standards, archives, and infrastructures, those objects can be treated as real components of the explanatory domain without requiring a final ontology of collective entities. Stronger commitments remain possible, but they carry additional argumentative burdens.

Local commitment also protects against a common error in interdisciplinary work. A concept transferred from one domain can be useful without carrying its entire source ontology with it. Field language, network language, dynamical systems, category theory, information, geometry, or computation may disclose structure in an economic problem. Their successful use does not automatically establish that the economic world is fundamentally a field, network, dynamical system, category, informational object, geometric manifold, or computation. The imported representation earns authority over the relations it successfully captures; claims beyond that scope require separate support.

The locality principle prepares the distinction developed in the next sections. Ontological reality, relational reality, and manifestational reality will allow GR to specify different forms of claim without forcing them into a single hierarchy. The present section establishes the prior discipline: the scope of an ontological commitment should remain visible, and movement from a local claim to a stronger claim should be argued rather than assumed.

4.1.4 Methodological Restraint in Ontological Claims

Methodological restraint governs the transition from analytical success to ontological assertion. GR uses strong conceptual resources because generative systems can be difficult to describe with ordinary entity-centered language. Relations can have higher-order structure; constraints can alter the space of possible action; historical trajectories can produce attractors or path dependence; categories can change the behavior of classified subjects; and manifestations can feed back into the systems from which they emerge. Each of these phenomena may invite formal representations. The quality of a representation, however, does not by itself determine the ultimate ontology of the represented system.

The distinction can be stated through three questions. The first asks whether a representation is useful: does it organize observations, distinguish mechanisms, support inference, or enable intervention? The second asks whether the represented structure is real within the domain: does the structure persist, constrain, enable, or causally alter the system in ways that survive changes in description? The third asks whether the representation identifies the ultimate constitution of what exists. These questions can receive different answers. A network model can be useful even when edges are constructed from imperfect proxies. A relational structure can be causally

real even when several mathematical representations capture it equally well. An empirically successful representation can remain silent about ultimate ontology.

Remark 4.5 (Representation and ontological inference). The empirical or explanatory success of a representation can support claims about structures captured by that representation while leaving stronger claims about the ultimate constitution of reality underdetermined.

Remark 4.5 is particularly important for a framework that draws from several formal traditions. A graph can reveal patterns of connectivity, a dynamical system can reveal stability and transition, a field representation can express spatially or relationally distributed influence, and a category-theoretic formulation can clarify mappings among structures. These representations may overlap without being mutually reducible. GR therefore treats formal plurality as evidence that the relation between representation and ontology itself requires analysis.

Methodological restraint also applies to ordinary language. Terms such as “subject,” “institution,” “value,” “power,” “relation,” and “field” can acquire an apparent solidity through repetition. A concept introduced as an analytical convenience may gradually be spoken of as though its boundaries were discovered rather than constructed. Conversely, a familiar category can appear natural even when its persistence depends on legal, technological, cultural, and historical conditions. Ontological discipline requires the manuscript to mark when a term refers to a stipulated analytical unit, an empirically inferred structure, a relationally stabilized object, a manifestation, or a stronger ontological claim.

Caution 4.6 (Ontological inflation). Ontological inflation occurs when an analytical distinction, representation, measurement, or successful local explanation is extended into a stronger claim about reality without an additional argument adequate to that stronger scope.

Caution 4.6 applies in both formal and qualitative inquiry. Quantification can inflate a proxy into a property; interpretive analysis can inflate a recurrent meaning into a universal structure; historical reconstruction can inflate a contingent lineage into necessity; a relational model can inflate explanatory dependence into a claim that only relations exist. Restraint does not weaken inquiry. It preserves the distinction between what the evidence establishes and what remains open.

The same discipline applies to causal language. GR often studies objects that acquire causal efficacy through relational stabilization. Causal efficacy here means that the presence, persistence, transformation, or disappearance of the object makes a difference to subsequent states or possibilities under relevant conditions. It does not require that the object be fundamental in a reductionist hierarchy. Nor does it imply that causality can always be assigned to a single isolated object. In generative-relational systems, causal contribution may be distributed across configurations, histories, interfaces, and feedback processes. The ontological commitment should match the causal claim being made.

Methodological restraint therefore has a positive function. It makes room for strong local explanation, plural representation, and cross-disciplinary borrowing while protecting the framework from premature metaphysical closure. This discipline will become especially important when relational reality is defined later in the chapter. The fact that an object is relationally real will establish a substantive claim about its emergence, persistence, stability, and causal efficacy within a system. It will not by itself settle whether that object is ontologically fundamental, reducible to

another level, or comparable with every other relationally real object.

4.1.5 Ontological Commitment without Closure

GR's ontological position can now be stated more precisely. The framework is committed to the reality of change, difference, constraint, structure, persistence, and causal efficacy wherever these are required and warranted by the inquiry. It is committed to treating generative relations as analytically consequential when transformations in relations alter what objects, capacities, manifestations, or possibilities can emerge. It is also committed to the possibility that some emergent objects become sufficiently stable to act back upon the systems through which they arose. These commitments provide the minimum ontological depth necessary for generative-relational explanation.

The framework simultaneously leaves several stronger questions open. GR does not need to determine whether relations are more fundamental than relata in every domain. It does not need to identify one privileged formal language in which all reality must be represented. It does not need to decide whether every socially consequential object is reducible to physical processes, whether every physical process is best understood relationally, or whether one universal metric can compare heterogeneous forms of reality. These questions can be addressed where a particular inquiry requires them, but the book does not make their settlement a prerequisite for economic analysis.

This openness is compatible with substantive disagreement. Two researchers can share a GRE analysis of the relational generation of money while holding different metaphysical views about social ontology. Two researchers can agree that a self-model becomes relationally stable and causally consequential while disagreeing about consciousness or personal identity. Two researchers can study how a religious object organizes economic action while differing on its ontological status outside the relational domain under investigation. The research programme remains coherent because its shared commitments concern the generative-relational structures required for the explanation, while stronger metaphysical claims can remain explicit points of divergence.

The position can therefore be summarized through a principle of graded commitment. Claims should become ontologically stronger only when the research question, evidence, and argument require and support the additional strength. Observation may justify a claim about manifestation. Recurrent and causally consequential organization may justify a claim about relational reality. A further claim about ontological reality requires its own warrant. Movement among these registers cannot be inferred merely from vocabulary or intuitive resemblance. Section 91 develops these distinctions directly.

Proposition 4.7 (Open ontological commitment). *GR permits substantive commitments concerning the reality, persistence, efficacy, and transformation of objects within generative-relational systems while keeping stronger metaphysical questions open whenever those questions are not required for the explanatory task.*

Proposition 4.7 expresses the balance sought throughout this chapter. An ontology too thin to distinguish reality from representation would leave GRE unable to explain how emergent objects become causally consequential. An ontology that converts every useful analytical form into an ultimate metaphysical claim would make

the programme unnecessarily brittle and would collapse heterogeneous domains into premature unity. Open ontological commitment occupies the intermediate position: reality claims are made where generative explanation requires them, their scope is stated, and further closure remains an additional task rather than an automatic consequence.

This position also preserves historical revisability. The objects recognized by an inquiry can change as institutions, technologies, categories, and relations change. New forms of economic subjecthood may emerge; old classifications may disappear; new infrastructures may create objects that earlier vocabularies could not represent adequately; improved methods may separate structures previously treated as one or reveal continuities previously missed. An ontological position adequate to generative inquiry therefore includes the possibility that its own categories will require revision. Revisability concerns the framework's descriptions and commitments, while the reality under study may exceed any one historical vocabulary used to describe it.

Section 90 thus establishes the ontological discipline for what follows. GR will make reality claims strong enough to support explanation, causal analysis, and historical inquiry. It will distinguish the scope of those claims, preserve the difference between representation and represented structure, and resist the extension of local success into unsupported metaphysical closure. With this position established, Section 91 turns to the chapter's central architecture: ontological reality, relational reality, and manifestational reality as three distinct but mutually mediating registers.

4.2 The Three Levels of Reality

This section introduces the three-register architecture through which GR distinguishes ontological reality, relational reality, and manifestational reality. The inherited outline uses the word *levels*, but the three are not ordered strata in which one sits above or below another. They are better understood as registers that answer different questions about reality and that can mediate one another through historically situated generative relations. The distinction is necessary because GR repeatedly encounters objects that are causally effective without requiring a settled claim about their ultimate ontology, as well as manifestations that disclose, transform, or even help stabilize the realities to which they relate. Treating these cases within a single undifferentiated category of "reality" would obscure differences among what obtains, what becomes stably effective in a relational system, and what becomes manifest under particular conditions.

The architecture developed here is deliberately minimal. It does not claim that every philosophical problem can be assigned uniquely to one register, nor that each object possesses only one form of reality. The same object may be considered differently according to the question being asked. Money can be examined through the material and institutional conditions that participate in its existence, through the stabilized relational reality by which it organizes exchange and obligation, and through the perceptual, symbolic, legal, or computational forms in which it becomes manifest. A sense of self can likewise be approached through bodily and ontological questions, through the relational processes that stabilize continuity and identity, and through the forms in which selfhood becomes experienced, narrated, classified, or represented. The registers therefore separate analytical questions without requiring

the realities under study to be separable in practice. (Whitehead 1929)

4.2.1 Ontological Reality

The first register concerns reality in its ontological status. GR needs this register because an inquiry can refer to what obtains or occurs without claiming that it has already captured the ultimate constitution of what obtains or occurs. The distinction is particularly important when perception, symbolic representation, institutional classification, or model construction provides only partial access to the processes under investigation. Ontological reality marks the fact that the reality of an event, structure, difference, or process cannot be reduced simply to the manner in which it has become available to a particular observer or system of representation. (Husserl 2012; Merleau-Ponty 2012)

Definition 4.8 (Ontological reality). *Ontological reality* denotes what obtains, occurs, or possesses efficacy insofar as its reality is not constituted merely by its being perceived, manifested, represented, measured, classified, or known within a particular epistemic situation. GR may refer to this register while leaving the ultimate constitution of what is ontologically real under ontological suspension.

Definition 4.8 is intentionally compatible with different metaphysical positions. It does not identify ontological reality with matter, physical substance, mind, relation, process, information, or another privileged category. Nor does it define ontological reality as whatever is permanently inaccessible. Some ontologically relevant structures may be directly observable under suitable conditions; others may be reconstructed from traces, inferred through intervention, or remain only partially accessible. The defining distinction concerns the status of the claim rather than the accessibility of the object: ontological reality is not exhausted by a particular manifestation or representation of it.

This register therefore gives GR a place to formulate questions that exceed what has presently become manifest. A physical process may continue whether or not it is observed. Historical conditions may constrain later possibilities even when no contemporary subject explicitly recognizes those constraints. Differences in biological, ecological, technological, or material organization may participate in generative processes before they acquire a social classification. In each case, an inquiry may have reasons to refer to a reality whose full ontology remains unsettled while resisting the stronger reduction of that reality to what is presently available in experience or representation.

The ontological register also protects GR from an opposite reduction. The fact that a relational or manifestational phenomenon is historically generated does not by itself imply that all aspects of the phenomenon are exhausted by the history through which it has been interpreted. An ontological question may remain open even after a rich account of relational emergence has been developed. This openness is especially important when different ontological interpretations remain compatible with the same relational evidence. The framework can then preserve the difference rather than forcing premature metaphysical closure.

Ontological reality is thus a register of commitment and restraint at once. GR can acknowledge that inquiry addresses realities rather than only descriptions while limiting its claims to what the research problem and evidence support. Section 92 develops this discipline through ontological suspension. For present purposes, the first reg-

ister provides the background against which relational reality can be distinguished from both ultimate ontological identity and manifest appearance.

4.2.2 Relational Reality

Relational reality is the central technical category through which GR recognizes objects that become real within generative-relational systems. The category was developed to avoid a recurrent false choice. Many consequential objects are difficult to treat as fundamental or independently existing substances, yet treating them as merely fictional, subjective, or representational fails to explain their persistence and causal effects. Money, institutional authority, debt, trust, socially sustained identities, religious objects, and the experienced continuity of a self can organize action and reshape subsequent relations even when their ultimate ontological status is left unsettled. GR therefore requires a criterion of reality grounded in emergence and efficacy within a relational system.

Definition 4.9 (Relational reality). *Relational reality* denotes an object that emerges within a generative-relational system and, over some region or interval of spacetime, persists with sufficient stability to exert causal efficacy upon that system. Its relational reality consists in its generated and sustained participation in subsequent relations rather than in a prior requirement that it possess an independently established ontological identity.

The word *object* in Definition 4.9 is deliberately broad. It can refer to a stabilized relation, configuration, pattern, institution, capacity, identity, process, or other analytically individuated object when the relevant conditions are satisfied. The definition is not meant to reify every transient correlation or every label introduced by an observer. Emergence alone is insufficient. A relationally real object must acquire persistence or recurrent stability over an analytically relevant spacetime domain, and its presence must make a causal difference within the generative-relational system in which it has emerged. Sections 93 and 94 will develop these conditions more carefully.

The criterion permits GR to treat money as relationally real without requiring a metaphysical substance called money. Monetary reality is sustained through legal recognition, accounting practices, expectations, exchange relations, institutional infrastructures, material and digital inscriptions, and histories of coordinated action. Once sufficiently stabilized, money affects access to goods, contractual possibilities, investment, labor, debt, expectations, and later relations. Its reality within such systems is therefore not adequately characterized by saying that participants merely believe in it. The belief, inscription, institution, and practice form parts of the generative relations through which the monetary object acquires persistence and causal efficacy.

The same logic can apply to a god within a religiously organized generative-relational system without requiring GR to settle the theological question of divine ontological existence. A divine object may become relationally real insofar as it is stably generated through ritual, memory, doctrine, architecture, collective practice, personal experience, authority, and other relations, and insofar as it causally reorganizes conduct, obligation, temporal practice, resource allocation, affect, identity, or institutional life. The relational claim neither establishes nor denies an independent divine ontology. It concerns the reality generated within the relational system and the causal work that this reality performs there.

A similar distinction applies to the experienced continuity of “I.” A relatively stable sense of self can emerge through bodily continuity, memory, recognition by others, language, institutional identity, habit, affect, and narrative. Once stabilized, this self-object can organize intention, responsibility, expectation, action, and interpretation. Its relational reality can therefore be studied without requiring GR first to decide whether a metaphysically invariant self exists. The example is especially useful because it shows that relational reality is not confined to conventionally external social objects. A reality can be intimate and subjectively consequential while still being relationally generated and historically sustained.

Relational reality also does not require prior perception. A generative-relational structure can persist and act before any subject recognizes it, before it receives a name, and before it is stabilized in symbolic form. This feature is important for the GR treatment of contingency and aesthetic judgment. The structure through which a contingent conjunction becomes possible can already be historically and relationally real before its contingency becomes salient to a subject. An eventual experience of surprise, beauty, significance, or curiosity is then a manifestation within a structure whose relevant generative conditions did not begin with the experience itself. The relational reality of those conditions is therefore conceptually prior to their recognition, even though later recognition can feed back into the system and change what follows.

Claim 4.10 (Manifestation is not required for relational reality). *An object can satisfy the conditions of relational reality before it is perceived, consciously recognized, linguistically articulated, symbolized, or otherwise manifested to a particular subject.*

Claim 4.10 prevents relational reality from collapsing into phenomenology, discourse, or representation. It also leaves room for a stronger recursive thesis developed later in the chapter: although manifestation is not a general precondition for relational reality, manifestations can become relations within the system and can therefore participate in generating, stabilizing, transforming, or dissolving relational realities. The absence of necessary priority in one direction is precisely why the three-register architecture must be understood as a graph rather than a chain.

4.2.3 Manifestational Reality

The third register concerns the reality of manifestation. Something can become present to a subject, instrument, institution, classificatory system, archive, legal process, market interface, or other relational configuration without the manifestation exhausting either the relational structure from which it emerged or the ontological reality to which it may refer. GR therefore treats manifestation as a positive object of analysis rather than as a transparent window through which an already complete reality is simply observed.

Definition 4.11 (Manifestational reality). *Manifestational reality* denotes reality insofar as something becomes available, differentiated, experienceable, perceptible, recordable, articulable, measurable, classifiable, symbolizable, or otherwise present within a particular relational and historical configuration. A manifestation is conditioned by the relations through which this availability occurs, and its reality does not by itself establish the complete ontological or relational structure of what is manifested.

Manifestation is broader than symbolization. A pain can become manifest affect-

tively and bodily before it is named. A pattern can become manifest statistically through an instrument or dataset without being available to unaided perception. An institutional boundary can become manifest through differential access or treatment before its rules are explicitly articulated. A landscape can become manifest aesthetically through a mode of attention that is partly perceptual and affective. A market condition can become manifest through price movements, queues, shortages, or changes in conduct. Symbolic representation is an especially powerful mode of manifestation because language, categories, diagrams, records, and numbers can stabilize and circulate what has become available, but symbolic inscription does not exhaust the manifestational register.

Manifestational reality should also be distinguished from the referential truth of a manifestation. A vivid perceptual flower generated under pathological or altered perceptual conditions can possess manifestational reality: the flower appears, organizes attention, and may provoke action or affect. An ordinary perceptual flower associated with a physically existing plant can likewise possess manifestational reality. The fact that both are manifestations does not establish that their ontological sources or generative structures are identical. Conversely, a difference in ontological interpretation does not make one of the manifestational events analytically nonexistent. GR can therefore investigate the reality and consequences of a manifestation while keeping separate the further question of what produced it and what ontological status should be assigned to its apparent object.

This distinction becomes important whenever manifestation itself has effects. A classification printed on a document can alter eligibility. A diagnosis can reorganize self-understanding and institutional treatment. A price displayed on a market interface can change subsequent bids. A public declaration of trust can reshape expectations between participants. A representation of a social category can influence how people act toward those classified by it. In such cases, the manifestation is not merely evidence about an antecedent relational reality. Once incorporated into subsequent interactions, it becomes part of the generative environment.

Claim 4.12 (Manifestational mediation). *A manifestation can enter a generative-relational system as an operative relation or object and thereby participate in the generation, stabilization, transformation, or dissolution of subsequent relational realities.*

Claim 4.12 does not imply that every manifestation substantially changes the system in which it occurs. Its significance is structural: the architecture permits such mediation and therefore cannot treat manifestation as only the terminal output of a prior process. The causal importance of any particular manifestation remains an empirical and historical question. Section 100 will later examine recursive relations among reality, manifestation, and representation in greater detail.

Manifestational reality also has a historical dimension. What can become manifest, to whom, through which medium, and with what resolution depends on available sensory capacities, concepts, institutions, instruments, archives, languages, technical infrastructures, norms, and practices of attention. A relation that was difficult to manifest under one historical configuration can become readily measurable or publicly articulable under another. Conversely, changes in classification or institutional practice can render previously salient realities less visible. Manifestation therefore belongs to history rather than constituting a timeless interface between mind and world.

4.2.4 Distinctions among the Three Registers

The three definitions establish different criteria and therefore resist several common reductions. Ontological reality concerns the status of what obtains or occurs without reducing that status to a particular manifestation. Relational reality concerns stable and causally efficacious emergence within a generative-relational system. Manifestational reality concerns becoming available under a particular configuration of relations and mediation. These registers can overlap in concrete cases, but overlap does not erase the difference among the questions they pose.

A relationally real object does not thereby acquire a settled independent ontology. The social efficacy of money, a legal person, a deity, an institutional role, or a stabilized self does not require GRE to decide that the relevant object exists as a fundamental substance. The relational claim can remain both strong and limited: the object has emerged, persists, and causally matters within the system. Conversely, an ontologically real process does not automatically possess relational reality relative to every generative-relational system. Something may exist yet remain causally disconnected from the system under study, or it may fail to become sufficiently stabilized within that system to constitute the relational object relevant to the inquiry.

Relational reality likewise does not require manifestation, as Claim 4.10 states. Historical constraints, latent institutional structures, unrecognized patterns of dependence, or the generative conditions of a contingent encounter may operate before they are consciously noticed or symbolically articulated. Manifestation is therefore neither the origin nor the universal criterion of relational reality. At the same time, once a manifestation enters subsequent relations, Claim 4.12 allows it to become one of the conditions through which later relational realities are generated. The distinction between the registers thus supports directional asymmetry in particular cases without imposing a permanent hierarchy among them.

Manifestational reality also does not guarantee that the apparent object possesses the ontological status attributed to it by a subject. A manifestation can be vivid, stable, socially consequential, and repeatedly recorded while the ontological interpretation of its source remains uncertain or contested. Nor does manifestational similarity establish relational identity. Two similar experiences, measurements, classifications, or observable patterns may arise from different generative structures. The inverse problem is equally important: similar relational structures can manifest differently under different bodily, institutional, cultural, technical, or historical conditions. Later sections will develop these many-to-one and one-to-many possibilities more formally.

The distinctions also prevent a further assumption: shared relational reality does not entail comparability. Two objects can each satisfy the criteria of relational reality while lacking a justified common metric, ordering, coordinate system, or structure-preserving comparison. They may inhabit different metric spaces, non-metric relational spaces, or domains for which no warranted mapping has yet been constructed. A hallucinated flower and an ordinarily perceived physical flower provide a simple illustration. Both can be relationally consequential within the systems in which they arise, yet their generative structures need not be treated as instances of the same measurable object merely because the word “flower” is used for both manifestations. Establishing a comparison relation is an additional analytical achievement, not an automatic consequence of assigning the same reality-status.

Claim 4.13 (Non-necessary comparability of relational realities). *The fact that two*

objects possess relational reality does not by itself establish a common metric, ordering, equivalence relation, structural map, or other justified basis of comparison between them.

Claim 4.13 has methodological consequences throughout GRE. Comparative analysis must specify what is being compared, through which relation, and under what invariances or losses of information. Isomorphism, homomorphism, simulation, statistical resemblance, functional equivalence, and analogical comparison answer different questions and require different assumptions. Where no warranted comparison structure exists, preserving incomparability can be more rigorous than imposing a common measure for analytical convenience. This point becomes especially important when GRE studies heterogeneous values, forms of life, subjectivities, institutions, and modes of manifestation.

The distinctions among registers should therefore be read as safeguards against premature reduction. Ontological uncertainty need not erase relational reality. Relational efficacy need not establish ultimate ontology. Manifestational vividness need not disclose either register completely. Lack of manifestation need not imply lack of relational structure. Shared reality-status need not imply shared geometry. Each of these distinctions preserves a question that would otherwise disappear if “reality” were treated as a single undifferentiated category.

4.2.5 Relations across the Three Registers

The three-register architecture becomes most distinctive when the relations among the registers are considered. A tempting interpretation would treat them as a sequence: an ontological reality first exists, relational structures subsequently form around it, and a final manifestation presents the result to a subject. Such a trajectory may describe some local cases, but GR does not adopt it as the general architecture. The three registers form a graph of heterogeneous and historically variable relations. Different paths can connect them, and what becomes an effect along one path can become a condition along another.

Ontological conditions can participate in the emergence of relational realities. Material resources, bodily capacities, ecological processes, technical infrastructures, spatial arrangements, and other ontologically relevant conditions can constrain or enable the relations through which an object stabilizes. Yet the resulting relational object need not be reducible to those conditions. A monetary system, for example, requires material and technical supports but acquires causal properties through legal, institutional, symbolic, and practical relations that cannot be read directly from the physical medium of a banknote or database entry.

Relational realities can condition manifestation. What becomes salient, nameable, measurable, experientially coherent, institutionally visible, or symbolically available depends partly on the relations already organizing subjects, instruments, categories, institutions, and environments. A relation of trust can change what conduct is interpreted as reassuring or suspicious. An institutional category can determine which differences enter administrative records. A scientific instrument and its associated practices can make a pattern manifest that unaided perception could not distinguish. The manifestation therefore emerges within a relational field rather than arriving from outside it.

The reverse mediation is equally important. Once a manifestation occurs, it can

alter the relational field. A statement, image, classification, measurement, judgment, or public performance can be remembered, circulated, institutionalized, contested, or incorporated into later expectations. Through these processes, manifestation can contribute to new persistence and causal efficacy. A relation may thus help generate a manifestation, while the manifestation becomes one of the relations through which a later relational reality is stabilized. Historical time matters because the system encountered after manifestation need not be the system that preceded it.

This recursive possibility is particularly significant for aesthetic judgment and contingency. The relational-generative-historical structure through which a contingent encounter becomes possible can exist before the encounter is apprehended as contingent. When contingency later becomes manifest through surprise, attention, aesthetic judgment, or conceptual recognition, the manifestation can redirect inquiry, memory, valuation, preservation, or future practice. The recognition therefore neither creates the entire preceding structure nor merely reflects it. It enters the history of that structure and can change what the system subsequently generates.

The architecture has a limited heuristic affinity with Lacan's three registers of the Imaginary, the Symbolic, and the Real. Lacanian register theory itself changed substantially over time, and later formulations emphasize mutual dependence among the registers rather than treating them as a simple developmental sequence (Johnston 2026). GR does not adopt Lacan's definitions or identify its registers one-to-one with his. Ontological reality is not the Lacanian Real; relational reality extends well beyond the Imaginary; and manifestational reality includes forms of appearance and mediation that are not reducible to the Symbolic. The useful analogy lies at the architectural level: a plurality of registers can be mutually conditioning, and the relations among them can be more informative than an attempt to place them in a single hierarchy.

Remark 4.14 (Graph rather than chain). Ontological, relational, and manifestational reality should be treated as registers connected by heterogeneous relations rather than as stages in a universal sequence. Their connections may be recursive, many-to-many, historically changing, and only partially invertible. A path observed in one case does not establish the direction or form of mediation in another.

The graph conception also leaves room for missing edges. A research programme need not assume that every ontological condition is relationally relevant to the system under study, that every relational reality becomes manifest, or that every manifestation permits reliable inference toward its generative conditions. Some relations may be weak, historically absent, technically inaccessible, or analytically unjustified. Treating the architecture as a graph therefore does not mean multiplying connections without discipline. It means that connections are objects of inquiry whose existence, direction, stability, and explanatory importance must be established rather than presumed.

The three registers can now support the rest of the chapter. Section 92 clarifies the methodological status of ontological suspension. Section 93 identifies the primitive vocabulary through which emergence and stabilization can be analyzed. Sections 94 and 95 then return separately to relational and manifestational reality, allowing persistence, stability, causal efficacy, forms of manifestation, and participation in subsequent relations to receive fuller treatment. The later analysis of manifestation mappings, non-invertibility, symbolization, and recursive mediation builds on the architecture established here. The purpose of the present section is therefore not to close

the ontology of GR but to preserve three analytically distinct questions and to make their interrelation available for disciplined investigation.

4.3 Ontological Suspension

This section develops *ontological suspension* as a methodological discipline within GR. The preceding sections established that generative-relational inquiry requires explicit ontological commitments while also distinguishing ontological, relational, and manifestational reality. Ontological suspension specifies how those commitments can remain proportionate to the explanatory task. Its role is neither to weaken reality claims nor to replace ontology with epistemic uncertainty. Rather, it allows inquiry to affirm what has been sufficiently established at one register while withholding stronger claims whose resolution is unnecessary, unavailable, or not yet warranted. The section proceeds by distinguishing suspension from denial and agnosticism, then treats suspension as a disciplined practice, examines its use under ontological disagreement, and concludes by clarifying how suspended questions can remain analytically usable without being prematurely settled. (Fraassen 1980; Quine 1948)

4.3.1 Suspension and Denial

Ontological suspension begins with a distinction between declining to affirm a stronger ontological claim and denying that claim. The distinction is elementary but consequential. An inquiry may have sufficient grounds to establish that an object is relationally real while lacking grounds to determine whether that object possesses an independent ontological status. In such a case, GR does not infer nonexistence from the absence of a stronger commitment. It leaves the stronger question open and continues the analysis at the register for which evidence and explanatory need are available.

Consider money. GRE can study money as a relationally real object because monetary forms can emerge through institutional, legal, material, symbolic, and practical relations; persist with sufficient stability; and causally affect allocation, obligation, expectation, production, and future relations. None of these claims requires GRE to settle whether “money” corresponds to an independently existing ontological kind beyond the relations through which monetary reality is sustained. Suspension therefore preserves the reality relevant to the inquiry while withholding a metaphysical conclusion that the analysis does not need.

The same distinction applies to less conventional objects. A deity can possess relational reality within a religious community when the relevant object is historically sustained, structures expectations and conduct, enters institutional practices, organizes temporal and spatial routines, and causally affects subsequent relations. GR can analyze this relational reality without determining whether the deity also possesses ontological reality independent of those relations. Suspension in this case does not entail atheistic denial, theological affirmation, or the reduction of religious experience to error. It identifies the precise ontological question that the inquiry is not presently resolving.

A similar structure can arise in the analysis of selfhood. The experienced continuity of an “I” may be relationally stabilized through embodiment, memory, recogni-

tion, language, institutional identity, habit, and historical continuity. This stabilized self can organize action and therefore possess causal efficacy within the system. The corresponding relational claim does not require GR to affirm or deny an invariant metaphysical self. The inquiry can proceed by studying the generative conditions, persistence, transformations, and consequences of selfhood while suspending stronger ontological commitments about what the self ultimately is.

Definition 4.15 (Ontological suspension). *Ontological suspension* is the disciplined withholding of commitment concerning an ontological claim whose resolution is not presently warranted or required for the explanatory task, while preserving and using those weaker or differently scoped reality claims that the inquiry can support.

Definition 4.15 contains two positive components. First, suspension is directed toward a specified claim rather than toward reality in general. Second, suspension preserves other warranted commitments. It is therefore compatible with strong claims at another register. An inquiry may suspend the ontological status of money while affirming its relational reality; suspend the ultimate nature of consciousness while studying manifestational and relational structures of subjectivity; or suspend the metaphysical status of a social category while examining its institutional stability and causal effects.

This claim-specific character prevents ontological suspension from becoming an indiscriminate refusal to decide anything. GR does not treat uncertainty as an intellectual virtue in itself. Where evidence, argument, or explanatory necessity supports a stronger commitment, suspension can be narrowed or lifted. Where a claim has been sufficiently falsified within the relevant domain, denial may be justified. Suspension therefore occupies a distinct methodological position between unwarranted affirmation and unwarranted negation.

The distinction is particularly important for generative inquiry because the objects of interest may cross registers. A manifestational event can have effects even when the ontological status of what appears remains unsettled. An illusory flower perceived under altered physiological conditions can become relationally consequential through attention, movement, fear, memory, communication, or later interpretation. A physically present flower can likewise become relationally consequential through perception and subsequent action. The fact that both can possess relational reality does not erase differences in their ontological conditions. Suspension allows the inquiry to preserve those differences without requiring an immediate final comparison between them.

Claim 4.16 (Suspension does not imply unreality). *Suspending the ontological status of an object does not entail that the object is unreal at other registers. Relational and manifestational reality remain independently assessable under their own conditions.*

Claim 4.16 is foundational for the remainder of the chapter. It prevents a recurrent collapse in which only ontologically fundamental objects are treated as real, while institutionally, psychologically, culturally, or symbolically mediated objects are relegated to a secondary status. GRE instead asks which reality claim is being made, under which conditions, and with what explanatory consequences.

4.3.2 Suspension and Agnosticism

Ontological suspension also differs from general agnosticism. Agnosticism ordinarily describes a position of non-knowledge or unresolved belief concerning a ques-

tion. Suspension, as used here, is more local, functional, and methodologically organized. A researcher may personally hold a metaphysical view while suspending it within a particular analysis because the view is not required to establish the argument. Conversely, a researcher may remain personally undecided while the inquiry itself reaches a sufficiently strong local ontological conclusion. GR therefore treats suspension as a property of an analytical procedure rather than as a report of the researcher's private belief state.

This difference matters because a research programme must coordinate inquiry across people who may hold incompatible metaphysical commitments. If every empirical or theoretical analysis required prior agreement concerning the ultimate ontology of persons, institutions, meanings, values, information, or social facts, large portions of inquiry would become hostage to disputes operating at a different level. Ontological suspension creates a disciplined space in which researchers can identify the stronger question, state that it remains open for the purposes of the analysis, and continue working with commitments that are both sufficient and jointly assessable.

Suspension is also compatible with differentiated confidence. The framework need not divide claims into only affirmed, denied, or suspended categories. A claim can be weakly supported, strongly supported, locally adequate, historically contingent, scale-dependent, or open to revision. Suspension concerns the point beyond which the inquiry refrains from extending its commitments. In this sense, it functions as a boundary on inference. The boundary may move as new evidence, conceptual distinctions, or explanatory requirements emerge.

For example, suppose an analysis establishes that a particular institutional category has persistent effects on eligibility, behavior, and resource distribution. The category can be treated as relationally real within the institutional system. Whether that category tracks a natural kind, a socially constructed kind, a historically contingent administrative device, or some combination may remain unresolved. The inquiry can suspend this further ontological classification while retaining the causal and institutional findings. If later research demonstrates that the distinction among these possibilities is itself necessary to explain the observed dynamics, the suspended question becomes active and must be investigated.

This temporality is important. Suspension is not a permanent exile of difficult questions. It is a way of sequencing inquiry so that questions are addressed when their resolution becomes relevant and when the available methods can bear on them. A suspended claim may later become central; a previously central ontological dispute may later become irrelevant to a more local explanatory task. GR therefore understands suspension as revisable and historically situated.

Remark 4.17 (Suspension is inquiry-relative). The same ontological proposition may be suspended in one inquiry and actively investigated in another. Suspension attaches to the relation between a claim and an explanatory task, not permanently to the object itself.

This inquiry-relative character also prevents the framework from treating ontological suspension as a universal solution. Some questions cannot be responsibly deferred. A study of legal responsibility may require a more explicit account of agency than a study of transaction frequency. A study of machine subjecthood may require ontological distinctions that can be suspended in a narrow analysis of machine-mediated market behavior. A study of hallucination may require distinctions between perceptual generation and external physical objects that are

unnecessary in an analysis limited to the subsequent behavioral effects of the experience. The appropriate degree of suspension therefore depends on what explanatory burden the analysis places on its objects.

A further difference from agnosticism concerns positive use. Agnosticism can leave a proposition untouched. Suspension often permits the object associated with that proposition to remain analytically active under another description. One can suspend whether a deity possesses independent ontological reality while analyzing the relational reality of divine authority; suspend whether the self is ontologically fundamental while analyzing self-continuity; suspend whether value exists independently of valuation while studying value as a historically stabilized relational formation. The suspended question remains visible, but inquiry does not need to stop at it.

4.3.3 Suspension as Methodological Discipline

Ontological suspension becomes useful only when it is practiced with discipline. An unspecified statement that “ontology is suspended” can conceal ambiguity just as easily as an unspecified ontological assertion can. GR therefore requires suspension to identify the claim being withheld, the commitments being retained, the reason for suspension, and the conditions under which the question would need to be reopened.

A minimal procedure can be stated in four steps. First, the inquiry identifies the ontological proposition whose stronger resolution is at issue. Second, it states the reality claims that remain necessary for the analysis. Third, it explains why the stronger proposition is not presently required or not sufficiently warranted. Fourth, it tracks whether later stages of the inquiry silently depend on the suspended proposition. These steps make suspension auditable rather than rhetorical.

Definition 4.18 (Disciplined suspension). A suspension is *disciplined* when the inquiry specifies the suspended claim, preserves the commitments required for explanation, states the reason for withholding further commitment, and prevents later inference from covertly presupposing what has been suspended.

The final condition is especially important. An analysis might claim to suspend whether a category is natural or socially constituted, then later interpret its persistence as evidence of naturalness. It might suspend whether an artificial system possesses subjecthood, then assign responsibility to it in a way that presupposes a particular theory of agency. It might suspend whether a market category reflects intrinsic value, then treat observed price as if it directly disclosed such value. These moves would not constitute ontological suspension. They would amount to concealed reintroduction of the stronger claim.

Disciplined suspension therefore requires attention to language. Terms such as “entity,” “agent,” “subject,” “value,” “information,” “institution,” “identity,” and “cause” can carry stronger ontological implications than an analysis intends. GR does not require abandoning ordinary terminology, but it does require sensitivity to when a convenient analytical label begins doing metaphysical work. Local definitions, explicit qualifications, and distinctions among registers can prevent such slippage.

Suspension also has a scalar dimension. An object may be treated as sufficiently real and stable at one scale while its internal constitution remains suspended. A firm can be analyzed as an organizational actor in a market model even though its internal relations are heterogeneous and contested. A person can be treated as a subject of a legal relation while a theory of personal identity remains open. A currency can

be treated as a stable monetary unit for one period while its institutional production, material carriers, and symbolic representations are separately investigated. The relevant question is whether the chosen level of objecthood supports the explanatory task without obscuring transformations that matter to the result.

The same logic applies temporally. A relational object may be stable enough for analysis over one interval and unstable over another. Ontological suspension can prevent the local stability of an object from being mistaken for timeless identity. This is especially important in GRE because many objects of economic analysis are historically generated. Firms change legal form, markets change infrastructure, currencies change institutional backing, identities change classificatory regimes, and technologies alter the relations through which objects acquire causal efficacy. Suspension preserves the distinction between “stable enough here” and “fundamentally invariant.”

Methodological discipline further requires that suspension remain compatible with causal explanation. GR does not use suspension to avoid specifying mechanisms. If an object is treated as relationally real because it exerts causal efficacy, the analysis must still investigate the relations through which that efficacy arises. Saying that the object’s ultimate ontology is suspended does not permit causal vagueness. On the contrary, the weaker metaphysical commitment increases the importance of showing how persistence, stability, and causal participation are generated within the relevant system.

Claim 4.19 (Suspension and explanatory burden). *Ontological suspension reduces unnecessary metaphysical commitment but does not reduce the explanatory burden associated with relational or manifestational claims. The mechanisms, conditions, and scope supporting those claims remain open to investigation.*

Claim 4.19 prevents suspension from functioning as a refuge from difficult analysis. If GRE claims that trust, money, authority, or identity is relationally real, it must still account for how that reality is generated and maintained. Suspension concerns what need not be claimed beyond that analysis, not what need not be explained within it.

4.3.4 Suspension under Ontological Disagreement

Ontological disagreement is common in the domains GRE studies. Social ontology, philosophy of mind, philosophy of science, religious ontology, theories of value, institutional theory, and theories of agency all contain persistent disagreements concerning what kinds of things exist and what makes them real. Generative-relational inquiry requires a way to work across such disagreement without pretending that the disagreements have disappeared.

Ontological suspension provides one such mechanism. When competing ontologies generate the same commitments required for a local analysis, the inquiry can bracket their stronger divergence and examine the shared relational or manifestational structure. For example, researchers may disagree over whether institutions possess a reality irreducible to individual action. If both accounts nevertheless recognize a stabilized pattern of rules, expectations, roles, and sanctions that causally affects behavior, a GRE analysis can investigate that relational configuration while leaving the deeper disagreement unresolved for the purposes of that task.

This strategy does not imply that ontological disagreement is always irrelevant. Competing ontologies may produce different explanations, identify different objects,

or recommend different methods. A strongly individualist ontology and a strongly structural ontology may disagree not only about metaphysical grounding but also about where causal efficacy should be located. In such cases, suspension of the disagreement would remove precisely what the research needs to test. GR therefore distinguishes *non-operative disagreement*, which can be suspended for a particular task, from *operative disagreement*, which changes the explanatory consequences and must remain visible within the analysis.

Definition 4.20 (Operative ontological disagreement). An ontological disagreement is *operative* for an inquiry when competing ontological commitments alter the identification of relevant objects, mechanisms, causal relations, evidence, or explanatory consequences within that inquiry.

Definition 4.20 gives suspension a limit. If an ontological difference changes what the model predicts, what evidence counts, what mechanism is possible, or what intervention follows, the difference cannot be treated as merely philosophical background. Conversely, when competing metaphysical accounts leave the local explanation unchanged, insisting on prior resolution can add controversy without adding explanatory power.

This distinction also supports pluralism within GRE. Researchers can develop different ontological interpretations of the same generative-relational phenomenon while remaining part of a common research programme, provided the differences are explicitly stated and their consequences can be compared. Ontological suspension therefore does not require theoretical homogeneity. It can create a shared analytical surface on which competing deeper accounts become comparable where comparison is possible.

The possibility of comparison, however, must itself be established. Section 91 emphasized that two relational realities need not inhabit a common metric or even a common comparison space. The same caution applies to ontological theories. Two accounts may use incompatible primitive vocabularies or organize reality at different scales. Suspension can permit local cooperation without forcing artificial commensurability. When translation is possible, the mapping should be stated; when it is partial, the loss should be acknowledged; when no justified mapping exists, the disagreement may remain structurally unresolved.

This point is important for cross-cultural and interdisciplinary inquiry. A phenomenon can be embedded in distinct conceptual, religious, scientific, legal, or experiential ontologies whose categories do not align cleanly. GRE should not assume that one vocabulary can always translate another without remainder. Ontological suspension can preserve analytical openness while allowing researchers to study the relational consequences of each framework within its own domain. The aim is not to declare all ontologies equivalent but to avoid manufacturing equivalence before the conditions of comparison have been established.

Under disagreement, suspension also has an ethical dimension. Prematurely declaring one ontology to be the sole legitimate description can erase forms of experience or institutional reality that remain causally consequential for the people and systems under study. At the same time, treating every ontological claim as equally warranted would abandon standards of evidence and argument. GR therefore seeks a middle position: stronger ontological judgments remain possible, but they are made only when the inquiry requires them and when the grounds for doing so are explicit.

4.3.5 Suspension and Analytical Usability

The practical value of ontological suspension lies in the fact that analytically useful objects need not wait for metaphysical closure. Economic and social inquiry routinely operates with objects whose ultimate status is contested but whose effects are sufficiently stable to investigate. GRE systematizes this practice by distinguishing analytical usability from final ontological settlement.

An object is analytically usable when it can be specified with enough stability, relational location, and causal relevance to support the explanatory task. This criterion is intentionally weaker than ontological fundamentality. A market index can be analytically useful without constituting a fundamental natural kind. A legal person can be analytically useful without resolving metaphysical theories of personhood. A social identity can be analytically useful without assuming that the category is natural, timeless, or internally homogeneous. A manifestational form can be analytically useful even when the underlying generative structure remains only partially known.

Claim 4.21 (Analytical usability under suspension). *An object whose stronger ontological status is suspended can remain analytically usable when its relevant boundaries, persistence, relations, and causal consequences are sufficiently specified for the explanatory task.*

This principle helps GR avoid two symmetrical errors. The first is ontological inflation: treating analytical usefulness as proof of fundamental existence. The second is ontological paralysis: refusing to analyze an object until every metaphysical question surrounding it has been settled. The former converts models into ontology too quickly; the latter makes inquiry dependent on conclusions it may never need. Suspension preserves a working space between them.

Analytical usability is nevertheless conditional. The object must remain adequate to the task. If a category's internal heterogeneity begins to change the result, the category must be refined. If a boundary that was previously harmless becomes causally consequential, the boundary must be reconsidered. If a manifestation once treated as a proxy ceases to track the relational structure of interest, the proxy must be revised. Suspension therefore works together with the revisability of analytical objects.

This revisability becomes particularly important in recursive systems. A category used for analysis can enter the system and alter what it describes. A risk classification can change credit access; a diagnostic label can alter self-understanding and institutional treatment; an economic forecast can change expectations and investment; an aesthetic judgment can redirect attention and preservation; a legal designation can reorganize rights and obligations. Once the analytical or manifestational form becomes generatively active, its status may need to be reconsidered as part of the relational reality under study. Suspension does not isolate the analyst from this recursion. It requires the inquiry to notice when its representations have become causal components of the system.

The same principle applies to contingency. A contingent relational configuration may become stable enough to exert causal efficacy before any subject recognizes it as contingent. Its relational reality can therefore be analyzed prior to conscious manifestation. If the contingency later becomes aesthetically salient, symbolically articulated, or institutionally recorded, those manifestations may feed back into the relations through which the object persists. Ontological suspension allows the analysis to follow this history without forcing the pre-manifestational structure, the manifested

object, and the ontological substrate into a single category.

The method can therefore be summarized as selective commitment. GR commits to what the explanatory task can support, suspends what lies beyond that support, and reopens suspended questions when they become operative. This practice preserves the reality of emergent and causally efficacious objects while resisting the conversion of local explanatory success into universal metaphysical closure.

Remark 4.22 (Suspension and the three-register architecture). Ontological suspension is one of the mechanisms that keeps the three registers analytically distinct. It permits a researcher to affirm relational or manifestational reality while leaving a stronger ontological claim unresolved, and it permits later evidence or argument to modify that suspension without retrospectively invalidating the earlier local analysis.

Ontological suspension thus completes the methodological groundwork established by Sections 90–92. Section 90 showed why GR requires explicit ontological commitments without ontological closure. Section 91 distinguished ontological, relational, and manifestational reality and treated their relations as a graph rather than a chain. The present section has specified how inquiry can move among those registers without making every local reality claim carry the burden of a final metaphysics. Section 93 can now turn from the status of ontological claims to the primitive analytical vocabulary through which emergent stability becomes describable: change, structure, constraint, and difference.

4.4 Primitive Structure and Ontological Emergence

Chapter 4 requires a vocabulary capable of describing emergence before the analysis presupposes fully constituted entities, subjects, relations, institutions, or values. Chapter 3 introduced change, structure, constraint, and difference as a minimal primitive structure for GRE. The present section develops their specifically ontological role. Its objective is to show how these four methodological primitives can support descriptions of emergence and relative stability while remaining compatible with ontological suspension. The discussion considers each primitive separately, then examines their interaction and the formation of stable configurations. The method is constitutive and deliberately weak: the primitives provide conditions for describing how determinate objects can become analytically available without being declared the metaphysically fundamental constituents of reality.

Definition 4.23 (Methodological primitive). A *methodological primitive* is a distinction provisionally treated as analytically available before the framework constructs richer objects from it. Its primitive status concerns the organization of inquiry and does not, by itself, establish metaphysical fundamentality, temporal priority, indivisibility, or universal explanatory sufficiency.

Definition 4.23 preserves the restraint developed in Sections 4.1–4.3. Change, structure, constraint, and difference may themselves admit further decomposition under another theory or at another scale. A physical account may redescribe a social constraint through material processes; a phenomenological account may differentiate forms of experienced difference; a mathematical representation may replace ordinary structural language with a more specific formal object. GR does not require those approaches to converge on one final primitive basis. The quartet functions as a minimal analytical grammar within the present research programme.

The order in which the four primitives are presented should likewise be interpreted analytically rather than chronologically. GR does not posit a first moment of pure change followed by the later arrival of structure, constraint, and difference. Each becomes intelligible through the others. Change is identified through differences across configurations; structure supplies organization within which such differences can be tracked; constraints condition accessible transformations; and differences become consequential through structures that preserve, amplify, suppress, classify, or redirect them. Ontological emergence is therefore approached through their interaction rather than through a linear derivation from one primitive. (P. W. Anderson 1972; Simon 1962; Nicolis and Prigogine 1977)

4.4.1 Change

Change provides the minimal temporal opening required for emergence. An analysis of emergence must permit a later configuration to differ from an earlier one, or a process to produce distinctions that were previously absent at the selected resolution. GR therefore uses change in a broad sense: a transformation in state, organization, relation, capacity, boundary, rule, classification, or possibility. This formulation allows the identity of what changes to remain partly open. The object need not be fully constituted before the transformation begins.

This point matters for ontological analysis because many economic and social objects are encountered only after a period of formation. A firm may acquire legal identity after organizational relations have already developed. A monetary practice may stabilize before a standardized representation is established. A collective identity may become causally consequential while its boundaries remain contested. If inquiry requires the object to possess a fixed identity before change can be described, the formative process is partly hidden by the analytical vocabulary. Treating change as primitive permits the analysis to track transformations through which the object itself becomes more determinate.

Change can occur at several levels. A configuration can move among states while its constitutive organization remains relatively stable. Its structure can also change, altering the pattern through which later states become possible. Constraints can be modified so that transitions previously difficult or unavailable become accessible, while other transitions become costly or foreclosed. Differences that were once negligible can become consequential when a new institution, technology, category, or practice makes them operative. A still stronger transformation can alter the mechanisms through which subsequent change is generated. GR therefore distinguishes change in a configuration from change in the generative conditions of that configuration.

The primitive also includes maintenance. Relative stability frequently depends on continuing activity. A legal status persists through records, procedures, recognition, enforcement, and institutional reproduction. A currency remains usable through repeated practices of acceptance, accounting, settlement, and regulation. A self-description may remain stable through memory, bodily continuity, social recognition, and narrative reproduction. In these cases, stability at one analytical level coexists with ongoing transformations at another. Change and persistence consequently form compatible features of a generative-relational system.

Change alone does not identify emergence. Many transformations dissipate with-

out producing a persistent configuration. Others alter an existing object without generating a new one at the relevant scale. The ontological significance of change depends on the organization through which transformations become patterned, retained, and capable of affecting later processes. Structure supplies that second dimension.

4.4.2 Structure

Structure refers to patterned organization sufficiently coherent for distinctions, transitions, and dependencies to be tracked. Its use in GR is intentionally plural. A structure may be spatial, temporal, institutional, legal, symbolic, computational, ecological, organizational, or relational. Several descriptions may apply to the same configuration at different scales or for different research purposes. The concept therefore identifies organization without requiring one privileged formal representation.

Ontological emergence requires structure because a transient difference becomes analytically significant only within some organization that allows it to persist, recur, combine with other differences, or modify future transformations. A repeated exchange practice, for example, becomes more than a collection of isolated transactions when expectations, roles, records, conventions, enforcement, and material infrastructures organize later exchanges. The relevant structure may remain incomplete and historically variable while already giving the process a degree of continuity.

Structure should therefore be separated from rigidity. A configuration can preserve recognizable organization while its constituents change. An institution can maintain procedural continuity while officeholders, rules, technologies, and interpretive practices evolve. A network can retain a characteristic pattern while particular ties form and dissolve. A person can preserve an experienced continuity of self while memories, relations, capacities, and bodily conditions change. Structural stability is always relative to a selected resolution and timescale.

This relativity is especially important for the three-register architecture. A structure identified at the manifestational register may differ from the structure inferred at the relational register. Repeated observations can display a stable statistical pattern without uniquely determining the generative configuration that produces it. Conversely, a relational structure can remain sufficiently stable while its manifestations vary across contexts. Structure is therefore register-sensitive: the analyst should specify what is organized, at which register, over what interval, and under which observational or representational conditions.

Structure also enables the preservation of history. Earlier transformations can leave traces in current organization through institutional rules, material infrastructures, learned dispositions, network positions, accumulated resources, classifications, or path-dependent expectations. The resulting configuration carries a history without requiring every historical event to remain explicitly represented. In GR, emergence is therefore commonly historical: a stable object can condense prior transformations into a structure that shapes what happens next.

Treating structure as primitive does not establish that structure exists independently of process. The methodological role is narrower. GR requires a way to describe organized regularity before deciding whether a particular case is best understood through entities, relations, processes, fields, or another ontology. Structure supplies that analytical capacity while leaving its deeper constitution open.

4.4.3 Constraint

Constraint introduces asymmetry into the space of possible transformations. A configuration becomes generatively consequential when some transitions are enabled, favored, stabilized, delayed, made costly, prohibited, or rendered practically unavailable relative to others. Constraint therefore refers to conditions that shape the accessible trajectories of a system. Such conditions can be material, institutional, legal, informational, symbolic, bodily, ecological, computational, or relational, and their mechanisms need not be identical.

This primitive is central to emergence because persistence requires more than repeated occurrence. A configuration that can be displaced by arbitrarily small perturbations may appear momentarily without becoming stable at the timescale relevant to the inquiry. Constraints can help maintain a configuration by limiting departures, supporting repair, directing feedback, preserving boundaries, or making particular responses more probable. They can also prevent an incipient configuration from stabilizing. Emergence and dissolution are therefore both partly intelligible through changing constraints.

Constraint includes enabling conditions. A legal form can restrict certain actions while making others possible by defining authority, ownership, liability, or procedural competence. A technical standard can narrow acceptable formats while allowing coordination among previously disconnected participants. A language constrains expression through grammar and convention while enabling complex articulation. An infrastructure conditions where and how interaction occurs while expanding the range of activities that can be sustained. GR accordingly treats constraint through its effect on accessible possibilities rather than equating it with direct prohibition or coercion.

Constraints are often positional. The same institutional arrangement can enable one subject while restricting another; the same market structure can generate opportunity for one firm while creating dependency for another; the same symbolic classification can confer recognition in one setting and produce exclusion in another. The relevant question is therefore which transitions are conditioned for which subjects or configurations, through which mechanism, and over what scale. A general statement that a system is “constrained” is insufficient without this local specification.

Constraint can itself be historically generated. A practice repeated over time may produce expectations that later function as constraints. A manifestation can be recorded, classified, and institutionalized in ways that reshape subsequent possibilities. Material investments can harden earlier decisions into infrastructure. A legal category can stabilize a distinction and thereby affect later subject formation. In these cases, the outcome of one generative process becomes part of the constraint structure governing another. The graph-like architecture of Chapter 4 is therefore visible already at the primitive level: products of prior emergence can enter the conditions of later emergence.

No normative valence follows from constraint alone. A constraint may preserve a valuable capacity, stabilize domination, prevent harm, sustain cooperation, reproduce exclusion, or combine several of these effects. Normative evaluation requires additional concepts. At this stage, constraint identifies how the space of possible transformation acquires shape.

4.4.4 Difference

Difference provides the minimal condition for distinction. GR uses the term to indicate non-equivalence that becomes analytically or causally consequential within a configuration. Difference may concern state, position, timing, capacity, relation, classification, intensity, direction, accessibility, or another dimension selected by the inquiry. The concept remains weaker than inequality, opposition, hierarchy, or conflict. Those more specific relations can emerge from differences but should not be built into the primitive itself.

Difference is required for change to be identifiable, yet the two concepts remain distinct. A difference can coexist at one time between positions or components without representing a temporal transition. Change can then be described when a relevant difference appears, disappears, increases, decreases, or is reorganized across configurations. Structure determines which differences can be represented as belonging to a common organization, while constraint affects which differences can persist or alter later trajectories.

The significance of a difference is relational. A variation that has no effect under one configuration may become decisive under another. A minor difference in documentation can become institutionally consequential when a legal procedure uses that distinction to allocate status. A small variation in network position can matter greatly under a process that amplifies preferential access. An unarticulated bodily sensation can become salient after a new interpretive category is learned. A price difference can remain irrelevant where exchange is impossible and become operative once an infrastructure connects the relevant markets. Difference therefore becomes generative through the structures and constraints in which it participates.

This point also guards against equating manifestation with the production of difference itself. A difference can be relationally operative before it is perceived, named, or symbolized. A historical configuration may already contain an asymmetry or contingency that shapes subsequent possibilities before any subject recognizes it. Later manifestation can render that difference salient and can subsequently transform the relational configuration, but the manifestation is not necessarily the origin of the operative distinction. This possibility is especially important for GR accounts of contingency, aesthetic judgment, subject formation, and historical recognition.

Difference also raises the problem of comparability. Two differences cannot automatically be assigned magnitudes on a common scale. Some domains admit a justified metric; others support only ordering, classification, structural correspondence, or qualitative distinction; still others presently lack a warranted comparison map. The primitive of difference therefore establishes distinguishability without presuming commensurability. This restraint preserves the possibility that heterogeneous relational realities can each be real while remaining structurally incomparable under the currently available analytical framework.

4.4.5 Interaction among the Four Primitives

The four primitives acquire their explanatory force through interaction. GR does not treat change, structure, constraint, and difference as independent components that can simply be assembled after separate analysis. Each conditions how the others become meaningful. Structure permits differences and changes to be tracked; differ-

ence allows structures and transformations to be distinguished; constraints shape which transformations remain accessible; and change can modify the structures and constraints through which later differences become consequential.

A minimal generative description therefore asks how these dimensions co-organize over time. An initially small difference can be amplified when a structure channels repeated interaction through it. The resulting pattern can generate constraints that preserve the difference and make later trajectories dependent upon it. Conversely, a structural change can weaken an existing constraint, permitting previously suppressed differences to become operative and producing a new configuration. Feedback can stabilize the resulting organization, while another process may destabilize it. Emergence is located in this evolving organization rather than in any one primitive taken alone.

Claim 4.24 (Mutual constitution of the primitive structure). *Within GR, change, structure, constraint, and difference function as mutually conditioning methodological primitives. Their analytical separability supports explanation, while their interaction supplies the minimal vocabulary through which the formation, persistence, transformation, and dissolution of more determinate configurations can be described.*

Claim 4.24 also clarifies why the quartet should not be converted into a universal causal sequence. A local analysis may identify a historically specific trajectory—for example, an initial difference followed by structural amplification and later institutional constraint—but another process can begin from an inherited constraint, a structural rupture, or continuing change that gradually generates a distinguishable difference. The explanatory order is empirical and historical. The primitive architecture provides the vocabulary within which that order can be reconstructed.

The interaction is likewise compatible with multiple registers. A manifestational difference can alter a relational constraint when an articulated classification changes institutional treatment. A relational structure can condition which manifestations become likely or intelligible. An ontological condition, where warranted, can restrict both relational formation and manifestation. Later sections will develop these cross-register relations in greater detail. At the present stage, the important point is that primitive interactions can occur within a register and across registers, and the mapping among them need not be one-to-one.

This framework also accommodates observer dependence without reducing reality to observation. The analyst chooses boundaries, timescales, and distinctions through which change, structure, constraint, and difference are represented. Those representational choices can alter what becomes visible in the analysis. The causal efficacy of the configuration, however, does not depend on the analyst having represented it correctly. GR therefore separates the methodological primitives used to construct an account from the stronger claim that reality itself is exhausted by those primitives.

4.4.6 Emergence of Stable Configurations

Ontological emergence, in the restrained sense required here, concerns the formation of a configuration that becomes sufficiently organized and persistent to be treated as a determinate object of inquiry. Such a configuration can arise when changes are retained through structure, consequential differences are reproduced or transformed, and constraints support a degree of continuity across further change. Stability is relative to timescale, boundary, and analytical resolution. It does not require immobility,

permanence, equilibrium, or immunity to transformation.

Definition 4.25 (Relatively stable configuration). A *relatively stable configuration* is an organized pattern that preserves sufficient continuity across a specified region or interval of spacetime for its identity, effects, or transformations to be tracked at the resolution relevant to an inquiry. Its stability may depend on continuing generative activity and can coexist with substantial internal change.

Definition 4.25 deliberately stops short of defining relational reality. Relative stability is necessary for many relationally real objects, yet stability alone is insufficient. The following section will require the further question of causal efficacy within the generative-relational system. A recurring pattern that remains observationally stable but exerts no relevant causal effect may be descriptively important without satisfying the full GR criterion for relational reality. Section 4.4 therefore establishes the primitive conditions through which candidate objects become available for the stronger analysis that follows.

Stable configurations can be generated through heterogeneous mechanisms. Repetition can reinforce expectations; feedback can maintain a range of states; institutional rules can preserve boundaries; material infrastructures can retain earlier decisions; memory can transmit prior distinctions; legal recognition can stabilize roles; symbolic classifications can coordinate action; repair processes can restore a configuration after perturbation; and dependencies can make departure increasingly costly. GR does not assume that one mechanism explains every case. The ontological architecture should remain broad enough to distinguish different stabilization processes while still asking how they participate in generation.

The emergence of a configuration also does not guarantee a unique level of description. The same process may stabilize an object at one scale while remaining highly variable at another. A market can display stable aggregate patterns while individual relations change rapidly. A person's self-experience can preserve continuity while bodily and social conditions evolve. An institution can remain legally continuous while its practical operation is reorganized. Multiple relatively stable configurations can therefore overlap, nest, or intersect without being reducible to one common metric or hierarchy.

The historical dimension is decisive. Once a configuration stabilizes, it can become part of the conditions under which later emergence occurs. A relational object generated at one time can constrain later action; a manifestation can be institutionalized and become a component of subsequent relational structure; a difference can be preserved in records and reactivated under a later classification regime. Emergence therefore changes the generative field in which future emergence takes place. The result is a recursive historical process rather than a sequence in which completed objects simply accumulate alongside one another.

Claim 4.26 (Primitive structure and ontological emergence). *Change, structure, constraint, and difference provide GR with a minimal methodological grammar for describing how relatively stable configurations can emerge, persist, transform, and dissolve. The adequacy of this grammar is assessed through explanatory use, while stronger claims concerning the ultimate ontology of the primitives or the configurations generated through them remain subject to the local requirements of inquiry and to ontological suspension.*

Claim 4.26 locates the quartet within the broader ontological position of this chapter. GR commits to enough reality for emergence, persistence, and causal organiza-

tion to be investigated. It refrains from converting its starting vocabulary into a final metaphysics. This combination prepares the next step. Once a relatively stable configuration has emerged, the analysis can ask whether it also satisfies the stronger conditions of relational reality: emergence within a generative-relational system, persistence or stability over a relevant region or interval of spacetime, and causal efficacy within that system. The following section develops that criterion directly.

4.5 Relational Reality

Section 4.2 introduced relational reality as a technical category of GR: an object is relationally real when it emerges within a generative-relational system, persists with sufficient stability over a relevant region or interval of spacetime, and exerts causal efficacy upon that system. Section 4.4 then supplied the weaker primitive vocabulary through which candidate objects can become describable before the full criterion is satisfied. The present section develops relational reality in its own right. Its objective is to clarify the distinct work performed by emergence, persistence, stability, causal efficacy, and participation in subsequent relations, while preserving the separation between relational reality and ontological identity. The method is constitutive rather than reductive: the section specifies conditions under which GR is warranted in treating an object as real within a generative-relational system without claiming that those conditions provide a final metaphysics of the object.

The criterion is deliberately stricter than the claim that something is related to something else. Almost any object can be placed within a descriptive network, and almost any event can be associated with surrounding conditions. Relational reality instead concerns an object whose generation and continuation depend upon a relational domain in which it becomes sufficiently determinate to participate causally in what follows. A transient correlation, an observer's arbitrary grouping, or a label that leaves the system unchanged does not become relationally real merely because it can be represented relationally. The category therefore joins an ontological claim of limited scope to an explanatory burden: the analyst must specify the relevant system, the object that has emerged, the domain over which it persists, the sense in which it remains stable, and the causal differences attributable to its presence. (Emirbayer 1997; Berger and Luckmann 1966; Searle 1995)

Claim 4.27 (Relational reality is system-relative rather than merely observer-relative). *A claim of relational reality is indexed to a generative-relational system and an analytically relevant spacetime domain. This relativity does not reduce the object to an observer's description: once the relevant conditions are satisfied, the object can constrain, enable, or redirect processes independently of whether a particular subject recognizes or represents it.*

Claim 4.27 is important because the word *relational* can otherwise be misread as subjective or perspectival. GR uses the term differently. The system relative to which an object is real can include human subjects, institutions, technologies, material infrastructures, ecological processes, symbolic practices, artificial agents, or other relevant components. A subject's recognition may participate in the system, but recognition is neither a universal origin nor a universal criterion of relational reality. This allows GR to treat pre-perceptual and pre-symbolic structures as relationally real when they already satisfy the stronger conditions developed below.

4.5.1 Relational Emergence

Relational emergence concerns the formation of an object through the organization of relations rather than its simple discovery as an already individuated unit. The phrase does not imply that nothing existed before the object emerged. Components, processes, histories, constraints, and differences may already be present. What emerges is a relatively determinate object at the scale and register relevant to the inquiry: a monetary form, an institutional office, a trust relation, a collective identity, an experienced continuity of self, a market convention, or another configuration that was not previously available in the same organized form.

Definition 4.28 (Relational emergence). *Relational emergence* is the formation of an analytically individuable object through a generative configuration of relations such that the object's organization and later effects cannot be specified adequately by treating the participating relata as independent of the relations through which the object is generated.

This definition makes emergence stronger than aggregation. A pile of tokens and a currency system can contain some of the same material objects while differing radically in relational organization. A set of persons and an institution can contain the same persons while the institution introduces offices, expectations, procedures, permissions, records, sanctions, and histories that modify what those persons can subsequently do. The relationally emergent object is therefore not identified merely by listing its components. Its identity depends on the organization through which components, positions, practices, and constraints become mutually consequential.

Relational emergence can be gradual, punctuated, recurrent, or threshold-like. A trust relation may thicken through repeated interaction without a uniquely identifiable first instant. A legal status may acquire a conventional date of creation even though the relational conditions that make it operative developed earlier. A collective identity may emerge unevenly across subgroups and institutions. A digital asset may be technically instantiated at one moment while its economic relational reality develops only as practices of recognition, exchange, custody, valuation, and regulation stabilize around it. GR therefore avoids requiring a universal temporal signature for emergence.

The same caution applies to boundaries. An emergent object can possess fuzzy or contested edges while still becoming causally consequential. Institutional membership may be disputed; the practical boundary of a market may shift; a social category may be internally heterogeneous; the experienced continuity of self may vary over time. Relational reality requires enough individuation for the object's persistence and causal role to be investigated, but it does not require perfectly sharp boundaries. Boundary specification is part of the inquiry and may itself be historically generated.

Relational emergence also need not begin with manifestation. A configuration can develop through material, institutional, ecological, computational, or social relations before any subject recognizes it as a distinct object. This point is especially significant for contingency. A historically specific conjunction may already organize possibilities and causal pathways before its contingency becomes salient, aesthetically judged, or symbolically articulated. Later manifestation can disclose and transform such a configuration, but the event of recognition need not be the origin of its relational reality.

Conversely, manifestation can participate in emergence. A declaration, classification, measurement, ritual, image, diagnosis, price, legal inscription, or self-

description can become one of the relations through which an object is generated. The graph architecture developed in Section 4.2 therefore applies within relational emergence itself: the existence of pre-manifestational emergence in some cases does not imply that manifestation is causally external to emergence in all cases. Later sections examine this mediation more directly.

4.5.2 Persistence

Emergence alone is insufficient for relational reality because many configurations appear briefly and disappear without acquiring an enduring role in the system. Persistence identifies the temporal and spatial continuation required for an emergent object to become more than an evanescent event at the chosen scale. The relevant interval need not be long in absolute terms. What matters is whether the object remains available across enough of the system's evolution to participate in the processes under study.

Definition 4.29 (Persistence). For a specified generative-relational system and analytical domain, *persistence* is the continued or recurrent availability of an emergent object's identity across a region or interval of spacetime despite changes in some of its constituents, states, manifestations, or supporting relations.

Persistence is therefore compatible with transformation. A corporation can persist while employees, shareholders, strategies, assets, technologies, and offices change. A currency can persist while notes are redesigned, payment infrastructures change, exchange rates fluctuate, and particular users enter or leave the system. A sense of self can persist through changes in memory, body, social position, and narrative. Treating persistence as invariance would make relational reality unable to describe precisely the historically evolving objects for which the concept is intended.

The criterion instead requires an account of continuity. Such continuity can be maintained through legal succession, memory, records, repeated practices, network position, material infrastructure, reciprocal expectation, reproduction of rules, or other mechanisms. Different objects can therefore persist through different processes. GR does not require one universal substance that remains unchanged beneath all variation. The continuity relation itself is an object of analysis.

Persistence can also be intermittent. A ritual order may become active only at recurrent times; an institutional emergency power may remain latent between invocations; a social identity may become salient in some contexts and recede in others; a market convention may disappear locally and reappear under recurring conditions. If the organization that allows recurrence remains sufficiently preserved, relational reality can extend across periods in which the object is not continuously manifest. Persistence should therefore be evaluated relative to the object's mode of existence rather than by imposing uninterrupted perceptual presence as a universal standard.

This point again separates relational reality from manifestation. An institution does not cease to be relationally real whenever no one is looking at its records. A trust relation does not vanish between encounters merely because it is not presently expressed. A contingency-producing structure can remain operative before anyone recognizes the contingency it affords. Persistence concerns the continuation of the relational organization and its capacity to participate in later processes, not continuous appearance to a subject.

The spacetime domain of persistence must nevertheless be specified. An object can

be relationally real locally without possessing the same reality everywhere or indefinitely. A currency can cease to function beyond a jurisdiction or historical period. A deity can organize one community's practices without possessing the same relational status in another community. A classification can be institutionally decisive in one administrative system and irrelevant in another. Locality does not weaken the reality claim; it identifies the domain within which the claim is warranted.

4.5.3 Stability

Persistence and stability are related but distinct. Persistence asks whether the object continues or recurs across a relevant domain. Stability concerns whether its organization remains sufficiently coherent under ordinary variation and disturbance for the object to retain explanatory identity. A pattern can persist statistically while being too unstable to function as a recognizable causal object, while a highly stable configuration can exist only over a short but analytically decisive interval. GR therefore retains both criteria.

Definition 4.30 (Relational stability). *Relational stability* is the capacity of an emergent object to retain sufficient organizational coherence under a specified range of endogenous variation, environmental change, perturbation, or reproduction for its identity and causal role to remain analytically trackable.

The phrase *sufficient organizational coherence* is intentionally contextual. There is no universal numerical threshold at which an object becomes relationally real. Relevant tolerance depends on the system, timescale, question, and kind of object. A high-frequency market convention may be stable over minutes while a constitutional institution is assessed over decades. A transient coalition can be stable enough to determine a vote even if it dissolves immediately afterward. A psychological self-relation may fluctuate affectively while retaining a recognizable organization across a life period. The threshold should therefore be justified by the explanatory task rather than imported from an unrelated domain.

Stability also does not imply equilibrium. Some relational realities persist precisely through continual adjustment. A market-making practice can remain stable through rapid repricing; an institution can preserve authority through repeated reinterpretation; a language can persist through continuous lexical and grammatical change; a trust relation can remain viable because participants repair disruptions rather than because disruptions never occur. Dynamic maintenance is therefore fully compatible with relational stability.

Nor does stability imply desirability. Durable domination, exclusion, debt dependency, stigmatization, and distrust can all become highly stable relational realities. The criterion is descriptive and ontological within GR's limited sense: it asks whether a configuration has acquired sufficient persistence and coherence to act within the system. Normative evaluation remains a separate task. This separation is essential for GRE because some of the most consequential economic realities are precisely those whose stability reproduces harmful or unjust relations.

Stability can furthermore be self-enhancing. Once an object begins to affect expectations and action, those effects can generate relations that increase the probability of its continued reproduction. Trust can induce cooperation that produces shared experience, thereby strengthening later trust. Distrust can induce defensive behavior that is interpreted as evidence for further distrust. Institutional authority can coor-

dinate compliance that makes authority easier to reproduce. Capital can alter access to future opportunities in ways that facilitate further accumulation. GR treats such feedback as a possible mechanism of stabilization rather than as a universal property of relational reality.

The opposite process is equally important. Manifestations, interventions, shocks, reinterpretations, or changes in supporting relations can destabilize an object. A currency crisis can weaken expectations that previously sustained monetary coordination. A legal judgment can reorganize an institutional category. A new historical archive can transform a collective identity. An aesthetic or epistemic manifestation can redirect attention toward previously unnoticed contingencies. Stability is therefore historically produced and historically vulnerable.

4.5.4 Causal Efficacy

Causal efficacy supplies the decisive condition that prevents relational reality from collapsing into descriptive persistence. A pattern can persist because the analyst repeatedly groups observations in the same way while making no difference to the system itself. GR requires more. The emergent object must participate in producing, constraining, enabling, redirecting, amplifying, suppressing, or otherwise modifying subsequent processes within the relevant generative-relational system.

Definition 4.31 (Causal efficacy in relational reality). An emergent object possesses *causal efficacy* within a generative-relational system when its presence, organization, or state participates in producing differences in subsequent states, relations, capacities, constraints, possibilities, or transformations of that system under a warranted causal account.

This definition is deliberately plural about causal methodology. Causal efficacy may be supported through intervention, counterfactual analysis, process tracing, mechanistic reconstruction, temporal comparison, natural experiment, simulation, ethnographic evidence, historical reconstruction, or another method appropriate to the object. GR does not require every causal claim to be expressed through one statistical formalism. It does require the analyst to distinguish causal participation from mere co-occurrence or interpretive convenience.

The relevant effect also need not be direct. Money alters behavior partly through prices, accounting, law, expectations, infrastructures, and obligations. Institutional authority can act through role recognition, procedure, sanction, habit, and anticipatory compliance. A god that is relationally real within a religious system can affect conduct through ritual, obligation, architecture, collective memory, moral interpretation, or institutional organization without requiring the relational claim to settle independent theological ontology. The experienced continuity of “I” can organize plans, responsibility, avoidance, memory, and future self-interpretation through several mediating processes. In each case, the causal object is relationally constituted while its efficacy is distributed through other relations.

Causal efficacy can also be latent. A legal right may not be exercised during a given interval while its recognized availability changes bargaining and expectation. A credit line may remain unused while altering the decisions available to a firm. An institutional veto can shape proposals precisely because actors anticipate it and avoid triggering its use. An object’s causal reality therefore cannot always be inferred from visible episodes of activation. Capacities, constraints, and expectations can be

causally effective through the possibilities they open or foreclose.

At the same time, attribution must remain disciplined. Because relational objects are constituted through networks of supporting relations, it may be difficult to isolate their causal contribution. GR does not solve this problem by declaring every surrounding condition part of the object. The analyst must justify the individuation used in the causal account and remain open to competing decompositions. Different inquiries may locate causal efficacy at different but compatible scales; other decompositions may produce genuinely operative disagreements. Section 4.3 provides the framework for preserving such disagreements without forcing premature ontological closure.

The requirement of causal efficacy also clarifies why perception is unnecessary for relational reality. A structure can affect trajectories before it is recognized. Institutional exclusions can shape access before a person becomes aware of the classification producing them. A historical arrangement can make some encounters more likely than others before anyone interprets the resulting event as contingent. A biological or material condition can alter social relations before it is symbolized. Recognition may later become causally important, but the earlier efficacy is enough to establish that manifestation was not the origin of every relevant effect.

4.5.5 Participation in Subsequent Relations

Within GR, the most characteristic expression of causal efficacy is participation in subsequent relation formation. Relationally real objects do not merely produce isolated outcomes; they can alter who or what can enter into relation, which relations become possible or costly, how existing relations are interpreted, what capacities become available, which differences become salient, and how future objects can emerge. The reality of the object is therefore historical and generative: what has emerged can become part of the conditions of later emergence.

Claim 4.32 (Historical recursion of relational reality). *Once an emergent object becomes relationally real, it can enter the generative conditions of subsequent processes. It may thereby participate in producing relations and objects that were not part of the configuration through which it originally emerged.*

This recursive possibility gives relational reality particular importance for GRE. Money generated through prior legal, political, technological, and social relations can later organize labor relations, investment, debt, consumption, taxation, and institutional development. A firm generated through contracts, assets, labor, law, and organizational routines can become a subject of later relations and can itself create positions, technologies, products, obligations, and externalities. A category produced through administrative practice can redirect resource allocation and thereby alter the population to which the category is later applied. A reputation generated from past interaction can change access to future interaction. Relationally real objects can thus become relata in later systems while retaining histories of how they were generated.

This does not require the later system to reproduce the original generative conditions unchanged. An object can migrate across contexts, acquire new supports, or undergo partial reconstitution. A monetary instrument can move from one technological substrate to another. A religious symbol can enter commercial or political relations that differ from those through which its earlier significance formed. A self-description can be taken up by institutions and returned to the subject through clas-

sification. Relational reality can therefore accumulate layers of mediation over time.

Manifestational mediation is one important mechanism in this recursion. Once a relational reality becomes named, measured, pictured, priced, narrated, classified, or publicly performed, that manifestation can become part of the relations through which the object subsequently persists and acts. A trust relation can be altered by an explicit declaration of trust; a market can be changed by the publication of a price index; a person's institutional identity can be changed by the issuance of a document that records it. The manifestation is not merely a passive window onto a completed relational reality. It can become a causal component of the system.

The same logic applies to aesthetic judgment and contingency. A contingent configuration can already be relationally real before it is recognized. Once the contingency manifests as surprising, beautiful, significant, or worthy of attention, the judgment can redirect inquiry, preservation, imitation, funding, teaching, or collective memory. The manifestation then modifies the relational history of the object. GR can therefore affirm both pre-manifestational relational reality and later manifestational mediation without imposing a universal temporal chain between them.

Participation in subsequent relations also makes relational reality vulnerable to path dependence. Early stabilizations can influence which later relations become easier to form and which alternatives become progressively harder to realize. This does not imply deterministic lock-in. New relations, manifestations, shocks, interventions, and reinterpretations can reopen possibilities. The point is rather that a relationally real object can alter the field of later generation and therefore cannot be treated as an inert output of its own origin.

4.5.6 Relational Reality without Ontological Identity

The preceding conditions establish a mode of reality without settling ultimate ontological identity. An object can be generated, persistent, stable, and causally efficacious within a relational system even when competing metaphysical accounts of that object remain unresolved. This is not a concession that the object is somehow less real. It is a restriction on what kind of reality has been established.

Claim 4.33 (Relational reality does not entail ontological identity). *Establishing relational reality does not, by itself, establish that the relationally real object possesses an independent, fundamental, or uniquely specified ontological identity. Conversely, ontological existence does not by itself establish relational reality within every generative-relational system.*

Money again offers a simple example. Its relational reality can be demonstrated through the coordinated practices, institutions, expectations, inscriptions, and causal consequences that sustain monetary relations without deciding that money constitutes an ontologically fundamental kind. The experienced continuity of self can be relationally real because it persists and reorganizes action without requiring an invariant metaphysical ego. A divine object can be relationally real within a religious system because it organizes practice and causally affects subsequent relations while GR suspends the independent theological ontology of divinity. In each case, the relational claim is substantive even though a stronger ontological claim remains open.

This separation also accommodates objects whose manifestational structures differ radically. Consider a flower appearing under hallucinatory conditions and a flower encountered under ordinary physical conditions. Either can become relationally real

if, within the relevant generative-relational system, it acquires sufficient persistence or recurrent stability and causally affects attention, action, memory, affect, communication, or subsequent relations. Their common eligibility for relational reality does not imply that the two objects possess the same ontological status, arise through the same generative structure, or admit a justified common metric. Shared reality-status is therefore weaker than structural equivalence.

Remark 4.34 (Reality-status and comparability). Two objects can both satisfy the criterion of relational reality while lacking a warranted metric, ordering, equivalence relation, structure-preserving mapping, or other common comparison framework. Comparability is an additional analytical achievement rather than a consequence of shared relational reality.

Remark 4.34 protects the framework from a hidden homogenization. Money, grief, trust, institutional authority, divine presence, selfhood, market price, mathematical beauty, and physical objects may all become relationally real under appropriate conditions, while the structures through which they emerge remain heterogeneous. Some can be compared quantitatively, some only through partial mappings, some through qualitative or structural relations, and some may presently lack a justified common comparison domain. GR therefore separates the question of reality from the question of commensurability.

The same principle limits causal comparison. The fact that two objects affect a system does not imply that their effects can be placed on one scalar measure. Their causal pathways may differ in kind, scale, timescale, or register. GRE should therefore resist universal measures of “relational reality” unless a particular research problem establishes a defensible comparison structure. The criterion identifies whether an object has become stably and causally real within a system; it does not assign a universal magnitude of reality.

Relational reality consequently occupies a precise position within the three-register architecture. It is stronger than mere appearance because manifestation is not required for its existence. It is stronger than descriptive recurrence because causal efficacy is required. It is weaker than a final ontological identification because the ultimate metaphysics of the object can remain suspended. It is historically generative because objects that satisfy the criterion can become conditions of subsequent relation formation. And it remains heterogeneous because shared relational reality does not erase differences in structure, ontology, manifestation, or comparability.

Section 4.5 therefore provides the central ontological criterion that later GRE analyses will repeatedly use. The next section turns to manifestational reality, where the question changes from how an object becomes stably and causally real within a generative-relational system to how realities become available in particular modes of appearance, experience, articulation, measurement, classification, and symbolization. The distinction prepares the chapter to analyze manifestation without treating manifestation as either a transparent copy of relational reality or the universal condition of its existence.

4.6 Manifestational Reality

Section 4.5 established relational reality through a demanding criterion: an object must emerge within a generative-relational system, persist with sufficient stability

over a relevant spacetime region or interval, and exercise causal efficacy within that system. The present section turns to a different register. Its objective is to clarify what GR means when something becomes *manifest*, to distinguish manifestation from perceptual appearance alone, and to specify how manifestation can be real without being treated as transparent disclosure of either relational structure or ultimate ontology. The section also clarifies an asymmetry that is central to the three-register architecture. Relational reality can precede manifestation, while manifestations, once they occur, can enter generative-relational systems and mediate subsequent relational realities. The method is therefore register-specific: manifestation is analyzed according to the conditions of appearing, availability, differentiation, and mediation that make something manifest, rather than by importing the persistence criterion of relational reality into the manifestational register.

The term *manifestation* is used broadly but not loosely. GR does not restrict manifestation to what a human subject consciously sees, hears, or names. A phenomenon can become manifest through bodily sensation, affective salience, institutional classification, a legal record, a measuring instrument, a statistical pattern, a computational output, a material trace, a linguistic expression, or another medium through which a difference becomes available in a determinate form. Conscious perception is one important mode of manifestation, and symbolic articulation is another, but neither exhausts the category. The concept is intended to capture the general problem of how something becomes available in a *mode of appearance* within a historically and relationally structured situation. (Husserl 2012; Merleau-Ponty 2012; Gibson 1979)

Definition 4.35 (Manifestation). A *manifestation* is an event, state, or process through which a difference becomes sufficiently differentiated and available within a particular manifestational configuration to be encountered, registered, expressed, recorded, measured, classified, symbolized, or otherwise operative in a mode of appearance.

The phrase *manifestational configuration* is important. Something does not manifest in an abstract vacuum. Manifestation occurs through conditions that can include bodily capacities, sensory organization, instruments, media, languages, classificatory systems, institutional procedures, technical infrastructures, cultural expectations, temporal position, spatial scale, and prior relational histories. These conditions do not necessarily create ex nihilo whatever becomes manifest. They participate in determining the form, resolution, salience, and availability through which it appears.

Definition 4.36 (Manifestational reality). *Manifestational reality* denotes the reality of something insofar as it becomes manifest within a specified manifestational configuration. A claim of manifestational reality establishes that a manifestation occurs or is available in a determinate mode; it does not by itself establish the ultimate ontological identity of what manifests, the complete relational structure from which the manifestation emerges, or the persistence and causal efficacy required for relational reality.

Definition 4.36 gives manifestation its own reality-status without turning manifestation into an inferior copy of a supposedly more authentic domain. A pain can be manifestationally real as pain even while its physiological, psychological, or social constitution remains under investigation. A recorded market indicator can be manifestationally real as an institutional and statistical object even when the relation between the indicator and the economic processes it is intended to represent is contested. A flower appearing under hallucinatory conditions can be manifestationally real as an appearance without this settling whether its ontological or relational struc-

ture is equivalent to that of a physically encountered flower. Manifestational reality therefore protects the reality of appearance while keeping open the question of what kind of reality the appearance discloses.

Claim 4.37 (Manifestation does not require conscious recognition). *A manifestation can occur through a bodily, technical, institutional, material, statistical, or symbolic configuration without having already become the object of a subject's reflective awareness. Conscious recognition is one possible uptake of manifestation rather than its universal condition.*

A sensor can register a signal before a human observer inspects the record. An institution can classify an event through an automated procedure before any individual deliberates about the classification. A bodily change can become affectively or physiologically manifest before it is linguistically identified. A material trace can remain available for later interpretation even though no subject was present when it was formed. Claim 4.37 should not be read as making manifestation independent of every relation of availability. A purely postulated state that makes no difference in any manifestational configuration has not yet been shown to be manifest. The point is narrower: the configuration through which something manifests need not center a conscious human observer.

4.6.1 Manifestation and Appearance

Appearance is one of the most intuitive forms of manifestation, yet the two concepts should remain distinct. *Appearance* usually emphasizes how something presents itself within perceptual or phenomenological experience. *Manifestation* is broader. It includes appearance but also extends to forms whose availability depends on inscription, instrumentation, classification, computation, institutional procedure, or other mediating arrangements. GR uses the broader term because many economically consequential realities become available through mechanisms that are neither immediately perceptual nor reducible to an individual subject's phenomenal field.

A price displayed on a screen is perceptually available, but its economic manifestation also depends on pricing procedures, data infrastructures, currency conventions, temporal updating, and the institutional setting in which the number is treated as a price. An unemployment rate can become manifest through a published statistical series even though no individual can perceive the aggregate directly. A legal status can become manifest through a registry entry, certificate, database record, or institutional response. An affective orientation can become manifest through bodily sensation, conduct, speech, or repeated patterns of attention. These cases differ in medium, yet each involves a transition from conditions that are not fully available in the same form to a determinate mode in which some difference can be encountered or acted upon.

Remark 4.38 (Appearance is a mode of manifestation). Perceptual appearance is treated in GR as an important subset of manifestation rather than as its general model. This avoids making conscious perception the template against which institutional, technical, symbolic, statistical, and material manifestations must be understood.

The distinction also matters for the relation between manifestation and representation. Some manifestations are explicitly representational: a graph, map, account balance, legal document, or verbal statement purports to stand for or organize something

beyond the inscription itself. Other manifestations can occur before any such representational intention is established. Pain, surprise, bodily tension, a sensor spike, an anomalous pattern, or a change in behavioral regularity can become manifest without first being encoded as a representation of a known object. Representation is therefore one important organization of manifestation, but manifestation is analytically prior to the claim that a manifested form successfully represents what produced it.

This distinction is especially useful for contingency. A generative-relational and historical configuration can already exist before a subject recognizes a contingent relation within it. When contingency later becomes salient, striking, surprising, beautiful, troubling, or otherwise available to judgment, the event enters the manifestational register in a new way. The manifestation does not create the entire relational history that made the encounter possible. Yet the manifestational event can redirect attention and later action. GR can therefore distinguish the prior relational conditions of an encounter, the manifestational event through which contingency becomes available, and the subsequent relations generated after the encounter.

4.6.2 Stability of Manifestation

The stability requirement developed for relational reality should not be transferred mechanically to manifestational reality. A manifestation can be brief. A flash of pain, an unexpected image, a transient reading, a momentary affect, or a singular institutional announcement may be manifestationally real even if it disappears quickly. The occurrence of manifestation and the persistence of manifestation answer different questions.

Claim 4.39 (Manifestational reality does not require persistent stability). *A manifestation can be real as manifestation without satisfying the persistence and stability conditions required for relational reality. Stability is therefore a variable property of manifestation rather than a universal threshold for entry into the manifestational register.*

This claim prevents the three registers from collapsing into one criterion. If every real manifestation had to persist and exercise causal efficacy, manifestational reality would become only a special case of relational reality. GR instead permits an event to be manifestationally real while remaining fleeting, weakly consequential, or difficult to reproduce. The analytic task is then to ask what kind of stability, if any, the manifestation acquires.

Several forms of manifestational stability can be distinguished. A manifestation may be *temporally stable* when it remains available over an interval; *recurrently stable* when similar manifestations reappear under comparable conditions; *inscriptionally stable* when a record preserves the manifestation; *cross-contextually stable* when related forms appear across different manifestational configurations; or *procedurally stable* when a standardized practice repeatedly produces a comparable output. These forms should not be treated as equivalent. A persistent database entry, a recurring bodily sensation, and a reproducible measurement can all display stability while relying on different mechanisms.

Stability matters because stabilized manifestations can acquire new analytical and causal capacities. A fleeting observation can be remembered, recorded, replicated, standardized, circulated, or incorporated into a classification. Repeated manifestations can make a pattern easier to recognize. Institutionalized manifestations can become reference points for action. A statistical indicator that is repeatedly produced

can influence contracts, policy, expectations, and investment. Under such conditions, the manifestation itself may begin to satisfy the criteria of relational reality: it can emerge as a relational object, persist, stabilize, and exert causal efficacy within the system. This transition is possible rather than automatic.

Remark 4.40 (Stabilized manifestation and relational reality). A stabilized manifestation becomes relationally real only when the full relational criterion is warranted. Repetition, inscription, or durability can contribute to that criterion, but none alone establishes causal efficacy or relational emergence.

This distinction is particularly important in economics, where measurements and classifications can become embedded in the domains they describe. A rating, index, price category, credit score, or accounting classification may begin as a manifestational device. Once actors coordinate around it, institutions incorporate it, and future opportunities are conditioned by it, the manifestation can participate in producing a new relational reality. The framework therefore leaves open a historically important pathway from manifestation to stabilization to causal participation without treating that pathway as inevitable.

4.6.3 Context-Dependent Manifestation

Manifestation is context-dependent because what becomes available, and in what form, depends partly on the configuration through which availability is produced. Context here does not mean merely a subjective frame imposed by an observer. It includes the material, technical, institutional, bodily, linguistic, historical, and relational conditions that organize manifestation.

Definition 4.41 (Manifestational configuration). A *manifestational configuration* is the organized set of conditions through which differences can become available in a particular mode of manifestation. It may include subjects, bodies, instruments, media, institutions, categories, languages, technical procedures, spatial and temporal scales, and historically formed expectations.

Changing the configuration can change the manifestation without requiring that the underlying relational or ontological conditions have changed in the same way. A market process can look different at transaction-level, daily, and annual temporal resolutions. The same institutional relation can appear differently in a legal document, an ethnographic encounter, an administrative database, and a network representation. A bodily condition can manifest through pain for one subject, an imaging signal for a clinician, and a coded category for an insurer. These differences are not necessarily errors. They reflect distinct manifestational configurations that select, amplify, suppress, aggregate, or transform different aspects of what becomes available.

Context-dependence therefore places a burden on analysis. A manifestation should be reported together with the conditions under which it arose when those conditions materially affect interpretation. A number without a measurement procedure, an image without information about the instrument or scale, a classification without its institutional rule, or a statement without the relational situation of utterance can obscure how the manifestation was generated. This requirement becomes especially important when manifestations are used epistemically, because the analyst may otherwise mistake properties of the manifestational configuration for properties of the relational reality under study.

Claim 4.42 (Context-dependence and constraint). *The context-dependence of manifes-*

tation does not imply that manifestations are freely constructed by the manifestational configuration. Manifestations can be jointly constrained by the object, the generative-relational history, and the conditions of manifestation even when their form varies across contexts.

Claim 4.42 protects the framework from a simple opposition between naive realism and unrestricted constructivism. GR allows that a manifestation can be mediated and context-sensitive while still being constrained by realities not reducible to the mediating context. The exact distribution of constraint is an empirical and theoretical question. In some cases instrumentation dominates the form of output; in others the object strongly constrains what can appear; in still others institutional categories shape which differences become visible at all. The framework does not decide these cases in advance.

Historical context adds another dimension. Manifestational configurations themselves evolve. Categories that once lacked institutional existence can later become standardized. New instruments can make previously inaccessible differences measurable. Changes in language can alter what can be articulated. Political and administrative reforms can transform what gets counted, recorded, or ignored. Digital infrastructures can increase the granularity and frequency with which economic conduct becomes manifest. Manifestational reality is therefore historical not only because the objects manifested can change, but also because the conditions of manifestation acquire histories of their own.

4.6.4 Multiple Forms of Manifestation

The manifestational register is plural. A single relational reality can become available through multiple forms, and these forms need not preserve the same dimensions of the underlying relations. GR therefore resists treating any one manifestational mode as universally privileged.

For analytical purposes, several broad forms can be distinguished. *Perceptual manifestations* include sensory appearances and experienced salience. *Affective manifestations* include felt intensities, moods, attractions, aversions, and embodied orientations. *Behavioral manifestations* concern patterns expressed through action or response. *Material manifestations* include traces, spatial arrangements, artifacts, and physical inscriptions. *Institutional manifestations* include statuses, decisions, records, procedures, and classifications. *Symbolic manifestations* include linguistic expressions, images, signs, narratives, diagrams, and formal notations. *Statistical manifestations* make patterns available through aggregation, estimation, or comparison. *Computational manifestations* include model outputs, classifications, embeddings, simulations, scores, and other forms whose availability depends on computational procedures. These categories can overlap, and no exhaustive taxonomy is intended.

The plurality matters because different manifestations can support different kinds of action. A person may experience economic insecurity affectively before it becomes visible in an income statistic. A statistical indicator can reveal an aggregate pattern that is unavailable to individual perception. A legal category can make a relation institutionally actionable even when the lived experience of participants differs from the category's description. A model output can make a latent structure analytically tractable while remaining opaque to ordinary experience. GR treats these as different manifestational achievements rather than as successive approximations to a single

canonical appearance.

Claim 4.43 (Manifestational plurality). *The availability of multiple manifestations of an object does not establish that one manifestation is universally primary, nor does variation among manifestations by itself establish contradiction. Their relations depend on the conditions, scales, and dimensions through which each manifestation is generated.*

Manifestational plurality also means that absence in one mode does not establish absence in all modes. A relation that is not consciously perceived may nevertheless be institutionally recorded. A pattern that is statistically weak at one scale may become visible at another. A social expectation that is rarely articulated explicitly may manifest through repeated conduct. Conversely, strong manifestation in one mode does not guarantee corresponding manifestation elsewhere. A publicly salient narrative can be weakly reflected in measured behavior, while a powerful statistical regularity can remain culturally unnoticed.

This plurality prepares a later problem. If relationally different structures can sometimes give rise to similar manifestations, and if similar structures can sometimes generate different manifestations under different conditions, reverse inference from manifestation to relation becomes non-trivial. The present section does not yet formalize that inverse problem; Sections 96–98 will develop the generative relation and its possible non-invertibility. The point required here is simply that manifestation is many-formed and mediated.

4.6.5 Manifestation without Ontological Disclosure

A manifestation can be genuine without disclosing ultimate ontology. This is a direct consequence of the distinction among the three registers. The fact that something appears, is measured, is recorded, or becomes symbolically articulated establishes a manifestational fact. It does not automatically settle what ultimately exists, what type of entity is responsible for the manifestation, or which ontological account is uniquely correct.

Claim 4.44 (Manifestation does not entail ontological disclosure). *A warranted claim that something has manifested does not by itself warrant a unique claim about the ontological identity, fundamental constitution, or complete generative structure of what manifests.*

The point is stronger than the familiar possibility of perceptual error. Even highly reliable manifestations can underdetermine ontology. A reproducible measurement may be compatible with several theoretical interpretations. A stable institutional record may establish how an organization recognizes a status without resolving the broader ontology of that status. A subject's persistent experience of self can be manifestationally robust while competing accounts of selfhood remain open. A religious manifestation can be experientially and socially consequential while theological ontology remains under suspension. The reality of manifestation and the ontology of its source are therefore distinct questions.

The flower example clarifies the distinction. A flower appearing under hallucinatory conditions and a flower encountered under ordinary physical conditions can both possess manifestational reality as appearances. Their manifestational status does not establish that their relational structures are the same, that their ontological statuses are the same, or that they can be compared through a common metric. The manifested forms may even be phenomenologically similar while being gener-

ated through substantially different relational configurations. Manifestational reality preserves the reality of what appears without using similarity of appearance as a shortcut to ontological identity.

Ontological suspension is therefore especially useful in the manifestational register. An inquiry can investigate the conditions, stability, variation, and consequences of manifestations while suspending stronger claims that are unnecessary for the problem at hand. This suspension should remain disciplined. If an ontological difference becomes causally operative for the manifestation or for the question being studied, the inquiry can no longer treat that difference as irrelevant. Section 4.3's distinction between operative and non-operative ontological disagreement thus applies directly here.

The same restraint is needed in formal analysis. A manifestational space may be modeled statistically, geometrically, categorically, or computationally without implying that the modeled coordinates constitute the ontology of what manifests. Formal proximity among manifestations does not establish ontological proximity among their sources. A classifier can group observations efficiently while leaving open whether the grouped cases share a common generative structure. Manifestational tractability is analytically useful, but it should not silently become metaphysical identification.

4.6.6 Manifestational Reality and Relational Reality

Relational reality and manifestational reality are distinct registers whose relations can run in more than one direction. The first distinction is temporal and constitutive: an object can become relationally real before it manifests within a particular configuration. The second is generative: once a manifestation occurs, it can enter the relations through which later realities are stabilized, transformed, or dissolved. These two claims are compatible because the three-register architecture is a graph rather than a chain.

Claim 4.45 (Pre-manifestational relational reality). *Relational reality does not require prior manifestation to a subject, institution, symbolic system, or measuring apparatus. A relationally real object can already persist, remain stable, and exercise causal efficacy before it becomes manifest within a particular manifestational configuration.*

This claim is especially important for GR's account of contingency and aesthetic judgment. The generative-relational and historical conditions that make a contingent configuration possible can already be operative before the contingency is recognized. When the configuration later becomes manifest as surprising, beautiful, meaningful, or worthy of attention, the judgment belongs to the manifestational history of the object rather than to the origin of all its relational reality. The same structure applies to latent institutional tensions, unrecognized dependencies, or ecological relations whose effects are already causal before they become publicly salient.

Claim 4.46 (Manifestational mediation). *Once a manifestation enters a generative-relational system, it can participate in the generation, stabilization, transformation, or dissolution of relational realities by altering expectations, classifications, practices, capacities, constraints, or subsequent relations.*

A declaration of trust can modify the trust relation it manifests. A public price can alter transactions and expectations. A diagnosis can reorganize a person's institutional and interpersonal relations. A legal judgment can transform the relations

whose status it articulates. An aesthetic judgment can redirect attention, preservation, teaching, funding, imitation, and collective memory. In these cases manifestation is not merely an epistemic window onto a completed relational object. It becomes one of the relations through which later reality is generated.

Manifestational mediation does not imply that every manifestation becomes relationally real. A fleeting image can disappear without reorganizing later relations. A measurement can remain unused. A symbol can fail to stabilize a practice. Conversely, a manifestation can acquire relational reality when it becomes sufficiently persistent, stable, and causally efficacious within the relevant system. The distinction is therefore maintained at the level of criteria rather than by assigning each object permanently to one register.

This point also clarifies why the registers should not be pictured as layers through which an object passes once. The same object can occupy different positions relative to different systems and times. A relation may be causally operative before it is manifest; later it may become visible through measurement; the measurement can then alter the relation; a new manifestation can follow from the altered relation; and some manifestations can become stabilized relational objects in their own right. Historical recursion replaces a universal sequence.

Remark 4.47 (Graph architecture of manifestation and relation). The distinction between relational and manifestational reality specifies different criteria of reality, not a fixed ordering of stages. Their connections are historically variable and can include disclosure, mediation, feedback, stabilization, transformation, and loss.

Section 4.6 therefore gives manifestational reality a precise but non-reductive role within GR. Manifestation concerns the modes through which differences become available in determinate configurations. It can be perceptual without being only perceptual, symbolic without being only symbolic, stable without requiring stability, and causally consequential without being defined by causal efficacy. Its reality can be affirmed while its ontology remains suspended. Most importantly, manifestation neither creates all relational reality nor merely reflects it. The next section develops this relation more closely by asking how manifestation itself can emerge through generative-relational processes and how historically formed conditions govern what becomes available to manifestation.

4.7 Manifestation through Generative Relational Emergence

Section 4.6 defined manifestational reality in terms of the conditions under which differences become available in determinate forms. The present section asks a prior generative question: how do those conditions themselves arise, and through what relations does one rather than another manifestation become possible? The objective is to treat manifestation as an emergent event within historically formed generative-relational systems rather than as a transparent encounter between a finished object and an abstract observer. The section develops the manifestation relation, clarifies how manifestations can be relationally generated, examines the historical formation of manifestation rules, and studies institutional and cultural mediation. It concludes by specifying how manifestation mechanisms can themselves become embedded within relational reality. This formulation preserves the distinction between

the registers while explaining why their relations are recursive rather than sequential.

A manifestation can often be described retrospectively as though an object simply possessed an appearance that waited to be observed. GR treats this description as analytically incomplete. What becomes available, in what form, with what salience, at what resolution, and to which subject, instrument, institution, or practice depends on a configuration of relations. Some of these relations may be bodily or material; others may be linguistic, technical, institutional, historical, cultural, economic, or political. Their participation does not imply that they freely invent what manifests. It means that manifestation has generative conditions. These conditions can select, amplify, suppress, translate, discretize, classify, stabilize, or otherwise organize differences into forms that become available within a manifestational configuration. (Giddens 1984; Archer 1995; Bourdieu 1977)

Claim 4.48 (Generative condition of manifestation). *A manifestation is generated through a determinate configuration of relations among what can manifest, the conditions through which it becomes available, and the historical structures that organize that availability. Manifestation therefore cannot in general be reduced either to an intrinsic property of an isolated object or to a free construction by an observing subject.*

Claim 4.48 gives the term *generative* a specific role. It directs inquiry toward the conditions under which a manifestation becomes possible and toward the processes that shape its form. The claim is compatible with ontological realism, constructivism in limited domains, process ontology, phenomenological inquiry, and other positions whose stronger metaphysical differences may remain suspended. Its commitment is methodological and explanatory: manifested form has a history and a relational organization that can, at least in part, be investigated.

4.7.1 The Manifestation Relation

The most economical way to begin is to distinguish a manifestation from the *manifestation relation*. A manifestation is the available event, state, or form specified in Definition 4.35. The manifestation relation concerns the structured relation through which that availability is produced. It includes whatever configuration is relevant to explaining why a difference becomes manifest in one way rather than another.

Definition 4.49 (Manifestation relation). *A manifestation relation is a contextually specified relation among a potential source of difference, a manifestational configuration, and an available manifested form, such that the relations among these components participate in generating how the difference becomes manifest within the relevant system.*

The term *potential source of difference* is deliberately cautious. GR does not assume that every manifestation can be traced to a single antecedent object whose independent ontology is already established. The source can be a relational configuration, an event, a process, a field of variation, an interaction, or another analytically warranted object. In some inquiries, the source may remain partly unknown while its manifestations are well characterized. In others, the source may itself be relationally real but not ontologically identified. Definition 4.49 therefore avoids building a stronger ontology into the concept than the inquiry has earned.

The manifestational configuration likewise need not be centered on a conscious subject. A telescope, laboratory protocol, legal procedure, market platform, archival

system, machine-learning classifier, bodily sensory apparatus, ritual practice, or collective discourse can participate in the relation. Human awareness may enter later, or it may be only one component among several. The relation is consequently broader than perception and broader than representation.

A manifestation relation also need not be deterministic. The same relational configuration can permit several manifestations, and similar manifestations can arise under substantially different configurations. Noise, contingency, path dependence, measurement error, strategic behavior, institutional discretion, and historical variation can all contribute to this multiplicity. Section 98 will later examine the consequences for invertibility. At the present stage, the important point is that the manifestation relation can be probabilistic, underdetermined, multivalued, or only partially reconstructable.

Remark 4.50 (Manifestation relation and causal relation). A manifestation relation can contain causal relations without being reducible to a single causal edge. It may include enabling conditions, constraints, classifications, selection procedures, interpretive conventions, technical transformations, histories of training, and other relations whose combined organization produces an available form.

This distinction matters for GRE because many economic manifestations are composites. A market price is not merely caused by a single underlying value. It becomes manifest through bids and offers, market rules, time windows, transaction infrastructures, currencies, accounting conventions, data publication, and expectations. An unemployment rate manifests through administrative and statistical categories that distinguish employment, unemployment, labor-force participation, and reference periods. A credit score manifests through variables, models, institutional objectives, data histories, and technical procedures. In each case, what becomes visible to later actors is generated through a manifestation relation whose components can themselves become objects of economic analysis.

The relation can also alter the salience of what becomes manifest. Two systems may contain similar differences while making different differences available for action. An institution that records only monetary transactions can make financial exchange highly manifest while leaving unpaid care weakly represented. A platform interface can make some prices, ratings, or rankings immediately visible while rendering other dimensions costly to discover. A legal procedure can transform a diffuse conflict into a set of admissible categories. Manifestation is therefore partly a problem of organized availability.

4.7.2 Relational Generation of Manifestation

The manifestation relation becomes generative when relations among its components do more than transmit a preformed appearance. They participate in producing the differentiated form through which something becomes available. This does not require the strong claim that manifestation creates the underlying object. It requires only that the manifested form cannot be adequately explained without the relations through which it is generated.

Definition 4.51 (Relational generation of manifestation). *Relational generation of manifestation* occurs when the organization and interaction of elements within a manifestational configuration participate in producing the form, salience, resolution, classification, or availability through which a difference becomes manifest.

Several kinds of generation can occur. A relation may *select* among differences by making some detectable and others practically invisible. It may *transform* a difference by translating it into another medium, as when a physical signal becomes a numerical reading. It may *aggregate* multiple events into a statistical indicator. It may *classify* heterogeneous cases under a legal or administrative category. It may *amplify* weak variation into a salient signal, or *suppress* variation through thresholds and normalization. It may *sequence* events into a narrative or temporal ordering. It may *stabilize* an otherwise fleeting manifestation by inscription, repetition, storage, or institutional recognition. These are different mechanisms and should not be collapsed into a universal operation.

The relational generation of manifestation is especially clear when the same underlying configuration becomes available differently under changed conditions. A bodily process may manifest as pain, as an imaging signal, as a diagnostic code, as a disability category, or as an insurance claim. None of these manifestations is simply identical to the others. Each is generated through different relations, infrastructures, conventions, and purposes. The multiplicity does not make every manifestation arbitrary. It shows that the same object or process can enter several manifestation relations whose outputs differ because their generative conditions differ.

A similar structure appears in economic life. Productive activity can manifest as wage income, firm revenue, national accounts, household time use, ecological burden, or reputational value depending on the relational apparatus through which it is registered. A transaction can manifest simultaneously as a price, a legal transfer, a tax event, a behavioral data point, and a change in inventory. The manifestations overlap but need not coincide. Each selects and organizes a different dimension of the event.

Claim 4.52 (Relational generation without ontological reduction). *The relational generation of a manifestation does not establish that the manifested object is exhausted by the relations that generate its manifestation. A warranted account of manifestation can therefore remain compatible with ontological suspension concerning the ultimate constitution of what manifests.*

This claim prevents two opposite reductions. One reduction treats manifested form as if it transparently revealed an independently fixed object. The other treats the object as if it were nothing more than the manifestation apparatus that renders it available. GR can reject both shortcuts. A scientific measurement can be instrument-dependent without implying that the measured phenomenon is only an instrument effect. A legal identity can be institutionally generated without implying that every relevant aspect of the person is reducible to legal classification. A market category can be constructed through conventions while still producing effects that constrain actors independently of their individual intentions.

The same reasoning is important for contingency. A contingent encounter may become aesthetically or existentially salient only within a historically formed relational field of expectations, memories, concepts, bodily dispositions, and prior experiences. The field participates in generating how contingency manifests. Yet the relevant relational structure need not begin at the moment of conscious judgment. It can already be operative before the subject recognizes the encounter as contingent. Aesthetic judgment can then become a later manifestation within that structure and, once expressed or acted upon, can feed back into subsequent relations. The example illustrates why manifestation is relationally generated without making perception the

origin of relational reality.

4.7.3 Historical Formation of Manifestation Rules

Manifestations are not generated only by immediate relations. The relations governing manifestation can themselves have histories. Languages, measurement conventions, administrative categories, scientific instruments, market protocols, aesthetic canons, educational practices, and institutional procedures develop over time. These histories shape what can become manifest, what distinctions are available, and how manifestations are stabilized or interpreted.

Definition 4.53 (Manifestation rule). *A manifestation rule is a historically situated regularity, convention, procedure, threshold, classification, transformation, or selection principle that contributes to determining how differences become available within a manifestational configuration.*

The term *rule* should not be read as requiring explicit codification. Some manifestation rules are written: accounting standards, legal definitions, laboratory protocols, survey instructions, platform ranking procedures, or diagnostic criteria. Others are tacit: habits of attention, cultural expectations, aesthetic conventions, professional judgment, or learned bodily sensitivities. Still others are embedded materially in instruments and infrastructures. Their common feature is that they shape manifestation with sufficient regularity to be analytically relevant.

Manifestation rules can emerge through deliberate design, cumulative convention, conflict, adaptation, technological change, institutional inheritance, or combinations of these processes. Their histories therefore matter. A category that appears natural at one moment may be the product of earlier administrative choices. A statistical threshold can reflect technical constraints that later become institutionalized. A visual convention can persist long after the original reason for its design has disappeared. Historical formation can thus become sedimented into present manifestation without remaining visible to current users.

Claim 4.54 (Historicity of manifestation rules). *Manifestation rules can be historically generated, reproduced, contested, and transformed. Their present operation therefore does not imply timeless necessity, and changes in these rules can alter what becomes manifest without requiring the underlying generative system to change in the same way or at the same rate.*

This claim is important for historical comparison. An economic object recorded under one classificatory regime may not be directly comparable with an apparently similar object recorded under another. A change in measured unemployment can reflect economic change, classificatory change, or both. The visibility of unpaid labor can change when survey design changes even if household practices remain partly continuous. A new diagnostic category can produce a sharp increase in recorded cases by reorganizing manifestation conditions. Historical analysis must therefore distinguish changes in what is generated from changes in how generation becomes manifest.

The same issue appears in intellectual history and aesthetics. What counts as a salient problem, elegant proof, beautiful form, or meaningful contingency is mediated by historically formed repertoires of attention and judgment. These repertoires do not mechanically determine judgment. They condition what is available for recognition and provide distinctions through which some encounters become expressible.

An aesthetic judgment can therefore be both genuinely emergent and historically mediated. GR treats those properties as compatible.

Manifestation rules can also become self-reinforcing. Once an institution measures a phenomenon through a particular category, actors may adapt to the category; resources may be allocated through it; records may accumulate around it; and later inquiry may inherit the same distinction because data already exist in that form. The rule then participates in generating the relational reality it was initially used to manifest. Classification and object formation can become recursively coupled without becoming identical.

4.7.4 Institutional and Cultural Mediation

Institutions and cultures are especially important mediators because they stabilize manifestation relations across persons and time. They supply categories, roles, standards, symbols, practices, technologies, authorities, and expectations through which manifestations become publicly recognizable and actionable. Their mediation can increase coordination while also making some dimensions more visible than others.

Institutional mediation is evident in legal, administrative, financial, educational, scientific, and organizational settings. A legal institution can transform a history of conduct into a status, claim, liability, or judgment. A central bank can make monetary conditions manifest through rates, statements, balance sheets, and operational procedures. A university can convert heterogeneous intellectual activity into grades, degrees, publications, rankings, and appointments. A firm can make performance manifest through accounting categories and internal metrics. These manifestations often acquire consequences precisely because institutions authorize and reproduce them.

Cultural mediation operates through partially shared repertoires of interpretation, value, symbolism, attention, narrative, and expectation. Cultural mediation can affect which manifestations are immediately legible, which require explanation, which are trusted, and which are ignored. It can also affect the emotional and aesthetic force of manifestation. The same material configuration can be encountered as sacred, ordinary, threatening, beautiful, wasteful, prestigious, or economically valuable under different cultural relations. GR does not infer from this variability that cultural meaning is unconstrained. Material conditions, histories, institutions, and other relations can sharply delimit the range of viable manifestations.

Claim 4.55 (Mediation without passivity). *Institutional and cultural mediation can participate in generating manifestational form while the manifested object, the mediating structures, and the subjects involved remain capable of constraining and transforming one another. Mediation is therefore a generative relation rather than a one-way transmission channel.*

This reciprocal structure becomes visible when manifestations modify the institutions and cultures through which they were generated. A published economic indicator can alter policy debate and market expectations. A court judgment can reshape the categories used in later adjudication. A public aesthetic judgment can redirect preservation, funding, teaching, and imitation. A religious manifestation can reorganize ritual practice or institutional authority. A newly visible form of vulnerability can generate advocacy, legal reform, or changes in professional classification. What manifests through a mediating system can return as a difference within that system.

The possibility of recursive mediation also clarifies why power matters without making power the sole explanation of manifestation. Institutions can privilege some forms of visibility, define admissible evidence, allocate attention, or authorize classifications. Cultural hierarchies can make some voices more legible than others. Yet manifestation can also escape intended control, generate unintended consequences, or reveal differences that established institutions cannot easily assimilate. The manifestational field is structured, but structure does not imply perfect determination.

For GRE, this point is central to the analysis of value. Market price is a powerful manifestation because institutions, currencies, infrastructures, legal rights, expectations, and accounting practices make it actionable across many relations. Its institutional strength does not entail that price exhausts value. Other values may manifest through care, ecological resilience, symbolic significance, social recognition, lived capability, or forms that remain weakly commensurable with price. Treating one manifestation as exhaustive can therefore become an epistemic and political act with generative consequences of its own.

4.7.5 Manifestation Mechanisms within Relational Reality

The final step is to locate manifestation mechanisms within the relational reality developed in Section 4.5. A manifestation mechanism is not merely an abstract rule for converting one description into another. It is an organized process through which relevant relations participate in producing a manifestation. Instruments, institutions, habits, classifications, algorithms, rituals, sensory systems, and discursive practices can all function as components of such mechanisms.

Definition 4.56 (Manifestation mechanism). *A manifestation mechanism is an identifiable organization of relations and processes through which differences are selected, transformed, amplified, suppressed, aggregated, classified, recorded, expressed, or otherwise made available in a manifestational form.*

Manifestation mechanisms can themselves become relationally real when they satisfy the criteria of relational emergence, persistence, stability, and causal efficacy. A statistical bureau's classificatory practice can persist across administrations and alter resource allocation. A pricing mechanism can become stable enough to organize expectations and transactions. A diagnostic infrastructure can shape treatment pathways and self-understanding. A platform ranking system can influence attention and behavior while being continually reproduced through technical and organizational relations. In such cases, the mechanism is not only a means through which other objects manifest; it becomes an efficacious object within the generative-relational system.

Claim 4.57 (Relational reality of manifestation mechanisms). *When a manifestation mechanism emerges within a generative-relational system, persists with sufficient stability, and exercises causal efficacy within that system, the mechanism can itself possess relational reality independently of whether the objects it manifests share the same ontological or relational status.*

The qualification at the end of Claim 4.57 is important. A measurement institution can be relationally real even when what it attempts to measure remains ontologically contested. A religious interpretive practice can be relationally real without resolving the ontology of the divine object it concerns. A hallucination-generating process can be relationally real even when the manifested flower lacks the same physical ontology

as an ordinarily encountered flower. The reality-status of the mechanism and the reality-status of what manifests through it therefore require separate analysis.

This separation also prevents a common inferential shortcut. The persistence and efficacy of a manifestation mechanism do not guarantee the truth of every manifestation it produces. Stable institutions can classify incorrectly. Reliable instruments can be applied outside their calibrated domain. Cultural conventions can stabilize misleading interpretations. Algorithms can reproduce systematic error. Relational reality concerns the mechanism's efficacy within the system; epistemic warrant concerns the adequacy of the manifestation as evidence for another claim. Chapter 5 will develop this distinction more fully.

At the same time, recurrent manifestation can alter the mechanism itself. Users adapt to metrics, institutions revise categories after disputes, instruments are recalibrated, algorithms are retrained, and cultural expectations change after repeated encounters. The mechanism therefore participates in a recursive history: it generates manifestations, those manifestations enter subsequent relations, and those relations can reconfigure the mechanism. This recursion is one reason the three registers are better represented as a graph of historically evolving relations than as a fixed chain.

Section 4.7 has therefore shifted the analysis from manifestation as an available form to manifestation as a generative-relational achievement. A manifestation relation connects potential sources of difference with historically situated configurations of availability. Relations can generate manifestational form through selection, transformation, classification, amplification, aggregation, and stabilization. The rules governing these operations can themselves be historical products, while institutions and cultures can mediate manifestation without fully determining it. Finally, manifestation mechanisms can become relationally real when they acquire persistence, stability, and causal efficacy. The next section develops the stronger possibility that the mapping through which relational reality becomes manifest can itself be treated as a relationally real object, provided that its own conditions of stability, persistence, and causal efficacy are established.

4.8 Relational Reality of Manifestation Mapping

Section 4.7 treated manifestation as a generative-relational achievement and introduced manifestation mechanisms whose histories can become part of the conditions of later appearance, classification, measurement, and symbolization. The present section takes one further step. It asks whether the relation through which manifestation is generated can itself become an object of relational reality. The answer is affirmative under conditions that are already familiar from Section 4.5: a manifestation mapping can become relationally real when it emerges within a generative-relational system, persists with sufficient stability over a relevant region or interval of spacetime, and exercises causal efficacy within that system. This claim does not require the mapping to be ontologically fundamental, mathematically exact, consciously represented, or epistemically correct. It requires the mapping to become sufficiently organized and effective to participate in the subsequent generation of relations and manifestations.

The term *mapping* is used cautiously. It does not presuppose a mathematical function with a fixed domain, codomain, and unique output. Many manifestation map-

pings are partial, probabilistic, multivalued, path-dependent, historically revised, or only locally stable. A perceptual apparatus, an administrative classification, an accounting convention, a legal procedure, a scientific instrument, an algorithmic classifier, a market protocol, or a linguistic convention can all establish structured correspondences through which differences become manifest. In some cases a formal function is an appropriate representation. In others, a rule, relation, stochastic kernel, institutional procedure, embodied disposition, or family of transformations is more adequate. The ontological point made here is prior to the choice among those representations. (Giere 2004)

Definition 4.58 (Manifestation mapping). A *manifestation mapping* is a relatively organized relation, rule, process, or mechanism through which differences available within a generative-relational system are transformed, selected, classified, amplified, aggregated, translated, or otherwise rendered into one or more manifestational forms under specified conditions.

Definition 4.58 makes the mapping itself analytically visible. Instead of treating a manifestation as if it simply followed from an antecedent object, inquiry can ask what mediates the transition from a field of differences to the form in which those differences become available. This shift is important because the mediator can acquire a history, a domain of validity, a characteristic stability, and causal consequences of its own. Once this occurs, the mapping is no longer merely a convenient description imposed by an analyst. It can become part of the reality through which the system continues to generate later manifestations.

4.8.1 The Manifestation-Mapping Lemma

The relation between manifestation mapping and relational reality can be stated as a direct consequence of the criterion developed in Section 4.5. The statement is called a lemma because it does not introduce a new criterion of reality; it applies the existing criterion to a higher-order object whose role might otherwise remain implicit.

Lemma 4.59 (Manifestation-mapping lemma). *Let a manifestation mapping be generated within a specified generative-relational system. If, over a relevant region or interval of spacetime, the mapping persists with sufficient stability and exercises causal efficacy in the production, organization, interpretation, or subsequent use of manifestations, then the manifestation mapping qualifies as relationally real relative to that system.*

The lemma is intentionally conditional. A proposed mapping does not become relationally real merely because an analyst can write it down. A transient coincidence, an unused classification scheme, a hypothetical function, or a rule that has not entered the operation of the relevant system may remain an analytical representation rather than a relationally real object. The mapping acquires relational reality when the system itself sustains it sufficiently for it to make a causal difference to what subsequently occurs.

This distinction can be illustrated by comparison between an analyst's model and an institutional classification. An economist may construct a mapping that groups heterogeneous transactions into a set of categories for one exploratory analysis. Unless that mapping enters broader practice, its reality may remain primarily representational. By contrast, when a tax authority, statistical office, payment platform, or accounting regime repeatedly classifies transactions according to a rule that affects

reporting obligations, eligibility, prices, audits, or later decisions, the mapping can become relationally real. The classification rule participates in producing subsequent relations. Its effects can persist even when individual actors do not understand the rule in detail.

The same logic applies outside explicit institutions. A learned perceptual discrimination can become stable enough to alter attention and action. A linguistic distinction can guide recognition and social response across repeated situations. A ritualized interpretive practice can channel what members of a community notice and how they respond. An algorithmic ranking rule can shape visibility, participation, and incentives. In each case, the mapping is not merely between two descriptions. It is an operative relation embedded in a system.

Remark 4.60 (Higher-order relational objects). The manifestation-mapping lemma illustrates a broader feature of GR: a relation among objects, or a relation among relations, can itself become an analytically relevant object when it acquires persistence, stability, and causal efficacy. Relational reality therefore does not restrict objecthood to substance-like entities.

This remark is especially important for the graph architecture of the three registers. If mappings among relational and manifestational configurations can themselves become relationally real, then the edges of the graph are not always analytically external to the graph. Some edges can stabilize into objects that later participate in additional edges. A classification relation can become an institution; an interpretive convention can become a norm; a measurement protocol can become an infrastructure; an interface rule can become part of a market's operating environment. The system can therefore generate not only new nodes but also relatively stable relations that subsequently function as nodes at another analytical scale.

4.8.2 Stability of the Mapping

Stability is one of the conditions through which a manifestation mapping can become relationally real, but stability should not be confused with exact invariance. A mapping can remain sufficiently stable while its parameters, categories, thresholds, implementation, or local outputs change. The relevant question is whether enough of its organization persists for the mapping to remain identifiable and causally operative within the inquiry's scale.

Definition 4.61 (Mapping stability). A manifestation mapping exhibits *mapping stability* when variations in its conditions, implementation, or inputs remain compatible with sufficient continuity of its organizing relation for the mapping to retain an identifiable role in generating manifestations over the relevant analytical interval.

This definition allows several forms of stability. A legal mapping from circumstances to status can be stable because courts and agencies reproduce a rule even while interpretations evolve. A market protocol can remain stable while prices and participants change continuously. A perceptual mapping can remain stable across ordinary variation in illumination or bodily state. A machine-learning classifier can preserve a recognizable decision regime across a period of use even if its inputs vary widely. Stability concerns the organization of the mapping, not identity of outputs.

The degree of stability required is domain-relative. A high-frequency trading rule may be relationally significant over milliseconds or hours. A monetary classification can persist for decades. A ritual or linguistic mapping may persist across generations

while changing gradually. GR therefore does not impose a universal temporal threshold. The relevant interval is set by the system and the explanatory question. What matters is that the mapping endure long enough, and coherently enough, to influence subsequent relational development.

Stability also has spatial and institutional dimensions. A classification may be stable within one jurisdiction and absent in another. A cultural mapping may operate within a community without extending beyond it. A measurement protocol may be valid only within a calibrated range. A platform's ranking mechanism can be stable inside one technical environment while changing rapidly after a redesign. Treating stability as local prevents a relationally real mapping from being mistaken for a universal law.

Claim 4.62 (Stability without universality). *A manifestation mapping can be sufficiently stable to possess relational reality within a specified system without being invariant across all times, places, scales, institutions, or domains.*

Claim 4.62 is consequential for economic analysis. Economic categories often appear natural after long institutional stabilization. Wage, price, ownership, debt, unemployment, creditworthiness, productivity, and risk can become highly stable manifestations within particular infrastructures. Their stability can make them causally powerful without establishing that the mappings producing them are timeless or ontologically universal. A category may be deeply real in a relational sense precisely because institutions reproduce it, not because the category exists independently of those institutions.

Mapping stability can also be endogenous to repeated use. When actors anticipate how a system maps differences into manifestations, they can adapt their conduct accordingly. Firms alter reports to fit accounting categories; applicants modify behavior in response to scoring systems; researchers adapt experiments to measurement protocols; users optimize content for ranking systems. Repeated adaptation can stabilize the mapping by making surrounding behavior increasingly compatible with it. It can also destabilize the mapping by exploiting its weaknesses. Stability is therefore an historical outcome rather than a purely formal property.

4.8.3 Persistence of the Mapping

Persistence differs from stability. Stability concerns continuity of organization under variation; persistence concerns continued existence or recurrence of the mapping across the relevant spacetime interval. A mapping can persist while becoming less stable, as when a contested classification remains institutionally present but its interpretation fragments. Conversely, a mapping can be locally stable during each use yet fail to persist because the mechanism is abandoned after a short episode. Relational reality requires attention to both dimensions.

Definition 4.63 (Mapping persistence). A manifestation mapping exhibits *persistence* when the relations, practices, mechanisms, or infrastructures that sustain the mapping continue or recur across a relevant spacetime interval such that the mapping remains available to participate in subsequent manifestation.

Persistence can be maintained through material infrastructure, institutional memory, embodied habit, repeated practice, archived rules, software, education, law, ritual, language, or combinations of these. Different supports can substitute for one another. A monetary mapping between numerical denomination and purchasing ca-

capacity, for example, does not persist through one material carrier alone. It can be reproduced through bank ledgers, legal obligations, payment networks, accounting systems, public expectations, pricing practices, and state institutions. The relational object persists through distributed supports whose composition can change.

This distributed persistence matters because the disappearance of one carrier need not dissolve the mapping. Paper certificates can disappear while account-based records remain. A spoken norm can become codified. An institutional category can migrate from paper forms to databases. A scientific measurement practice can move from one instrument generation to another. Persistence therefore belongs to the generative organization rather than necessarily to a single substrate.

Historical transmission also permits mappings to outlive the conditions under which they first emerged. Categories may continue to organize manifestation after the original rationale has weakened. Administrative systems can preserve distinctions whose historical origin is forgotten. Economic indicators can continue to guide policy after production structures have changed. Such persistence is analytically important because the mapping can remain causally efficacious even when actors no longer possess a clear account of its genealogy.

Claim 4.64 (Persistence without conscious maintenance). *A manifestation mapping can persist relationally without being continuously represented, understood, or intentionally maintained by any single subject, provided that the generative-relational system continues to reproduce the mapping through relevant practices, structures, or infrastructures.*

This claim parallels the pre-manifestational status of relational reality discussed earlier. Just as a relationally real object does not require prior perception, a relationally real mapping does not require a subject who explicitly knows the mapping. Some mappings are tacit, distributed, embodied, or infrastructural. Their reality becomes visible through regularities in what systems make available and through the effects that follow from those regularities.

Persistence also makes the history of mappings empirically investigable. One can trace when a distinction entered an institutional vocabulary, when a metric became standardized, when a legal category acquired force, when an algorithmic rule was deployed, or when a perceptual convention became culturally salient. Such histories can reveal that what later appears to be an immediate manifestation was mediated by a mapping that had itself undergone a process of stabilization and transmission.

4.8.4 Causal Efficacy of the Mapping

Persistence and stability alone do not complete the criterion. A mapping becomes relationally real in the stronger GR sense when it also exercises causal efficacy within the relevant system. Causal efficacy can arise at several points. The mapping can influence which differences become available, how they are organized, how actors respond to them, which resources are allocated, what categories are reproduced, and how later mappings are formed.

Definition 4.65 (Causal efficacy of a manifestation mapping). A manifestation mapping has *causal efficacy* when its operation makes a difference to subsequent manifestations, actions, relations, constraints, capacities, allocations, classifications, or trajectories within the relevant generative-relational system.

A mapping's causal efficacy need not be deterministic. A credit score may change the probability of receiving credit without uniquely determining the decision. A diagnostic category may alter the range of available treatments without fixing an individual's course. A market price can reorient behavior while different actors respond differently. A cultural symbol can modify salience and expectation without compelling one interpretation. Probabilistic, enabling, constraining, and path-shaping effects can all be causal in the relevant sense when the mapping makes a counterfactually or dynamically significant difference within the system.

Causal efficacy also distinguishes the reality of a mapping from the accuracy of the manifestation it produces. A mistaken classification can still be causally powerful. A biased indicator can redirect resources. A misleading rumor can alter market behavior. A hallucinated object can affect bodily action and memory. An institution can stabilize an erroneous category whose consequences are nevertheless real. The mapping's relational reality therefore cannot be inferred from epistemic correctness, nor can epistemic correctness be inferred from relational reality.

Claim 4.66 (Reality of mapping and epistemic adequacy). *The relational reality of a manifestation mapping and the epistemic adequacy of the manifestations it produces are distinct questions. A mapping can be persistent, stable, and causally efficacious while remaining inaccurate, biased, incomplete, or inappropriate for a particular inferential purpose.*

This distinction is particularly important in GRE. Economic systems are filled with manifestations that guide action because their mappings have become institutionally real: ratings, prices, scores, indicators, legal statuses, performance measures, rankings, and classifications. Their causal power can induce actors to reorganize behavior around them. Once this occurs, a measurement can partially participate in producing the reality it later appears merely to describe. A performance metric can reorganize work; a risk category can change financing conditions; a ranking can redirect attention; a price index can enter contracts; an eligibility threshold can reshape household decisions. The mapping becomes part of the generative field.

Causal efficacy can also operate through reflexivity. Actors can learn the mapping and strategically act upon it. Once a threshold is known, behavior can cluster around the threshold. Once a ranking formula is inferred, participants can optimize for it. Once a legal classification becomes consequential, actors can reorganize transactions to fall inside or outside its categories. Reflexive response does not make the mapping less real. It often provides evidence of its causal incorporation into the system.

At the same time, causal efficacy can contribute to transformation of the mapping itself. Strategic adaptation can expose failures, institutions can revise rules, and accumulated outcomes can alter normative or technical expectations. A manifestation mapping can therefore be both cause and object of later change. This recursive position reinforces the graph architecture: the mapping mediates manifestation, manifested outcomes alter relations, and those relations can return to modify the mapping.

4.8.5 Manifestation Mapping within Relational Reality

The preceding analysis allows manifestation mapping to be located more precisely within the three-register architecture. A mapping is not a fourth register. It is a relation whose analytical status depends on what it does. Some mappings remain hypothetical or representational devices introduced by inquiry. Others become embedded

in generative-relational systems and thereby acquire relational reality. Once embedded, they can mediate what becomes manifest while also being transformed by the manifestations and relations they help generate.

Proposition 4.67 (Relational reality of manifestation mapping). *A manifestation mapping belongs to relational reality when its generative-relational emergence, persistence, stability, and causal efficacy are sufficiently established relative to the system and scale under investigation. Its relational reality does not require that the mapping be consciously represented, mathematically exact, epistemically adequate, ontologically fundamental, or universally valid.*

Proposition 4.67 consolidates the section's argument. It also prevents several conflation. First, the mapping's reality is distinct from the ontological reality of what enters or exits the mapping. A perceptual mechanism can be relationally real whether the manifested object is physical, imagined, hallucinatory, remembered, or ontologically unresolved. Second, the mapping's reality is distinct from the reality-status of a particular manifestation. A durable classification system can produce fleeting manifestations, while a transient mapping can occasionally produce a stable recorded output. Third, the mapping's relational reality is distinct from its normative desirability. Persistent and causally efficacious mappings can reproduce exclusion, distortion, domination, or injustice. Reality does not imply legitimacy.

The distinction is also useful for the earlier example of the hallucinatory flower and the ordinarily encountered physical flower. Both can enter manifestation reality, and both can participate in relationally real consequences. Their manifestation mappings can nevertheless differ substantially. One may involve bodily or neurological conditions that generate a flower-like manifestation without a corresponding ordinary external flower; another may involve interactions among an external physical object, sensory apparatus, environmental conditions, memory, and perceptual organization. GR need not place these mappings in one metric space or claim that their structures are directly comparable. It can instead ask whether each mapping is identifiable, persistent, stable, and causally efficacious within its relevant system. Shared relational reality does not require shared generative architecture.

The same caution applies to comparisons among economic mappings. A price mechanism, a religious valuation practice, a legal recognition procedure, an aesthetic judgment, and an algorithmic score can all become relationally real mappings while lacking a justified common metric. Comparison requires an independently warranted relation of comparison. One can sometimes compare causal effects, stability, information loss, accessibility, or institutional reach, but each comparison constructs a domain and selects dimensions. The common label *relationally real* establishes a criterion of reality rather than a universal coordinate system.

This point becomes important for formalization. If an inquiry represents a manifestation mapping as

$$\mathcal{M}_C : X \rightsquigarrow Y, \quad (4.1)$$

where C denotes relevant conditions, Equation 4.1 should be interpreted cautiously: the symbol $\rightsquigarrow$ should be read as a deliberately general mapping relation rather than automatically as a single-valued mathematical function. Depending on the domain, $\mathcal{M}_C$ may be deterministic, stochastic, partial, multivalued, path-dependent, or historically variable. The formal representation becomes useful only after the analyst specifies what X , Y , C , and the mapping relation mean in the problem under study. The

notation is therefore a compact placeholder for a family of possible structures rather than an ontological claim that manifestation universally follows one mathematical form.

Remark 4.68 (Mapping and graph architecture). When a manifestation mapping becomes relationally real, the graph connecting relational and manifestational registers contains historically generated mediating structures with their own trajectories. The graph is therefore not merely a diagram of static correspondences; its mediating relations can emerge, stabilize, exercise causal efficacy, and transform.

This dynamic graph helps explain why manifestation cannot be treated as the terminal stage of a chain. A relationally real mapping participates in producing a manifestation; the manifestation can enter subsequent action and representation; those consequences can alter the system that sustains the mapping; and the altered mapping can generate different manifestations later. The history of the mapping becomes part of the history of what can appear.

Section 4.8 has therefore elevated manifestation mapping from an implicit bridge to an explicit object of relational analysis. The manifestation-mapping lemma applies the criteria of relational reality to mappings themselves. Stability concerns continuity of organizing relation under variation; persistence concerns continued or recurrent reproduction across a relevant spacetime interval; causal efficacy concerns the difference the mapping makes to later manifestations and relations. When these conditions are satisfied, the mapping is relationally real even while stronger ontological and epistemic questions remain open. The next section turns to a different problem. Once a mapping has been identified, the availability of a manifestation does not guarantee that the mapping can be reversed. Non-invertibility, multiplicity, and loss of relational information therefore become central to any inference from manifestational reality back toward the structures from which manifestation emerged.

4.9 Non-Invertibility of Manifestation

Section 4.8 established that a manifestation mapping can itself become relationally real when it is sufficiently persistent, stable, and causally efficacious within a generative-relational system. The present section examines a different property of such mappings: whether a manifestation can be used to recover, uniquely and adequately, the relational configuration from which it emerged. The central result is a disciplined account of *non-invertibility*. Manifestation may compress, select, transform, aggregate, or contextually reorganize relational differences. Consequently, a manifestational form can be compatible with several relational configurations, while a given relational configuration can admit several manifestations. These possibilities limit reverse inference from what appears, is recorded, is measured, or is symbolized to the relational reality that participated in generating it. The argument proceeds through many-to-one manifestation, one-to-many manifestation, manifestational equivalence, relational difference beneath manifestational similarity, and the resulting limits of reverse inference.

The term *non-invertibility* is used here in an analytical rather than universally algebraic sense. Some manifestation mappings can be represented by ordinary functions and studied with familiar notions of inverse functions. Others are stochastic, partial, multivalued, historically variable, institutionally mediated, or dependent on condi-

tions that cannot be held fixed across observations. Section 4.8 therefore represented a general manifestation mapping by Equation 4.1, using $\rightsquigarrow$ to indicate a mapping relation whose exact mathematical form remains to be specified locally. Non-invertibility concerns the information and structure that cannot be uniquely recovered when inquiry moves from a manifestational result back toward the relational configurations compatible with it. (Giere 2004)

A convenient formal device is the *compatibility set*. Let $\mathcal{M}_C$ denote a manifestation mapping under relevant conditions C , let X denote a selected space of relational configurations, and let Y denote a selected space of manifestations. For a manifestation $y \in Y$, define the set of relational configurations compatible with y under C by Equation 4.2.

$$\mathcal{P}_C(y) = \{x \in X \mid x \mathcal{M}_C y\}. \quad (4.2)$$

The notation in Equation 4.2 does not assume that X or Y is metric, that $\mathcal{M}_C$ is deterministic, or that every relevant relational configuration has already been exhaustively specified. It identifies a local inverse problem: given a manifestation and a specified manifestation regime, which relational configurations remain compatible with what has become manifest? When the compatibility set contains several materially different configurations, manifestation underdetermines relational reconstruction.

Definition 4.69 (Manifestational non-invertibility). A manifestation mapping is *non-invertible for a specified inquiry* when the available manifestation, together with the mapping conditions and admissible evidence, does not support unique and warranted recovery of the relevant antecedent relational configuration at the scale required by that inquiry.

Definition 4.69 makes non-invertibility relative to an inquiry, scale, and evidential regime. A mapping can be invertible with respect to one coarse variable while remaining non-invertible with respect to a finer relational history. A measurement may uniquely determine a reported category while failing to determine the heterogeneous trajectories that produced that category. A legal status may uniquely identify the institutionally recognized state of a person while leaving the underlying social, economic, and historical relations radically underdetermined. Conversely, additional manifestations or interventions can sometimes narrow the compatibility set. Non-invertibility therefore concerns the relation between available manifestation and warranted reconstruction rather than an assertion that recovery is impossible under every conceivable extension of evidence.

4.9.1 Many-to-One Manifestation

Many-to-one manifestation occurs when materially different relational configurations generate the same, or sufficiently similar, manifestational form under the relevant conditions. This is the most direct source of non-unique reverse inference. If several relational configurations belong to $\mathcal{P}_C(y)$, observing y establishes compatibility with each of them until further evidence differentiates among the alternatives.

Definition 4.70 (Many-to-one manifestation). A manifestation mapping exhibits *many-to-one manifestation* relative to conditions C when two or more relationally distinguishable configurations are compatible with a common manifestational form, or with forms treated as indistinguishable under the operative manifestational criterion.

The source of many-to-one manifestation can differ across domains. A mapping may aggregate several relational configurations into one category. An instrument may register only one dimension of a multidimensional process. An institutional procedure may intentionally suppress distinctions judged irrelevant to its purpose. A perceptual system may resolve several materially different stimuli into one recognizable form. A statistical summary may retain an average while discarding distributional structure. A market price may summarize heterogeneous beliefs, constraints, liquidity conditions, institutional rules, and strategic positions without uniquely revealing their composition. In each case, the manifestation can remain highly useful while carrying less relational information than the configuration from which it emerged.

Compression is therefore one important mechanism of many-to-one manifestation. Compression should be understood broadly. It includes numerical aggregation, categorical classification, perceptual simplification, institutional standardization, linguistic naming, algorithmic feature selection, and other processes through which a richer relational field is rendered into a lower-dimensional or less differentiated manifestational form. The compressed manifestation can be stable and causally powerful. Its stability does not restore the distinctions removed during manifestation.

Many-to-one manifestation can also arise without deliberate compression. Different histories can converge on similar configurations at the point of manifestation. Distinct causal paths can produce the same observed outcome. Heterogeneous social relations can produce similar behavioral regularities. Different institutional arrangements can yield the same reported indicator over a limited interval. Distinct bodily, perceptual, and environmental configurations can generate similar experiences. The manifestational similarity can therefore result from convergence rather than from a single mechanism that intentionally groups diverse inputs.

The distinction between *same manifestation* and *sufficiently similar manifestation* matters. Exact equality is often unavailable or analytically unnecessary. A measurement system can treat values within a tolerance interval as the same reading. A legal regime can place heterogeneous cases in the same category. A human observer can experience two appearances as indistinguishable despite physical differences. A model can treat two distributions as equivalent for a selected decision rule. The operative equivalence criterion belongs to the manifestation regime and should be stated rather than presumed.

Claim 4.71 (Manifestational underdetermination). *When a manifestation is generated through a many-to-one mapping, the manifestation alone underdetermines the antecedent relational configuration. Reverse inference requires additional evidence, constraints, interventions, or assumptions capable of differentiating among the configurations that remain compatible with the manifestation.*

Claim 4.71 does not imply that reverse inference is futile. It specifies its evidential burden. If the compatibility set can be reduced through additional manifestations, historical records, controlled interventions, cross-context comparison, or independent knowledge of the mapping, reconstruction can become more informative. The point is that the manifestation does not carry a unique antecedent merely by virtue of appearing determinate.

This distinction has particular importance for GRE because economic manifestations often appear in standardized forms. A price, score, balance, wage, category, ranking, or aggregate may be numerically precise while remaining relationally underdetermined. Precision of manifestation and uniqueness of generative history are

different properties. A highly precise number can summarize a heterogeneous field of relations, just as a coarse category can sometimes correspond to a relatively specific institutional mechanism. The degree of manifestational precision therefore provides limited information about the invertibility of the mapping.

4.9.2 One-to-Many Manifestation

Non-invertibility also arises in the opposite direction. A single relational configuration can generate several manifestational forms across contexts, observers, instruments, symbolic regimes, times, or scales. Section 4.6 already established that manifestational reality is condition-dependent and can take heterogeneous forms. The present subsection makes the consequence for inversion explicit: variation in manifestation need not imply variation in the relational object at the level under investigation.

For a relational configuration $x \in X$, define its admissible manifestation set under conditions C by Equation 4.3.

$$\mathcal{Y}_C(x) = \{y \in Y \mid x \mathcal{M}_C y\}. \quad (4.3)$$

Equation 4.3 allows the manifestation mapping to be multivalued. Even where a deterministic function is appropriate under fixed conditions, variation in C can generate a family of manifestations for the same selected relational configuration. The analyst must therefore distinguish changes in the relational configuration from changes in the conditions through which that configuration becomes manifest.

Definition 4.72 (One-to-many manifestation). A manifestation mapping exhibits *one-to-many manifestation* relative to the selected analytical scale when one relational configuration can become manifest in more than one materially distinguishable form across admissible manifestation conditions.

The qualification *relative to the selected analytical scale* is essential. What appears to be one relational configuration at a coarse scale may contain fine-grained differences that explain manifestational variation. Conversely, an inquiry may have good reason to treat those differences as irrelevant to its present object. One-to-many manifestation therefore does not establish that an identical microstate generates arbitrary outputs. It states that the relational identity preserved by the inquiry can coexist with plural manifestations.

A monetary relation illustrates the point. The same institutionalized monetary claim may become manifest as a banknote, an account balance, a payment message, an entry in a ledger, a spoken amount, or a displayed price. These manifestations differ materially and symbolically while participating in a relational structure that can remain continuous across them. Likewise, an institutional status can be manifested through a document, database record, uniform, title, access permission, spatial arrangement, or pattern of deference. A relation of trust can become manifest through speech, action, silence, delegation, disclosure, or patterned expectation. The plurality of manifestations does not by itself establish plurality of the relational object.

One-to-many manifestation also appears in scientific and empirical inquiry. A process can leave different traces under different instruments. A latent relation can generate several observable indicators. A historical event can become available through documents, material remains, memories, later institutional records, and statistical

consequences. Each manifestation selects and transforms aspects of the underlying relational history. Their differences can be informative precisely because they arise through different manifestation mappings.

This plurality creates a second inverse problem. If one relational configuration can appear in several ways, then inferential procedures that expect a single canonical manifestation can miss relational continuity beneath manifestational difference. A change in representation can be mistaken for a change in the represented relation. A change in instrument can be mistaken for a change in the measured process. A change in symbolic vocabulary can be mistaken for the disappearance of the phenomenon. Conversely, stable terminology can conceal substantial relational transformation. The ontological and epistemic tasks therefore require attention to both directions of mismatch.

Remark 4.73 (Manifestational plurality and identity). Manifestational plurality does not by itself establish either relational identity or relational difference. Whether several manifestations concern one relationally continuous object depends on the persistence, stability, causal organization, and historical continuity that define the relational object at the relevant scale.

Remark 4.73 prevents an opposite overcorrection. The existence of one-to-many mapping does not license the analyst to declare diverse manifestations identical. The relation among them has to be established. The three-register architecture therefore places a burden on both identification and differentiation: similarity of appearance does not establish relational identity, and difference of appearance does not establish relational difference.

4.9.3 Manifestational Equivalence

Many-to-one manifestation requires a concept for cases in which distinct relational configurations cannot be distinguished within a specified manifestation regime. The appropriate concept is *manifestational equivalence*. The term is deliberately weaker than ontological identity, relational identity, or structural isomorphism. It describes indistinguishability with respect to a specified manifestation mapping and criterion.

Definition 4.74 (Manifestational equivalence). Two relational configurations are *manifestationally equivalent* relative to a specified manifestation regime when the distinctions between them are not expressed in the manifestational forms that the regime recognizes as relevantly distinguishable for the inquiry at hand.

Manifestational equivalence is therefore indexed by a regime. The regime includes the mapping, conditions, resolution, categories, instruments, symbolic resources, tolerances, and analytical purposes that determine what counts as a relevant manifestational difference. Two configurations can be equivalent under one regime and distinguishable under another. The equivalence can also disappear historically when new instruments, categories, practices, or sensitivities make previously unavailable differences manifest.

This relativity does not make manifestational equivalence arbitrary. A regime can have stable procedures and well-specified criteria. Under those criteria, the equivalence may be reproducible and operationally important. Two chemical states can be indistinguishable to one instrument and distinguishable to another; two institutional practices can receive the same administrative code while producing different lived consequences; two economic trajectories can yield the same quarterly aggre-

gate while diverging in distribution, vulnerability, or future capacity. In each case, equivalence is real relative to a manifestation regime while remaining narrower than identity of the relational configurations.

Proposition 4.75 (Locality of manifestational equivalence). *Manifestational equivalence warrants claims of indistinguishability only relative to the specified manifestation regime and criterion. It does not, by itself, warrant ontological identity, relational identity, equal causal structure, equal historical trajectory, or interchangeability across other manifestation regimes.*

Proposition 4.75 is especially important for comparative analysis. A common indicator can create an equivalence class that is useful for one purpose. Treating the same equivalence class as valid for another purpose requires additional justification. Equal income at one date does not imply equal wealth, security, capabilities, obligations, histories, or future opportunities. Equal test scores do not imply identical learning processes. Equal prices do not imply identical market structures. Equal institutional classifications do not imply identical relations of power. The manifestation criterion selects the dimension of equivalence; it does not silently generalize that equivalence to every other dimension.

Manifestational equivalence can itself become relationally consequential. Once an institution treats distinct cases as equivalent, resources, rights, obligations, attention, or sanctions may be allocated according to the shared manifestation. The equivalence relation then becomes part of the generative-relational system. An administrative category can make heterogeneous persons institutionally interchangeable for one procedure. A credit category can group heterogeneous borrowers and alter their future financing conditions. A ranking band can group organizations and affect later demand. A standardized diagnosis can coordinate treatment while also reorganizing self-understanding and institutional response. In these cases, manifestational equivalence begins as a criterion of indistinguishability and can become part of the relational reality that shapes future trajectories.

This recursive possibility reinforces the graph architecture developed throughout the chapter. Manifestational equivalence can be generated by a relationally real mapping; the manifested equivalence can guide action; those actions can reshape subsequent relations; and the resulting relational changes can alter later manifestation mappings. Equivalence is therefore neither a passive label nor a guarantee of deep sameness. It can be an active component in the historical production of similarity and difference.

4.9.4 Relational Difference beneath Manifestational Similarity

The most important ontological consequence of non-invertibility is the possibility that substantial relational difference persists beneath manifestational similarity. A manifestation can be shared while the relations that generated it differ in organization, history, scale, causal mechanism, or normative significance. GR therefore treats the relational structure beneath a manifestation as an open object of inquiry rather than as something uniquely disclosed by appearance.

The example of the hallucinatory flower and the ordinarily encountered physical flower makes the distinction vivid. Both can enter manifestational reality as a flower-like appearance. Both can become causally consequential for attention, movement, memory, language, or subsequent action. Yet the relational configurations through

which the manifestations arise can differ substantially. One may involve bodily or neurological conditions that generate a flower-like percept without the ordinary external object; another may involve an external physical flower, environmental conditions, sensory transduction, perceptual organization, memory, and learned categorization. The fact that both are manifestationally available as a flower does not establish a common generative structure, and GR has no need to presume that the two structures belong to a single metric space.

This example also shows why relational reality and manifestational reality should remain distinct. A hallucinatory flower can participate in relational reality if the generated object persists sufficiently and exerts causal efficacy within the relevant system. The relational reality of that object does not depend on identifying its generative structure with the structure of an ordinarily perceived physical flower. Shared manifestational form and shared relational reality-status therefore remain compatible with structural heterogeneity.

The same pattern appears in less unusual cases. Two organizations can report the same productivity indicator while relying on different labor relations, technologies, environmental externalities, or temporal strategies. Two households can report the same income while occupying different debt structures, care obligations, legal statuses, social networks, or exposure to risk. Two communities can exhibit similar rates of participation while differing in trust, coercion, institutional accessibility, or cultural expectations. Two artificial systems can produce similar outputs while relying on different architectures, data histories, or inference procedures. In each case, manifestational similarity narrows some differences while leaving others unresolved.

Claim 4.76 (Relational remainder beneath manifestation). *For a specified manifestation regime, relational differences that do not alter the recognized manifestation constitute a relational remainder relative to that regime. Such differences can remain causally and historically significant even while they are absent from the manifestational distinction used by the inquiry.*

The term *remainder* does not imply that the omitted relations are secondary in reality. They are a remainder only relative to a particular manifestation regime. A variable excluded from an indicator can be central to later dynamics. A relation invisible to an administrative category can structure access to resources. A historical difference suppressed by aggregation can determine vulnerability under future disturbance. A symbolic system can render one distinction salient while leaving another difficult to articulate. The remainder is therefore an analytical warning against treating the dimensions made manifest as exhaustive of the relational configuration.

Relational remainder also clarifies why greater manifestational detail does not automatically eliminate non-invertibility. Adding variables can reduce the compatibility set, but every representation selects a domain, scale, resolution, and set of distinctions. A richer manifestation can reveal differences that a coarser regime concealed while still leaving other differences unexpressed. Complete inversion would require a specification of what counts as the full relational configuration and a mapping that preserves every distinction relevant to the inquiry. In many social, economic, historical, and perceptual settings, that requirement is stronger than the available evidence can support.

This point should be kept separate from skepticism. GR does not infer that knowledge is impossible because manifestation can be non-invertible. It infers that knowledge claims should be calibrated to the information preserved by the manifestation

regime and to the additional evidence used in reconstruction. An inquiry can learn a great deal from a non-invertible mapping. It can identify equivalence classes, exclude incompatible explanations, estimate probabilities, compare mechanisms, reconstruct partial histories, and test interventions. The loss of unique inversion calls for epistemic discipline rather than epistemic paralysis.

4.9.5 Limits of Reverse Inference

Reverse inference begins from a manifestation and attempts to reconstruct relational structures, histories, mechanisms, or objects compatible with it. The analysis above yields a general constraint: the warranted strength of reverse inference depends on the structure of the manifestation mapping, the size and heterogeneity of the compatibility set, the stability of the conditions, and the availability of independent evidence. Manifestation can support inference without transparently revealing its antecedent relational reality.

Proposition 4.77 (Reverse-inference discipline). *An inference from manifestational reality toward relational reality should state the manifestation regime, identify plausible multiplicity in the compatibility set, distinguish assumptions supplied by the analyst from information preserved by the manifestation, and limit the reconstructed claim to the level supported by the available evidence.*

The principle has several consequences. First, a manifestation should not be treated as a self-interpreting trace. A number, category, statement, image, behavior, or institutional record becomes evidentially informative through knowledge of the relations and mappings that produced it. Second, reconstruction gains strength when independent manifestations arise through partially different mappings. If several traces with different failure modes converge on a compatible relational account, the compatibility set can become narrower. Third, interventions can sometimes distinguish among otherwise manifestationally equivalent configurations. Changing a condition and observing differential response can reveal structure that passive observation leaves hidden. Fourth, historical reconstruction requires attention to mapping change. A category recorded in one period can have a different generative and institutional meaning in another period even when the visible symbol remains constant.

Reverse inference can also be asymmetric across directions. A mapping may reliably predict a manifestation from a relational configuration while providing weak reconstruction from manifestation to configuration. If a broad range of configurations all produce the same output, forward prediction can be stable while inverse identification remains underdetermined. Conversely, a manifestation can sometimes be highly diagnostic of a narrow class of relational structures even when forward manifestation is probabilistic. The epistemic properties of the forward and reverse problems therefore need separate assessment.

This asymmetry is important for causal interpretation. A causal model can identify how a specified relation would affect manifestation under defined conditions without claiming that every observed manifestation uniquely identifies that cause. Similarly, an institution can reliably translate a legal status into a standardized record while the record alone remains insufficient to reconstruct the full path through which the status was obtained. Predictive adequacy in one direction does not guarantee explanatory uniqueness in the other.

Remark 4.78 (Manifestation and disclosure). A manifestation can disclose genuine aspects of relational reality while remaining non-invertible with respect to the relational configuration as a whole. Partial disclosure and non-unique reconstruction are compatible.

Remark 4.78 protects the chapter from two opposed simplifications. Manifestation is more than arbitrary projection because it can be constrained by, and informative about, relational reality. Manifestation is also less than exhaustive disclosure because the mapping can transform or suppress relational differences. The three-register framework therefore allows a manifestation to be real, constrained, causally consequential, and epistemically useful without treating it as a transparent duplicate of what generated it.

The same discipline applies to symbolic and representational forms, which become central in Section 99. Symbolization can preserve some differences, create new distinctions, stabilize categories, and make relations transmissible across time and space. It can also compress, standardize, and reorganize what becomes manifest. A symbol can therefore increase epistemic reach while adding another mapping whose invertibility requires examination. The transition from manifestation to symbolization should consequently be treated as a further generative relation rather than as a neutral copying operation.

Section 4.9 has established non-invertibility as a structural possibility within the three-register architecture. Many-to-one manifestation generates underdetermination because several relational configurations can be compatible with one manifestational form. One-to-many manifestation generates plurality because a relational configuration can become manifest differently across conditions and regimes. Manifestational equivalence identifies local indistinguishability without converting it into ontological or relational identity. Relational remainder names differences that remain outside a specified manifestation criterion while potentially retaining causal and historical significance. Reverse inference is therefore possible under disciplined conditions, but its strength depends on the mapping, the evidence, and the scale of reconstruction. These results prepare the analysis of symbolization, where manifestations can become stabilized, transmitted, classified, and recursively incorporated into later relational reality.

4.10 Symbolization and Manifestation

Section 4.9 established that manifestation can preserve genuine information about relational reality without providing a uniquely invertible image of the relational configuration from which it emerges. The present section introduces a further mediation: symbolization. Its role is to distinguish manifestation from the processes through which manifestations, relations, subjects, values, and other objects are rendered in symbolic form. Symbolization is analytically important because symbols can preserve distinctions across time and space, make heterogeneous objects administratively or economically comparable, coordinate action among actors who do not share immediate experience, and enter institutions as operative records, categories, rules, and representations. These capacities give symbolic forms unusual generative reach. They also make it especially important to avoid treating symbolization as transparent copying. (Cassirer 1955; Bourdieu 1991; Wittgenstein 2009; Espeland and Stevens

1998)

The argument proceeds in six steps. It first separates manifestation from symbolization and defines a symbolic regime. It then examines symbolic representation as a selective relation rather than an identity between symbol and represented object. The following three subsections consider the symbolization of relations, subjects, and value. The final subsection asks when representations themselves become part of relational reality. Throughout, the method remains consistent with the three-register architecture: symbolization can mediate relational reality without being a prerequisite for relational reality, and symbolic efficacy does not establish that the represented object possesses the ontological status attributed to it.

4.10.1 Manifestation and Symbolization

Manifestation and symbolization overlap in many concrete cases but remain distinct analytical operations. A bodily sensation, a sudden interruption of expectation, a visible pattern, an affective response, a material trace, or a behavioral change can become manifest without first being encoded in a symbolic system. Conversely, a symbolic inscription can persist and circulate beyond the immediate manifestation through which it was first produced. The distinction therefore protects two claims already established in the chapter: relational reality can precede symbolization, and manifestation is broader than symbolic representation.

Definition 4.79 (Symbolization). *Symbolization* is a generative-relational process through which a difference, object, relation, manifestation, possibility, or constructed category is rendered in a symbolic form whose differentiation and use are organized by a symbolic regime.

The definition is deliberately broader than linguistic naming. Numbers, diagrams, legal categories, monetary denominations, account identifiers, rankings, scores, icons, mathematical expressions, database fields, ritual signs, and conventional gestures can all participate in symbolization when their differences are organized within a system of use. A symbol need not resemble what it represents. Its efficacy can arise from the relations through which a community, institution, technical system, or practice distinguishes the symbol, connects it to other symbols, and treats it as relevant to subsequent action.

Definition 4.80 (Symbolic regime). A *symbolic regime* is a relatively organized set of relations, distinctions, conventions, procedures, media, and practices through which symbolic forms are produced, differentiated, interpreted, transmitted, or made operative within a specified generative-relational system.

A symbolic regime can be highly explicit, as in accounting standards, legal codes, programming languages, or administrative taxonomies. It can also be distributed across practice, as in ordinary language, professional conventions, ritual forms, or culturally stabilized categories. The regime may contain formal rules without being reducible to those rules. Institutional enforcement, habitual use, technological infrastructure, historical inheritance, and embodied competence can all contribute to the persistence of symbolic organization.

Symbolization therefore adds a further mapping to the architecture developed in Sections 4.7–4.9. A manifestation can be selected, segmented, named, quantified, classified, or otherwise encoded. Yet symbolization can also target something that has not been fully manifested to a particular subject. An automated system may classify

a transaction, assign an identifier, or generate a score without any human observer first experiencing the underlying relation in an immediate perceptual form. Symbolic mediation is consequently not equivalent to conscious interpretation.

The limited Lacanian analogy introduced in Section 4.2 is useful at precisely this point. Lacanian accounts of the Symbolic do not treat symbolic order merely as labels added after an independently completed field of experience; symbolic relations can organize positions, differences, and possibilities within which later experience and subject formation occur (Johnston 2026). GR does not import Lacan's specific account of language, desire, or subjectivity. The relevant architectural insight is narrower: symbolic mediation can be constitutive of subsequent relations rather than only descriptive of antecedent ones. This is one reason the three registers are represented as a graph rather than a chain.

Claim 4.81 (Symbolization is neither necessary nor terminal). *Relational reality does not require prior symbolization, and symbolization does not constitute a terminal stage of manifestation. Once symbolic forms enter subsequent relations, they can participate in further manifestation, stabilization, classification, coordination, and transformation.*

Claim 4.81 prevents two opposed reductions. A pre-symbolic relation need not be unreal merely because no vocabulary yet captures it. At the same time, a symbolic representation need not remain external to the object it represents. A new legal name, scientific category, market quotation, diagnosis, public label, or institutional identifier can alter the relations through which the represented object subsequently develops. Symbolization belongs inside generative history when it becomes causally operative.

4.10.2 Symbolic Representation

Symbolic representation is one important use of symbolization, but representation should not be treated as identity. A representation selects differences, organizes them through a symbolic regime, and presents them in a form suited to some practice, audience, institution, medium, or inquiry. The represented object can therefore exceed the representation even when the representation is accurate for its stated purpose.

Definition 4.82 (Symbolic representation). *A symbolic representation is a symbolically organized object, expression, record, or configuration that stands in a specified representational relation to another object, relation, manifestation, possibility, or constructed target within a symbolic regime.*

The term *specified* matters. The same inscription can represent different things under different regimes. A number may denote a price, quantity, rank, probability, account balance, legal threshold, or arbitrary identifier. A word can function as a name, category, command, promise, quotation, or fictional designation. An arrow in a diagram can indicate causation, implication, flow, sequence, correspondence, or merely graphical connection. Representation therefore depends on the relations that organize symbolic use rather than on the mark considered in isolation.

Symbolic representation inherits the non-invertibility examined in Section 4.9. Several relational configurations can be represented by the same symbolic category, while one relational configuration can receive different symbolic descriptions under different regimes. The symbolic form can compress history, suppress differences, aggregate relations, or introduce distinctions that were not previously operative. A category can be highly useful while remaining coarse relative to the relational domain. A detailed representation can preserve more distinctions while still leaving

a relational remainder.

This selectivity is not necessarily a defect. Representation is often useful precisely because it reduces complexity. A balance sheet excludes many features of an organization so that specified claims and obligations become legible. A map suppresses most properties of a landscape so that spatial relations relevant to navigation become visible. A legal category narrows heterogeneous histories into a form that permits institutional decision. A statistical variable makes comparison possible by holding some distinctions constant. The relevant question is not whether representation reproduces everything, but what it preserves, what it transforms, what it omits, and what later action is organized through it.

Remark 4.83 (Representational adequacy is purpose-relative). A symbolic representation can be adequate for one inquiry or practice while remaining inadequate for another. Adequacy therefore requires a stated purpose, scale, domain, and set of distinctions rather than an abstract demand for total correspondence.

Purpose-relative adequacy does not make representation arbitrary. A representation can fail because it omits a causally important distinction, misclassifies the object, applies a rule outside its domain, or produces consequences inconsistent with its stated purpose. The point is instead that symbolic adequacy is evaluated through a relation among representation, target, use, and conditions. No single representation is required to exhaust every relation in which an object participates.

Symbolic representation also introduces a distinction between the reality of the representation and the reality of its referent. A record can exist and be causally effective even if the proposition encoded in it is mistaken. A name can organize collective action even when the named object has uncertain ontological status. A false account balance, erroneous risk classification, or inaccurate administrative record can alter access, behavior, and expectations. The symbolic object and the truth of what it represents are therefore analytically separable.

4.10.3 Symbolized Relations

Relations frequently become actionable through symbolization. Contracts, titles, organizational charts, kinship terms, debt records, network links, legal statuses, platform connections, and institutional roles render some relation sufficiently explicit that it can be stored, communicated, enforced, compared, or incorporated into later decisions. Symbolization can thereby increase the persistence and reach of a relation without exhausting the relation itself.

A symbolized relation is not simply a picture of an antecedent connection. The act of recording, naming, or classifying a relation can change the relation's future trajectory. A debt entered into an enforceable ledger differs from an unrecorded expectation. An employment relation formalized by contract acquires rights, obligations, temporal boundaries, and institutional interfaces that can become causally significant. A platform's designation of two accounts as connected can affect information flow, recommendation, visibility, and later interaction. The symbolic form becomes one of the mediations through which the relation is reproduced.

Definition 4.84 (Symbolized relation). A *symbolized relation* is a relation rendered through a symbolic regime in a form that selects, encodes, or organizes some of its differences and that may subsequently participate in the persistence, interpretation, coordination, or transformation of the relation itself.

Definition 4.84 leaves open whether the symbolic form is constitutive, evidential, descriptive, or merely auxiliary in a particular case. A legal marriage status can partly constitute institutional relations that would not exist in the same form without recognition. A diagram of an informal friendship network may instead be an analyst's representation that has little effect on the represented relations. A public label such as "ally," "competitor," or "debtor" can begin descriptively and later alter expectations enough to become generatively important. The role of symbolization is therefore an empirical and historical question.

Symbolization can also stabilize relations by making them portable across contexts. A credential allows a relation of qualification to travel beyond the place where competence was originally demonstrated. A title allows ownership claims to be recognized by actors who did not witness the original acquisition. A contract allows obligations to persist despite changing memories and personnel. A standardized code allows an institutional relation to be processed by distant offices or automated systems. Symbolization can thus extend relational efficacy across spatial, temporal, and organizational discontinuities.

This portability has limits. The symbolic relation can outlive the conditions that initially made it accurate. A category may persist after the underlying relation has transformed. A database can reproduce an outdated status. A contractual label can conceal asymmetries that the formal description does not register. A network edge can imply a homogeneous connection even when the relation changes in intensity, direction, or meaning. Symbolization increases persistence partly by reducing the number of differences that must be reproduced, and that reduction can later become a source of distortion.

4.10.4 Symbolized Subjects

Subjects are especially vulnerable to confusion between relational reality and symbolic representation because modern institutions operate through names, identifiers, roles, statuses, profiles, records, classifications, and credentials. These symbolic forms make subjects legible to systems that could not otherwise coordinate across large populations and long time horizons. They can also become part of the processes through which subject positions are stabilized.

A person can possess relationally effective subjecthood before or beyond any particular representation. Bodily continuity, memory, practical orientation, recognition by others, participation in institutions, and histories of interaction can sustain a subject across changes in name, account, role, or classification. Conversely, a symbolic subject can be generated institutionally even when the deeper ontological status of subjecthood remains unsettled. A corporation, state agency, software account, autonomous system, or legal estate can be treated as a subject for specified operations without GRE inferring that all such subjects share the same metaphysical or moral status.

Definition 4.85 (Symbolized subject). A *symbolized subject* is a subject-position rendered within a symbolic regime through names, identifiers, categories, roles, records, credentials, profiles, or related representational forms that permit the subject to be recognized or acted upon within specified relations.

The definition refers to a subject-position rather than to the complete subject. This distinction is important. An institutional identifier can be necessary for taxation, pay-

ment, healthcare, education, migration, or platform participation while representing only a small subset of the relations through which the person exists. A legal person can be highly effective in contracting and ownership while remaining distinct from a human subject. A computational agent can occupy an operational role in a market or organization without the symbolic role settling questions of consciousness, responsibility, rights, or moral standing.

Symbolized subjecthood can nevertheless become causally powerful. A classification can determine access to benefits, credit, employment, insurance, mobility, or legal procedures. A professional title can organize expectations and authority. A public reputation can affect bargaining position. A profile assembled from behavioral traces can shape which opportunities become visible. Once these symbolic forms enter repeated institutional action, they can become part of the relational reality through which the subject's later possibilities are generated.

The possibility of misrepresentation is therefore normatively and economically significant. A mistaken or reductive representation of a subject can still have real effects if institutions act upon it. The subject may be forced to respond to a symbolic object that has acquired causal efficacy independently of its accuracy. This is another instance in which relational reality and epistemic adequacy must remain distinct: a representation can be relationally real in its consequences while being false, incomplete, outdated, or unjust.

4.10.5 Symbolized Value

Economic life depends heavily on symbolic forms of value. Prices, wages, account balances, exchange rates, ratings, scores, rankings, budgets, asset values, accounting categories, and monetary denominations make heterogeneous activities and objects available to calculation and coordination. Yet the presence of a common symbolic scale should not be confused with proof that the underlying values are intrinsically commensurable.

A price is a particularly important example. It can manifest conditions of exchange under a specified market arrangement and can represent a monetary valuation at a particular time. Once displayed, recorded, anticipated, or used as a reference, the price can also affect bargaining, expectations, investment, production, and later prices. The symbolic form therefore does more than report an antecedent value. It can participate in the generation of subsequent valuation relations.

The same is true of non-price representations. A credit score compresses a set of observations and modeling choices into a symbolic scale that can influence lending. A ranking compresses multiple criteria into an ordering that can alter applications, prestige, and resource flows. A performance indicator can reorganize work around what is measured. An accounting category can make one form of contribution legible while leaving another outside the reporting system. Symbolized value can therefore create pathways through which some differences acquire institutional force.

Definition 4.86 (Symbolic commensuration). *Symbolic commensuration* is the construction or stabilization of a common symbolic scale, ordering, category system, or representational coordinate through which heterogeneous objects or relations can be compared for a specified practice, without thereby establishing that their underlying relational structures or values share an intrinsic common metric.

Definition 4.86 connects symbolization to the non-necessary comparability of rela-

tional realities established in Section 4.2. Symbolization can generate a practical comparison relation where none was previously available. Monetary units allow unlike goods to enter exchange calculations. Rankings place heterogeneous organizations in a common order. Composite indicators render different observations comparable by applying weights and normalization rules. These operations can be useful and consequential. Their success as coordination devices does not establish that the compared objects were already elements of one natural metric space.

Claim 4.87 (Symbolic comparability does not establish relational equivalence). *The successful placement of heterogeneous objects within a common symbolic scale or ordering establishes a practical relation of comparison under that regime; it does not by itself establish equivalence, identity, or intrinsic commensurability among the relational realities represented.*

This distinction matters for GRE because symbolic commensuration can redistribute attention and resources. Once a common scale becomes institutionally important, actors may adapt behavior toward improving the represented value. Objects may be redesigned to fit categories. Activities difficult to symbolize may receive less recognition. A symbolic metric can therefore help create the economic field it initially appears merely to measure. The normative evaluation of such a field requires more than checking whether the metric is consistently applied; it also requires asking which relations become visible, which remain outside the scale, and what generative consequences follow from acting through the representation.

4.10.6 Representation within Relational Reality

The preceding subsections converge on a central implication of the three-register architecture: a representation can itself become part of relational reality. The conditions are the same as for other relationally real objects. A symbolic form, symbolic regime, or representation must emerge within a generative-relational system, persist with sufficient stability over a relevant region or interval, and exercise causal efficacy within that system. Symbolicity alone is insufficient; relational efficacy is what makes the representation relationally real.

Proposition 4.88 (Relational reality of representation). *A symbolic representation or symbolic regime qualifies as relationally real relative to a generative-relational system when it is sufficiently persistent and stable to exercise causal efficacy in the generation, coordination, constraint, interpretation, or transformation of subsequent relations within that system.*

Proposition 4.88 allows representation to be treated symmetrically with the manifestation mappings discussed in Section 4.8. An accounting standard can become relationally real because organizations reorganize reporting, investment, and compliance around it. A currency unit can become relationally real because obligations, prices, and expectations are denominated through it. A legal category can become relationally real because institutions repeatedly act upon it. A public narrative can become relationally real when it persists sufficiently to orient collective action. None of these conclusions requires the representation to be ontologically fundamental or epistemically flawless.

The distinction between causal efficacy and truth is particularly important. A representation can be inaccurate and still cause decisions. A rumor can move a market before being corrected. An erroneous database entry can block access. A mistaken

classification can alter treatment by institutions. A misleading indicator can redirect resources. The relational reality of the representation concerns its generated persistence and causal participation, not the truth of every proposition associated with it.

Remark 4.89 (Reality of a representation and truth of a representation). The reality of a representation as an operative object and the epistemic adequacy of what it represents are distinct questions. A representation can be relationally real in its effects while remaining incomplete, inaccurate, contested, or false with respect to its target.

This distinction also prevents a converse mistake. Accurate representation does not automatically imply strong relational efficacy. A carefully verified scientific description can remain causally marginal if it does not enter institutions, practices, decisions, or other subsequent relations. Relational reality depends on how the representation participates in the system, not solely on its correspondence to the represented object.

Symbolic forms therefore occupy a distinctive position in the graph among the three registers. They can arise from manifestations, represent relational realities, encode claims about ontological reality, and become relationally real through their own persistence and causal efficacy. They can also condition later manifestations by organizing what actors, institutions, and technical systems are prepared to recognize. The graph is recursive because a representation produced at one moment can alter the mappings, categories, expectations, and relations through which later reality becomes manifest.

The analysis of symbolization also clarifies why representation cannot be added to the three-register framework as a simple fourth layer above manifestation. Representation is a family of mediated relations that can operate across the graph. A symbolic representation may target a manifestation, a relational object, an ontological claim, another representation, or a possible future configuration. It can remain a transient analytical artifact or become a persistent causal object. Its location is therefore determined by the relations in which it participates rather than by a fixed position in a vertical hierarchy.

Section 4.10 has established six points. Manifestation is broader than symbolization. Symbolization occurs within symbolic regimes whose rules and practices can have histories of their own. Symbolic representation is selective and purpose-relative rather than identical with its target. Relations and subjects can be symbolized in forms that subsequently alter their relational development. Symbolized value can generate practical commensurability without proving intrinsic comparability or relational equivalence. Finally, representations themselves can become relationally real when they persist, stabilize, and causally participate in subsequent generation. These results prepare Section 100, where the book turns from individual mediations to the recursive relations among relational reality, manifestation, representation, and the later relations that they help produce.

4.11 Recursive Relations among Reality, Manifestation, and Representation

Sections 4.5–4.10 separated relational reality, manifestation, manifestation mappings, non-invertibility, and symbolic representation so that each could be analyzed without collapsing into the others. The present section recombines those distinctions into a re-

cursive architecture. Its role is to explain how relational realities can condition what becomes manifest, how manifestations can be stabilized or transformed through representation, and how representations can re-enter the generative-relational system to alter subsequent relations. The resulting structure is neither a linear sequence nor a closed cycle. It is a historically evolving graph in which different pathways can become active, inactive, reinforced, interrupted, or redirected under changing conditions. (Merton 1948; Giddens 1984; Arthur 1989)

The section proceeds in five steps. It first examines the movement from relational reality to manifestation while preserving the possibility that much relational reality remains unmanifested. It then considers the movement from manifestation to representation and the selective operations involved in symbolic articulation. The third subsection treats representation as an input into subsequent relations rather than as a terminal description. The final two subsections distinguish recursive stabilization from recursive transformation. This distinction is important because repeated mediation can reproduce an existing relational reality, but it can also change the conditions under which later reality emerges. Recursion therefore concerns the historical consequences of mediation rather than the mere repetition of a fixed circuit.

Definition 4.90 (Recursive generative mediation). *Recursive generative mediation* is a historically situated process in which a manifestation or representation generated within a generative-relational system subsequently becomes an operative condition, input, constraint, capacity, or object within that system, thereby contributing to the generation of later relations, manifestations, or representations.

Definition 4.90 preserves the graph architecture established in Section 4.2. A manifestation need not arise only after a fully completed relational object, and a representation need not remain outside the relation it describes. Once a manifestation or representation acquires causal participation in subsequent processes, it becomes part of the history from which later configurations emerge. The recursion is generative because later states can differ from earlier states; it is historical because the effects of previous manifestations and representations can accumulate, dissipate, conflict, or become institutionalized over time.

For analytical purposes, one possible local description distinguishes a relational configuration $\mathcal{R}_t$, a manifestational configuration $\mathcal{M}_t$, a representational configuration $\mathcal{P}_t$, and a wider set of relevant conditions $\mathcal{C}_t$ at a time or interval indexed by t . A manifestation relation may be written schematically as

$$\mathcal{M}_t = \Phi_t(\mathcal{R}_t, \mathcal{C}_t), \quad (4.4)$$

while a representational process may be written as

$$\mathcal{P}_t = \Sigma_t(\mathcal{M}_t, \mathcal{R}_t, \mathcal{C}_t). \quad (4.5)$$

The subsequent relational configuration can then be represented schematically by

$$\mathcal{R}_{t+1} = \Gamma_t(\mathcal{R}_t, \mathcal{M}_t, \mathcal{P}_t, \mathcal{C}_t). \quad (4.6)$$

These expressions are not proposed as universal equations of social or economic reality. They provide a compact way to mark three analytical facts: manifestation depends on conditions, representation can depend on more than manifestation alone, and later relational configurations can be affected by what has previously manifested

or been represented. The mappings Φ_t , Σ_t , and Γ_t may themselves change historically and may, under the conditions established in Sections 4.5 and 4.8, become relationally real objects within the systems in which they operate.

4.11.1 Relational Reality to Manifestation

The first relation concerns how a relationally real object or configuration becomes manifest under specified conditions. Section 4.5 established that relational reality does not require prior manifestation. An institution, trust relation, debt relation, social expectation, symbolic convention, or historically stabilized sense of self can participate causally in a system even when parts of its operative structure remain outside present awareness, observation, or explicit articulation. Manifestation therefore selects from, responds to, or is generated through relational reality without exhausting it.

Equation 4.4 represents this relation only schematically. The manifestation $\mathcal{M}_t$ is generated through the conjunction of a relational configuration and the conditions under which manifestation becomes possible. Those conditions can include bodily capacities, technical instruments, institutional procedures, cultural categories, attention, spatial position, temporal position, data infrastructure, measurement rules, and prior symbolic expectations. A price becomes manifest through a market and quotation mechanism; an organizational hierarchy can become manifest through decisions, titles, reporting lines, or patterns of deference; trust can become manifest through disclosure, reliance, expectation, or vulnerability; a physical process can become manifest through an instrument whose design selects some differences while suppressing others.

The manifestation relation is therefore selective without being arbitrary. A relational reality can constrain the range of manifestations available under a given regime even when multiple manifestations remain possible. Conversely, a manifestation configuration can suppress, aggregate, or fail to disclose differences that remain causally important in the relational domain. The relational remainder introduced in Section 4.9 is especially relevant here: what remains unmanifested under one configuration may become important under another, and later consequences may reveal that an apparently negligible difference had continuing causal significance.

Claim 4.91 (Manifestational partiality). *A manifestation can be genuinely generated by and informative about a relational reality while remaining partial with respect to the relational configuration, history, and unrealized possibilities through which it emerged.*

Claim 4.91 permits a middle position between transparent disclosure and radical disconnection. Manifestation can carry real information. It can support explanation, evidence, coordination, and intervention. Yet the information preserved by a manifestation depends on the mapping conditions through which it arises. Reverse inference therefore remains disciplined by the plurality of relational configurations compatible with the observed manifestation.

This partiality becomes important in cases of contingency and aesthetic judgment. A contingent event can become salient to a subject at a particular moment, but the conditions through which that event becomes recognizable as surprising, beautiful, significant, or worthy of attention may have been generated historically before the moment of conscious judgment. Prior encounters, categories, practices, expectations,

bodily capacities, institutional histories, and other relations can contribute to a manifestational configuration without first appearing to the subject as explicit objects of awareness. The subsequent judgment concerns a manifestation, but the relational-generative structure enabling that manifestation can precede the judgment. The reality of that structure is therefore not created merely by being noticed.

The same point also protects a distinction between manifestation and ontological access. A manifestation can be generated through a relational reality whose own ontological status remains suspended. The manifestation can then become evidence about relational organization without licensing a stronger claim about ultimate ontology. The graph from relational reality to manifestation consequently remains compatible with the local sufficiency of ontological commitment developed in Sections 4.1 and 4.3.

4.11.2 Manifestation to Representation

A manifestation can subsequently become represented, recorded, named, classified, quantified, narrated, diagrammed, encoded, or otherwise symbolized. Section 4.10 showed that this movement introduces another selective relation. Representation can preserve a manifestation across time, transmit it across space, place it in relation to other manifestations, and make it available to institutions or actors who were absent from the original event. These capacities enlarge the reach of manifestation. They also introduce new sources of transformation.

Equation 4.5 therefore allows $\mathcal{P}_t$ to depend on more than $\mathcal{M}_t$ alone. A representation can incorporate background theories, institutional categories, prior records, legal rules, measurement conventions, or relational knowledge that is not contained in the immediate manifestation. A medical image can be represented differently under different diagnostic categories; an observed transaction can be represented differently under accounting, legal, or statistical regimes; a verbal statement can be classified differently depending on institutional context. Representation is thus not a passive second copy of appearance. It is an organized operation within a symbolic regime.

This operation can make previously dispersed manifestations comparable. A price system places heterogeneous goods within a monetary scale. A ranking places organizations within an ordinal relation. A legal record places heterogeneous histories within a procedural category. A scientific variable can transform observations into comparable measurements. Such symbolic commensuration can enable coordination and analysis while also suppressing differences that do not enter the symbolic scheme. The practical success of representation therefore remains distinct from the claim that the represented realities share one intrinsic metric.

Remark 4.92 (Representation can preserve and transform). Representation can simultaneously preserve selected information from a manifestation and transform the conditions under which that information is interpreted, compared, transmitted, and acted upon. Preservation and transformation are therefore not mutually exclusive descriptions of the same representational process.

This duality is particularly visible when a representation creates a durable record. A transient manifestation can disappear while its symbolic trace persists. Once preserved, the representation can become available to actors, institutions, or technical systems in later contexts that differ substantially from those of the original manifes-

tation. The later use can therefore generate relations that could not have arisen from the original manifestation alone. Historical records, legal precedents, archives, credit histories, scientific publications, accounting entries, and algorithmic profiles all illustrate ways in which representation can extend the temporal reach of a manifestation.

At the same time, what is represented can feed back into what later becomes manifest. Once actors learn the categories under which they are classified, they may adapt behavior, resist the category, seek inclusion, or reorganize self-understanding. Once organizations know the metrics by which they are evaluated, they may redesign processes to improve those metrics. Once a price becomes publicly quoted, expectations can change before the underlying production relation changes. Representation therefore begins to participate in the conditions of later manifestation even before it qualifies as a stable relational reality in its own right.

4.11.3 Representation to Subsequent Relation

The third relation is the point at which recursion becomes explicit. A representation can enter subsequent relations and thereby alter the generative-relational system from which later realities emerge. Section 4.10 established that a representation can itself become relationally real when it persists with sufficient stability and exercises causal efficacy. The present subsection focuses on what follows once such causal participation occurs.

Equation 4.6 represents the later relational configuration $\mathcal{R}_{t+1}$ as depending, where relevant, on prior relational structure, manifestation, representation, and wider conditions. This dependence need not be direct. Representations can act through institutions, expectations, technologies, incentives, memory, attention, authority, or collective coordination. The same representation can also generate different effects in different relational environments. A legal classification has little force without institutions able to recognize and enforce it; a market quotation acts differently under liquid and illiquid conditions; a self-description has different consequences depending on whether others recognize, contest, or ignore it.

The causal role of representation therefore depends on relational uptake. A symbol becomes generatively consequential when actors or systems are organized so that the symbol can affect later processes. This can occur through explicit interpretation, but conscious interpretation is not required. Automated scoring systems, database constraints, software permissions, payment infrastructures, and algorithmic classifications can produce consequences because technical and institutional relations are organized around symbolic states. A representation can therefore enter subsequent relations through human, institutional, material, or computational pathways.

Proposition 4.93 (Representational recursion). *When a representation generated within a generative-relational system becomes causally operative in later relations, the representation becomes part of the historical conditions through which subsequent relational and manifestational realities are generated. Its later effects are therefore not external commentary on the system but part of the system's generative history.*

Proposition 4.93 has important consequences for economic analysis. A credit score can affect access to credit, and the resulting access or exclusion can alter later financial behavior that contributes to future scores. A market price can affect production and demand, which then affect later prices. An accounting classification can alter organizational investment, which changes the activity later recorded under that clas-

sification. A public forecast can affect expectations and decisions that become part of the later economic configuration. In each case, representation and represented reality cannot be analyzed as permanently external to one another.

The same logic applies to subjectivity. A manifested experience can be narrated, named, or institutionally classified. That representation can affect memory, recognition, expectation, and future conduct, thereby participating in the relational conditions through which later subjectivity develops. The self-description is neither simply identical with the subject nor irrelevant to subject formation. It becomes one relation among others through which a relatively continuous subject can be sustained or transformed.

Aesthetic judgment provides another instructive case. A contingent encounter can become manifest as striking or beautiful; the judgment can then be symbolically articulated, recorded, taught, cited, or institutionalized. Such representations can redirect attention, confer prestige, organize preservation, influence research selection, and shape the conditions under which later observers encounter the object. The judgment therefore participates in a history that can alter the relational reality surrounding the object without implying that the object's earlier relational reality depended on having already been judged.

4.11.4 Recursive Stabilization

Recursive mediation can stabilize a relational reality when later manifestations and representations repeatedly reinforce the relations through which that reality persists. Stabilization is not mere repetition. Each iteration can occur under slightly different conditions, involve different actors, or produce different manifestations while nevertheless preserving enough structure for the relational object to remain recognizable and causally effective across time.

Definition 4.94 (Recursive stabilization). *Recursive stabilization* is the process through which manifestations or representations generated by a relational reality subsequently reinforce, reproduce, coordinate, or restore relations that contribute to the persistence and stability of that relational reality over a relevant spacetime interval.

Money provides a familiar illustration. Monetary relations generate prices, account balances, banknotes, receipts, quotations, and other manifestations and representations. These forms then guide exchange, accounting, debt settlement, planning, and expectation. Repeated use contributes to the persistence of the monetary relation itself. The relational reality of money is therefore reproduced partly through manifestations and representations generated within monetary relations and later re-entering those relations.

Trust can display a similar pattern without requiring explicit symbolic articulation at every stage. Repeated reliable interaction can generate manifestations of trust such as reliance, disclosure, delegation, or reduced monitoring. Some of these manifestations may be represented through promises, reputational records, narratives, or institutional certifications. Those representations can then support further reliance and coordination. The resulting recursive stabilization can make trust more persistent, although the process remains vulnerable to contradiction, changing conditions, and competing relations.

Institutional categories can also stabilize recursively. A category used to allocate

rights, resources, or responsibilities can shape behavior around the category. The resulting behavior can then appear to confirm the category's practical importance, leading to further institutional use. The recursion may be administratively useful, but stabilization alone does not establish epistemic adequacy or normative legitimacy. A poorly founded category can become highly stable when institutional relations repeatedly reproduce it.

Claim 4.95 (Stability does not validate the stabilized representation). *Recursive stabilization can increase the persistence and causal efficacy of a representation or relational object without establishing that the representation is epistemically adequate, normatively desirable, or ontologically fundamental.*

Claim 4.95 is especially important for GRE because economic systems frequently reward what they have already made legible. A metric used for allocation can cause actors to optimize for the metric; the resulting concentration of activity can make the metric appear increasingly representative of the field. A market category can attract capital, talent, and institutional attention; the resulting expansion can make the category appear more naturally given than it was at its emergence. Recursive stabilization can therefore generate historical depth and causal reality around initially contingent classifications.

This mechanism also helps explain why relational realities can exhibit self-reinforcing tendencies without becoming immutable attractors. Stabilization can be local, conditional, and reversible. Competing representations, institutional changes, shocks, new technologies, altered expectations, or previously suppressed relational differences can weaken the recursive support. The relevant analytical question is therefore which feedback pathways currently sustain the relational object, over what interval, and under what conditions those pathways may cease to reproduce it.

4.11.5 Recursive Transformation

Recursion can also transform rather than stabilize. A manifestation or representation can introduce a difference that changes the relations through which later manifestations and representations are produced. In such cases, the system does not simply reproduce an existing relational reality more strongly or weakly. The effective configuration of relations, constraints, capacities, categories, or manifestation rules changes.

Definition 4.96 (Recursive transformation). *Recursive transformation* is the process through which a manifestation or representation generated within a generative-relational system contributes to changing the relations, constraints, capacities, mappings, or symbolic regimes that condition subsequent relational and manifestational realities.

A new representation can transform the field by creating a distinction that later actors begin to organize around. A legal recognition can change who is able to contract, own, inherit, claim protection, or appear before an institution. A new accounting category can redirect investment and alter organizational boundaries. A scientific classification can reorganize research attention and intervention. A public articulation of an experience can provide a vocabulary through which previously dispersed manifestations become connected, compared, and institutionally recognized. In each case, representation contributes to changing the generative conditions rather than merely preserving an antecedent state.

Transformation can also occur through failure or contradiction. A representation may repeatedly fail to account for observed manifestations. Those mismatches can generate pressure to revise the symbolic regime, alter the manifestation mapping, or reconstruct the underlying relational model. The appearance of anomalies is itself conditioned by available representational resources, but once recognized, anomalies can become relationally consequential by reorganizing inquiry and intervention. Recursion therefore includes pathways in which the system revises the means through which it manifests and represents itself.

The distinction between stabilization and transformation should remain analytical rather than absolute. A recursive process can stabilize some relations while transforming others. The introduction of a standardized metric may stabilize a field of comparison while transforming organizational behavior. A legal reform may transform formal rights while stabilizing deeper resource asymmetries. A new identity category may stabilize recognition for some actors while transforming relations of affiliation and exclusion. GRE therefore requires the scale and object of stabilization or transformation to be specified rather than inferred from the existence of recursion alone.

Proposition 4.97 (Historical recursion of the three-register graph). *In a generative-relational system, manifestations and representations can become historical conditions of later relational reality when they enter subsequent relations with sufficient causal efficacy. The three-register architecture is therefore recursively historical: later relations can depend partly on how earlier relational realities became manifest, represented, interpreted, preserved, and acted upon.*

Proposition 4.97 summarizes the principal result of the section. The graph among ontological, relational, and manifestational reality cannot be adequately understood as a static taxonomy. Relational reality can precede manifestation, yet manifestation can alter later relational reality. Representation can preserve or transform manifestation, yet representation can itself become relationally real. Symbolic regimes can mediate what later becomes manifest, and changing relations can alter the symbolic regimes through which earlier realities were understood. Historical time therefore enters not as an external parameter added after the ontology, but as part of the generative conditions through which the relations among registers evolve.

This recursive architecture also clarifies the limited use of the Lacanian analogy introduced earlier in the chapter. The relevant similarity lies less in matching ontological reality, relational reality, and manifestational reality one-to-one with the Real, Imaginary, and Symbolic than in refusing a simple hierarchy in which one register merely reflects another. Symbolic and manifestational forms can reorganize later relations; relations can condition later manifestation; and some dimensions of reality can remain resistant to the available symbolic or manifestational regime. GR preserves this graph-like intuition while assigning its own criteria of relational reality, causal efficacy, persistence, and historical emergence.

Section 4.11 therefore completes the first major movement of Chapter 4. Sections 4.1–4.11 have established an ontologically restrained three-register architecture in which relational realities can emerge before perception or symbolization, manifestations arise through historically formed mappings, representations can preserve and transform what manifests, and recursive mediation can stabilize or transform subsequent relations. The next movement turns from the architecture itself to particular classes of object that occupy it. Section 101 begins with subjects, asking how

subjecthood can be distinguished across ontological, relational, manifestational, and institutionally represented forms without presuming that manifestational equivalence establishes subject identity.

4.12 Subjects across the Three Levels

The three-register architecture developed in Sections 4.2–4.11 becomes especially consequential when the analytical object is a subject. Economic, legal, institutional, interpersonal, and technical practices routinely treat subjects as if their identity were straightforward: a person signs a contract, an organization owns an asset, an account receives a payment, an employee performs a role, or an artificial system selects an action. Yet the apparently simple noun *subject* can refer to markedly different realities. It can refer to an ontological claim about what kind of being exists, a relationally stabilized locus of causal participation, a manifestation through which subjecthood becomes perceptible or experienceable, or an institutional representation through which a system identifies and acts upon a participant. The role of this section is to separate these senses while showing how they can recursively mediate one another. Its objective is to provide an ontologically restrained account of subjecthood adequate to GRE without reducing subjects to representations or presuming that every operationally similar subject shares the same underlying structure. The discussion proceeds from ontological subjecthood to relationally effective subjecthood, manifestational subjecthood, institutional representation, human and artificial subjects, and finally manifestational equivalence without subject identity. (Mead 1934; Ricoeur 1992; Goffman 1959; Honneth 1995)

The distinction extends rather than replaces the conception of the economic subject developed in Chapter 3, Section 75. Chapter 3 treated an economic subject as a relatively stabilized locus of economically consequential participation. The present section asks what kind of reality such a locus has and how that reality can diverge from the ways in which the subject appears, understands itself, or is represented by institutions. A worker, corporation, household, state agency, platform account, or artificial system can therefore be approached through several registers at once. These approaches need not converge into one exhaustive description. Their analytical value lies partly in making divergence visible.

Definition 4.98 (Register-sensitive subjecthood). *Register-sensitive subjecthood* is an analytical treatment of a subject that distinguishes among claims concerning its ontological status, its relationally stabilized and causally effective participation, its modes of manifestation, and its symbolic or institutional representation, while allowing these dimensions to mediate one another historically.

Definition 4.98 does not imply that every empirical inquiry requires four separate models of the same subject. It supplies a discipline of distinction. When the dimensions coincide sufficiently for the research question, a simpler representation can be appropriate. When they diverge, however, treating them as identical can conceal economically and normatively important mechanisms. A person can remain relationally consequential while disappearing from an administrative record; an institutional profile can persist after the relations that originally produced it have changed; a self-description can alter subsequent conduct; an artificial system can occupy a stable operational position without this position settling questions of consciousness or moral

personhood. The registers therefore help specify which kind of subjecthood is being claimed in any particular analysis.

4.12.1 Ontological Subjecthood

Ontological subjecthood concerns the strongest question in the section: what, if anything, the subject is independently of a particular manifestation, classification, role, record, or analytical representation. The formulation is intentionally open. Different ontologies can locate subjecthood in an embodied organism, a persisting person, a conscious field, a process of self-organization, a bundle of capacities, a relationally constituted agent, a narrative continuity, or some combination of these and other structures. GR does not need to adjudicate this entire field before investigating economically consequential subjecthood. The principle of ontological suspension established in Section 4.3 therefore applies with particular force.

The analytical importance of the ontological question remains even when it is suspended. A legal person, a remembered self, a behavioral profile, a biological organism, and an institutional role may all be associated with what ordinary language calls the same subject, yet they select different persistence conditions. The organism can persist through loss of a role. A legal identity can persist through substantial biological and psychological change. A role can persist through replacement of its occupant. A digital profile can persist after the person it represents has ceased to participate in the relevant system. These differences indicate that subject persistence cannot be inferred from a single criterion before the relevant register has been specified.

The sense of “I” provides a particularly instructive case. A continuing self-experience can become relationally real when it emerges through bodily, mnemonic, interpersonal, linguistic, historical, and other relations, persists with sufficient stability, and causally organizes later conduct. The existence of such relational reality does not by itself settle whether there is an ontologically independent, indivisible, or permanently self-identical entity corresponding to that experience. Conversely, ontological suspension concerning the ultimate status of the self does not weaken the causal reality of self-experience when it organizes memory, commitment, expectation, responsibility, attention, or action. The three-register architecture therefore allows inquiry into the reality of selfhood without forcing immediate passage from causal efficacy to metaphysical conclusion.

The same restraint applies to collective subjects. A corporation can own property, employ workers, enter contracts, borrow, sue, be sued, accumulate reputation, and survive replacement of many of its members. These properties make corporate subjecthood highly consequential in relational and institutional registers. Whether the corporation should also be treated as an ontologically irreducible collective subject is a stronger question. GRE can investigate the generative consequences of corporate action while leaving this stronger issue open unless the research problem makes it operative.

Remark 4.99 (Ontological subjecthood and analytical reference). Suspending a final ontology of the subject does not make the term *subject* empty. It requires the analysis to specify the properties, persistence conditions, capacities, and relations relevant to the inquiry rather than treating ordinary-language identity as a complete ontological account.

Remark 4.99 is especially important for interdisciplinary work. Economics, law,

psychology, computer science, biology, and political theory can refer to apparently similar subjects while selecting different properties as causally or normatively relevant. GRE can connect these descriptions where warranted, while preserving the possibility that their objects are only partially overlapping.

4.12.2 Relationally Effective Subjecthood

Relationally effective subjecthood concerns a different question: whether a subject has emerged as a sufficiently persistent and stable locus of participation to exercise causal efficacy within a generative-relational system. This formulation applies the relational-reality criterion from Section 4.5 directly to subjecthood. A subject is relationally effective when actions, expectations, obligations, memories, permissions, capacities, risks, or other consequences can accumulate around a recognizable locus and when that locus subsequently affects the development of the system.

Definition 4.100 (Relationally effective subject). A *relationally effective subject* is a subject-position or subject-configuration that emerges within a generative-relational system, persists with sufficient stability over a relevant spacetime region or interval, and exercises causal efficacy within that system through the organization of action, expectation, attribution, capacity, constraint, responsibility, or subsequent relation formation.

The definition permits considerable heterogeneity in how subjecthood is stabilized. Biological continuity can matter for a human subject. Legal registration can matter for a corporation. Memory and recognition can matter for interpersonal identity. Repeated interaction can stabilize a household or community role. An account, mandate, technical identity, and authorization structure can stabilize the operational position of an artificial system. The common analytical feature is not a common substance but the emergence of a causally consequential locus around which relations become organized.

This criterion also clarifies why relational subjecthood can precede explicit self-awareness or symbolic recognition. An infant can participate in relations of care, expectation, attachment, dependency, and resource allocation before possessing the symbolic capacities required for a mature self-description. A worker can occupy a structurally consequential position before recognizing its wider institutional significance. A population can be differentially affected by an institutional arrangement before a political or scholarly vocabulary exists through which that position is named. Subjecthood in the relational register therefore does not wait for complete manifestation to the subject itself.

Relational subjecthood can nevertheless be transformed through manifestation. A person who becomes aware of being trusted may act differently because that trust has become manifest. A worker who learns how an institution classifies a role can reinterpret obligations or opportunities. A community that acquires a shared description of its position can coordinate around that description. The manifestation does not create the entire relational history *ex nihilo*; it enters that history and can reorganize its subsequent development. Subjecthood therefore exemplifies the recursive mediation described in Section 4.11.

Persistence in this register remains relative to the relevant process. A market transaction may require only short-lived identification. Credit, employment, reputation, liability, insurance, inheritance, or long-term cooperation require longer continuity.

Some systems construct subject persistence through identifiers, records, biographies, organizational membership, addresses, credentials, or legal continuity. Others rely more strongly on embodied recognition, memory, or recurring interaction. The duration and mechanism of persistence are therefore empirical properties of the relational system rather than fixed attributes of subjecthood in general.

The relational criterion also permits subjecthood to be distributed. A decision attributed to one organization can depend on committees, software, routines, legal mandates, data infrastructures, professional norms, and external constraints. A subject can remain a useful locus of attribution even when the causal organization supporting that locus is internally heterogeneous. The analytical task is then to distinguish the stabilized subject-position from the wider relational architecture that enables it. Relative individuation and relational dependence can coexist.

Claim 4.101 (Relational subjecthood without exhaustive individuation). *A subject can become sufficiently individuated for causal, institutional, or economic analysis while remaining dependent on a wider relational configuration for the persistence, capacities, and boundaries through which that individuation is sustained.*

Claim 4.101 protects GRE from two opposite simplifications. Subjecthood need not be treated as fully pre-given before relation, and relational dependence need not dissolve every subject into an undifferentiated field. The degree and mechanism of individuation are themselves objects of inquiry.

4.12.3 Manifestational Subjecthood

Manifestational subjecthood concerns the ways in which a subject becomes available within a manifestational configuration. The subject may become manifest to itself, to another subject, to an institution, to an instrument, to a public, or to a computational system. These modes can include bodily appearance, speech, action, affect, memory, narrative, performance, biometric signal, statistical pattern, recorded behavior, visual image, or other forms through which some aspect of subjecthood becomes accessible.

Definition 4.102 (Manifestational subjecthood). *Manifestational subjecthood denotes the reality of a subject insofar as some aspect of that subject becomes available, distinguishable, experienceable, recordable, measurable, interpretable, or otherwise present within a specified manifestational configuration.*

Manifestational subjecthood can be fleeting. A facial expression may reveal a momentary affective state without becoming a persistent identity. A statement may disclose an intention that changes shortly afterward. A measurement may reveal one bodily or behavioral feature while leaving many others inaccessible. The entry condition for manifestational reality therefore differs from the persistence condition required for relational reality. A manifestation can be real as manifestation even when it does not stabilize into a durable subject-position.

The first-person case deserves particular care. Self-awareness is a manifestation of subjecthood, yet the relational conditions from which it emerges can precede the moment of explicit awareness. Memory, bodily continuity, habits, language, recognition by others, prior commitments, and institutional histories can participate in stabilizing a subject before those conditions become thematized by the subject. A reflective judgment such as “this is who I am” can then become a new manifestation that feeds back into the relational system. It can alter conduct, expectation, affiliation, mem-

ory selection, and the interpretations supplied by others. The manifestational and relational registers thus become recursively coupled without becoming identical.

Manifestation to others can diverge from manifestation to oneself. A person can experience continuity while being institutionally treated as discontinuous because of lost records or changed identifiers. Conversely, an institution can preserve a stable identity while the subject experiences profound discontinuity in self-understanding. A public performance can stabilize one recognizable persona while private experience remains substantially different. The three-register framework allows these differences to be described without requiring one manifestation to stand automatically as the complete truth of the subject.

Manifestations can also conflict. Spoken self-description, observed behavior, physiological measurement, administrative classification, and third-party testimony may disclose different aspects of a subject and can be produced through different manifestation mappings. Their disagreement does not necessarily imply that one simple hidden subject could be reconstructed by choosing the single correct manifestation. Section 4.9 already established that manifestation is generally non-invertible. The subject case makes the implication concrete: multiple manifestations can remain jointly informative while preserving a relational remainder that no one manifestation exhausts.

Remark 4.103 (Plural manifestation of a subject). Different manifestations of a subject can carry different forms of evidential, practical, or institutional relevance. Their plurality does not by itself establish either contradiction or equivalence because each manifestation can depend on a different mapping, audience, purpose, timescale, and relation to the subject's history.

This plurality becomes especially important in economic life. Creditworthiness, productivity, reliability, vulnerability, preference, risk, need, and identity may each be manifested through different procedures. Economic institutions frequently act on these manifestations as though they captured the subject itself. GRE instead asks which aspect became manifest, through which conditions, and with what consequences for later relations.

4.12.4 Institutionally Represented Subjecthood

Institutionally represented subjecthood is a more specific case in which manifestations are selected, symbolized, recorded, and made operational within an institutional system. A legal name, taxpayer identifier, employee number, account, credit file, eligibility category, citizenship status, corporate registration, professional credential, platform profile, or risk score can become a representation through which institutions recognize and act upon a subject. Such representations are often economically decisive because they determine access, liability, authority, visibility, payment, exclusion, or the accumulation of records across time.

Definition 4.104 (Institutionally represented subject). An *institutionally represented subject* is a symbolically or technically stabilized representation through which an institution identifies, classifies, tracks, authorizes, constrains, rewards, sanctions, or otherwise acts upon a purported subject within a specified domain of operation.

The word *purported* is analytically important. The institution's representation can refer adequately to a relationally effective subject, can refer only partially, can lag behind changes in the subject, can combine several subjects, can split one subject across

multiple records, or can persist after the relevant relation has ended. The representation and the represented subject are therefore distinguishable objects even when institutional practice treats them as interchangeable.

Represented subjecthood can itself acquire relational reality. An account profile can influence whether a payment is accepted. A credit record can alter borrowing possibilities. A legal status can determine which contracts become available. A credential can organize access to occupations. A platform category can change visibility and expected conduct. Once these representations become persistent, stable, and causally efficacious within the relevant system, they satisfy the relational-reality criterion in their own right. Their causal reality remains distinct from the accuracy or justice of the representation.

This distinction is especially important where institutional systems act faster than subjects can contest their representations. A classification can shape subsequent opportunities and thereby help generate the behavior that later appears to confirm the classification. A profile can influence which information, prices, tasks, or social contacts become available, changing the relational environment from which later manifestations emerge. The representation can therefore participate in producing the future subject-position that it was initially intended only to describe.

The recursive structure also permits resistance and revision. Subjects can correct records, challenge classifications, strategically present themselves, acquire new credentials, create alternative institutions, or refuse particular categories. Institutions can redesign identifiers, revise eligibility rules, or abandon representations that produce systematic error. Institutionally represented subjecthood is therefore historically alterable even when its practical effects are substantial.

Claim 4.105 (Representational efficacy and subject accuracy). *The causal efficacy of an institutional representation of a subject can vary independently from the representation's descriptive adequacy to the subject it purports to represent.*

Claim 4.105 extends the distinction developed in Section 4.10. A highly influential profile can be incomplete or mistaken; a highly accurate description can remain institutionally irrelevant. Economic analysis therefore needs separate accounts of representational accuracy, institutional uptake, and causal consequence.

4.12.5 Human and Artificial Subjects

The distinction among registers becomes particularly useful when human and artificial subjects occupy adjacent operational positions. Chapter 3 introduced a working distinction between *human subjecthood* and *artificial operational subjecthood*. The present chapter can now state why that distinction matters ontologically. Two systems can become manifest through similar outputs, occupy similar institutional roles, or even be treated as interchangeable for a bounded task while differing substantially in embodiment, historical formation, dependence relations, vulnerability, ownership, persistence conditions, and the wider structures through which their capacities are generated.

A human subject is relationally situated through bodily existence, care, development, language, memory, social recognition, material dependence, institutional position, and historical participation. Many economically relevant properties of human subjecthood are inseparable from vulnerability and finite embodiment: needs must be met through time, bodily capacities can change, care relations can become nec-

essary, and economic loss can affect lived possibilities. These observations do not provide a complete ontology of the human person. They identify dimensions that are causally and normatively relevant to economic analysis and that should not disappear merely because another system can reproduce a selected manifestation of human performance.

Artificial operational subjecthood can arise when an artificial system becomes a sufficiently stable and causally consequential locus of delegated or institutionally recognized action. A system can select transactions, generate offers, route resources, negotiate within constraints, produce classifications, communicate with counterparties, or maintain a persistent operational identity. Where these functions persist and affect subsequent relations, the artificial system can be relationally real as an operational subject-position. This claim does not require GRE to settle whether the system is conscious, possesses first-person experience, qualifies as a legal person, or has independent moral standing.

The relevant relations surrounding artificial operational subjecthood can include model architecture, training data, deployment infrastructure, ownership, authorization, interface design, objective specification, maintenance, oversight, and liability. These relations can differ radically from those that sustain human subjecthood. Even where a human and an artificial system generate the same answer to a query, execute the same trade, or satisfy the same institutional test, equality of manifestation under that test provides limited information about equality of relational structure.

The same caution applies in the opposite direction. Difference in underlying structure does not imply that artificial systems are economically negligible. A system can occupy a causally central position precisely because institutions, firms, markets, or individuals organize their activity around its outputs. The analytical task is therefore to identify the kind of subject-position that has emerged, the relations that sustain it, the manifestations through which it becomes legible, and the institutions through which its actions are attributed.

Claim 4.106 (Operational subjecthood and ontological restraint). *Attribution of operational subjecthood to an artificial system records a stabilized and causally consequential position within a generative-relational system. It does not, without additional argument, establish experiential, ontological, juridical, or moral equivalence with human subjecthood.*

Claim 4.106 permits GRE to analyze technologically mediated economies without choosing between two unhelpful extremes: treating artificial systems as mere inert tools regardless of their operational role, or treating functional substitution as sufficient evidence of full subject identity. The three-register architecture keeps the empirical consequences of artificial action visible while preserving stronger questions for the domains in which they can be responsibly examined.

4.12.6 Manifestational Equivalence without Subject Identity

The preceding distinctions culminate in the problem of manifestational equivalence. Two subjects can become indistinguishable with respect to a specified manifestation while remaining different in relational organization and with their ontological relation unresolved. The equivalence is therefore local to the manifestation criterion, the conditions under which it is produced, and the purpose for which the comparison is made.

Definition 4.107 (Local manifestational equivalence of subjects). Two subjects are *locally manifestationally equivalent* when, under a specified manifestational configuration and comparison criterion, the manifestations relevant to the inquiry are indistinguishable or sufficiently equivalent for that purpose. Such equivalence does not by itself establish relational identity, ontological identity, equal historical formation, equal capacities outside the comparison domain, or equal normative standing.

The definition applies to human–human, human–artificial, artificial–artificial, organizational, and other comparisons. Two people can produce identical answers while arriving at them through different memories or reasons. Two firms can display the same price while relying on different cost structures and financing relations. Two artificial systems can produce the same output while differing in architecture, training history, ownership, or failure modes. A human and an artificial system can generate behavior that is indistinguishable through a particular interface while belonging to substantially different relational structures. The manifestation therefore supports an equivalence claim only at the level for which the comparison criterion has been specified.

This point is stronger than the familiar observation that appearances can deceive. A manifestation can be completely accurate with respect to the property it manifests and still remain insufficient for subject identity. If two systems genuinely have the same measured response time, the equality need not be illusory. It simply establishes equality of that measured property. The inference from local equality to global identity requires additional mappings and additional evidence. Non-invertibility therefore arises even when the manifestation itself is reliable.

The relation between an illusory flower and an ordinarily perceived physical flower provides a useful limiting example from the wider architecture of this chapter. Both can become manifest, can enter attention and memory, and can produce subsequent action. Under suitable conditions, the experienced flower can also acquire relational reality through its causal participation in the subject's system. Yet shared manifestational properties such as apparent color, shape, or salience do not establish shared generative structure. The same discipline applies to subjects: similarity in one manifestational domain does not supply a universal metric through which their full relational structures become commensurable.

Manifestational equivalence can nevertheless have powerful institutional consequences. If an institution recognizes subjects only through a narrow interface, subjects that are equivalent under that interface may receive the same permissions, prices, rankings, opportunities, or liabilities. The institution can thereby convert local equivalence into a consequential social fact. Conversely, a representation that distinguishes subjects through an institutionally salient criterion can generate different treatment even when the subjects remain equivalent along many other dimensions. The design of manifestational criteria is therefore itself part of the generative-relational economy.

Claim 4.108 (Subject identity exceeds local manifestational equivalence). *Local manifestational equivalence licenses an equivalence claim only within the specified manifestational domain and comparison criterion. Extension from that equivalence to relational or ontological subject identity requires independent justification.*

Claim 4.108 provides a compact rule for later GRE analysis. It prevents operational tests, institutional classifications, market signals, or behavioral outputs from silently becoming complete ontologies of the subjects they classify. It also preserves

the legitimate analytical use of equivalence where a bounded comparison is sufficient. A payment system may need only authorization equivalence; a contractual process may need legal-capacity equivalence; a production model may need task-performance equivalence. The mistake lies in allowing the local criterion to expand beyond the scope it was designed to establish.

Subjects across the three registers can now be understood as historically coupled without becoming reducible to one another. Ontological subjecthood names the strongest and often partly suspended question of what the subject is. Relationally effective subjecthood identifies sufficiently persistent, stable, and causally efficacious loci of participation. Manifestational subjecthood concerns the modes through which aspects of those subjects become available. Institutional representation stabilizes selected manifestations into symbolic or technical forms through which systems act. Human and artificial subjects can occupy overlapping operational domains while retaining potentially substantial relational and ontological differences. Manifestational equivalence can support bounded coordination and comparison while leaving subject identity open.

This register-sensitive account also prepares the next section. Value and meaning are frequently attributed to, generated by, experienced through, represented for, and circulated among subjects. The same discipline that prevents subject representation from replacing the subject will therefore be required when GRE turns to value and meaning across the three levels.

4.13 Value and Meaning across the Three Levels

Value and meaning are central to economic life because subjects, institutions, and communities act through distinctions concerning what matters, what counts, what is worth preserving or exchanging, and what objects, events, relations, or representations signify. The three-register architecture developed in this chapter permits these phenomena to be examined without collapsing them into either objective properties or subjective reports. The role of this section is to specify how value and meaning can be approached across ontological, relational, and manifestational registers. Its objective is to distinguish the relational reality of value and meaning from stronger claims concerning their ultimate ontological status, normative validity, or semantic truth, while preserving the causal and historical importance of valuation and interpretation. The discussion proceeds from relationally emergent value and meaning to their manifestation, symbolic mediation, partial commensuration, and historical transformation. The method is analytical and reconstructive: the section applies the ontology developed in Sections 4.2–4.11 to evaluative and meaningful phenomena while keeping heterogeneous forms of value and meaning open to later domain-specific analysis. (E. Anderson 1993; Appadurai 1986; Bourdieu 1984; Reber et al. 2004)

Chapter 2, Section 43 reconstructed several existing traditions concerning value, valuation, plural forms of value, and commensurability. The present section has a different task. It asks what kind of reality value and meaning can possess within GR. The answer cannot be supplied by declaring that value is simply subjective, objective, social, or symbolic. A value can be historically generated yet highly stable; it can organize action before being explicitly articulated; it can acquire symbolic representation in prices, rankings, rituals, or categories; and its representation can subsequently al-

ter the relations through which value is generated. Meaning exhibits a parallel complexity. An interpretation can emerge through language, practice, memory, expectation, embodiment, and institutional history; it can become causally consequential before it is formulated propositionally; and its later articulation can transform the field of relations in which it continues to operate.

The resulting framework therefore separates three questions. The ontological question concerns whether value or meaning has a status independent of the particular relational and manifestational configurations through which it becomes available. The relational question concerns whether evaluative or meaningful structures have emerged with sufficient persistence, stability, and causal efficacy to become relationally real within a generative-relational system. The manifestational question concerns the forms through which value or meaning becomes perceptible, articulable, measurable, symbolizable, or otherwise available under particular conditions. These questions can interact without yielding identical answers.

Definition 4.109 (Register-sensitive value and meaning). *Register-sensitive analysis of value and meaning* distinguishes among their possible ontological status, their relational emergence and causal efficacy, and the particular forms through which they become manifest or represented, while allowing these dimensions to mediate one another historically.

Definition 4.109 preserves two forms of restraint. First, the existence of relationally real value does not by itself establish that whatever is valued is normatively good. Second, the existence of relationally real meaning does not by itself establish that the interpretation is semantically true, referentially successful, or epistemically justified. A society can stabilize harmful forms of valuation. A community can organize action around a false interpretation. These formations can nevertheless be causally real because they structure conduct, institutions, expectations, and subsequent relations. GRE therefore requires a vocabulary capable of studying the reality of value and meaning without treating causal stabilization as moral or epistemic vindication.

4.13.1 Value as Relationally Emergent

Value becomes relationally relevant when something acquires evaluative significance through a generative-relational system and that significance participates in the organization of subsequent action. The relevant relations can include desire, need, use, care, recognition, exchange, scarcity, obligation, attachment, institutional classification, historical memory, ecological dependence, collective identity, or aesthetic orientation. Different forms of value can therefore arise through markedly different structures. The relational account does not require these structures to be reducible to a common mechanism or a single scalar quantity.

Definition 4.110 (Relationally emergent value). *Relationally emergent value* is evaluative significance that emerges within a generative-relational system, persists with sufficient stability over a relevant spacetime region or interval, and exercises causal efficacy by orienting selection, preservation, exchange, allocation, attention, commitment, refusal, or subsequent relation formation.

The definition applies the general relational-reality criterion from Section 4.5. It does not imply that every transient preference is already a relationally real value. A fleeting attraction can become manifest without acquiring sufficient persistence or causal force to organize later relations. By contrast, a durable commitment to a

person, a sacred object, a professional norm, a currency, a landscape, an institutional mission, or a form of knowledge can become relationally real when the evaluative orientation survives across situations and affects future conduct.

Relationally emergent value can precede explicit valuation. A child can be embedded in relations of care before possessing a developed vocabulary of value. A community can sustain practices that preserve a landscape before articulating a formal environmental ethic. A researcher can repeatedly orient attention toward a problem experienced as promising or beautiful before producing an explicit account of why it matters. In these cases, the evaluative structure is already participating in the organization of action even though its later symbolic formulation remains incomplete.

This pre-manifestational possibility is especially important for aesthetic judgment. An object does not need to become explicitly judged as beautiful before the relational-generative-historical conditions that make such a judgment possible begin to exist. The history of training, perceptual formation, disciplinary practice, memory, cultural repertoire, bodily disposition, and previous encounters can already structure susceptibility to a later manifestation of beauty, elegance, significance, or importance. The eventual judgment therefore emerges within a field whose evaluative organization partly precedes conscious recognition.

Relational emergence also permits value to be plural without assuming that every plurality can be converted into one metric. Money, friendship, legal equality, ecological continuity, scientific insight, bodily integrity, cultural memory, and aesthetic experience can all acquire relational reality as forms of value while belonging to different evaluative domains. Some domains support stable conversion procedures; others permit only partial comparison; still others may lack a warranted common ordering for the relevant inquiry. The existence of multiple relationally real values therefore does not itself establish commensurability.

Claim 4.111 (Relational reality and normative validity). *The relational reality of a value establishes that the evaluative formation is sufficiently persistent, stable, and causally efficacious within a relevant generative-relational system. It does not by itself establish the normative validity, justice, desirability, or universal authority of that value.*

Claim 4.111 is indispensable for GRE. Market value, status value, ideological value, discriminatory valuation, and exploitative institutional priorities can become highly stable and causally consequential. Their relational reality is an object of explanation, not a certificate of legitimacy. Normative assessment requires additional arguments concerning justice, capability, freedom, care, ecological consequence, rights, or other relevant standards. The three-register architecture therefore keeps descriptive ontology and normative evaluation connected without allowing one to substitute for the other.

The ontological status of value can remain more open. A moral realist, constructivist, pragmatist, relational theorist, or other philosophical position may offer different accounts of whether some values obtain independently of their historical realization. GR does not need to resolve those disagreements in order to study how value becomes causally effective in economic systems. Ontological suspension is especially useful here because it permits strong claims about the historical reality of valuation while leaving stronger metaethical questions available for separate treatment.

4.13.2 Meaning as Relationally Emergent

Meaning concerns the significance through which an object, event, relation, sign, practice, or possibility becomes situated within a field of interpretation and action. It can involve semantic reference, practical significance, narrative orientation, institutional interpretation, affective salience, symbolic association, or a subject's understanding of what an encounter means for subsequent conduct. These modes should not be reduced to a single linguistic model. A gesture can carry meaning without being a sentence; a price can signal scarcity or prestige; a ritual can organize belonging; a legal category can determine institutional consequence; and an unexpected event can acquire significance before its interpretation becomes verbally explicit.

Definition 4.112 (Relationally emergent meaning). *Relationally emergent meaning* is significance generated through a relational configuration that persists with sufficient stability and exercises causal efficacy by organizing interpretation, expectation, attention, memory, orientation, communication, or subsequent action within a generative-relational system.

Meaning in this sense can be relationally real before it is fully symbolized. A familiar place can carry significance through repeated embodied and interpersonal relations without that significance being translated into a proposition. A social role can orient expectation before participants articulate its rules. A contingent encounter can become structured as potentially significant through a subject's history before the subject becomes reflectively aware of what the encounter means. Symbolic language may later stabilize and communicate such meanings, but symbolization is one mediating pathway rather than a universal prerequisite.

The distinction between relational meaning and semantic truth is parallel to the distinction between relational value and normative validity. A rumor can acquire meaning and alter behavior even when its propositional content is false. A mistaken diagnosis can reorganize a person's expectations, institutional treatment, and future decisions. A fictional character can possess enduring cultural meaning without being an ontologically existing historical person. A religious symbol can become highly consequential within a community while its associated metaphysical claims remain subject to independent inquiry. The causal reality of meaning therefore concerns what the interpretation does within a system, while truth concerns a different relation whose criteria depend on the relevant epistemic domain.

Claim 4.113 (Meaning and truth). *The relational reality of a meaning records the persistence, stability, and causal efficacy of an interpretive formation. It does not by itself establish the truth, referential adequacy, or epistemic justification of the interpretation through which that meaning is organized.*

Claim 4.113 protects the framework from a form of relational relativism. GR can recognize that meanings are historically and relationally generated while also allowing evidence, logical consistency, causal inquiry, testimony, measurement, and other epistemic practices to constrain claims about truth. Relational generation explains how an interpretation becomes operative; it does not make every operative interpretation equally warranted.

Value and meaning also interact without becoming identical. Something can be meaningful without being positively valued. A traumatic site can carry intense meaning while being associated with aversion. A market price can be valuable as information for one actor while symbolizing exclusion for another. A mathematical conjec-

ture can possess meaning within a disciplinary history before a community attributes high research value to it. Conversely, something can be valued instrumentally while carrying little broader meaning for the subject who uses it. GRE therefore benefits from treating evaluative orientation and interpretive significance as partially coupled dimensions rather than interchangeable terms.

4.13.3 Manifestation of Value

Relationally emergent value becomes manifest through heterogeneous forms. A price, ranking, vote, award, credential, investment decision, act of preservation, ritual gesture, refusal to sell, allocation of time, emotional response, legal protection, or pattern of care can each manifest evaluative significance under particular conditions. None of these manifestations is automatically exhaustive. A market price can manifest one institutionally stabilized form of valuation while leaving other forms of value unexpressed. A conservation designation can manifest institutional recognition while only partially representing the attachments, ecological dependencies, or historical meanings through which the protected object matters.

Definition 4.114 (Manifestation of value). A *manifestation of value* is a perceptual, behavioral, affective, institutional, symbolic, quantitative, or other form through which an evaluative significance becomes available within a specified manifestational configuration.

The definition preserves the distinction from Section 4.6: manifestation does not require the persistence or stability required for relational reality. A momentary expression of delight can manifest value even if the evaluation does not persist. Conversely, a relationally stable value may remain only partially manifested at any particular moment. The mapping from evaluative structure to manifestation is therefore neither complete nor necessarily invertible.

Economic analysis often relies on manifestations of value because many evaluative processes become observable through choices, bids, prices, quantities, scores, surveys, ratings, or institutional decisions. Such manifestations can be informative, but Section 4.9 implies a discipline of inference. Similar prices can arise from different evaluative structures; similar preferences expressed in a survey can be sustained by different histories; and the same underlying commitment can generate different behavior under changing constraints. An observed manifestation should therefore be treated as evidence about value under specified assumptions rather than as an automatic identity between the measure and the value itself.

Symbolization can further transform the evaluative field. Once a value is assigned a numerical score, price, label, ranking, or category, the symbolic representation can become part of the system through which later valuation occurs. Rankings can redirect attention. Prices can reorganize expectations. Certification can create prestige. Accounting categories can determine which contributions become visible. Repeated symbolic representation can therefore stabilize one evaluative dimension while weakening, obscuring, or transforming others.

This process can create practical commensurability among heterogeneous objects. A price system, index, scoring rubric, or ranking scheme can place previously heterogeneous objects within a shared representational space. Section 4.10 characterized this process as symbolic commensuration. The common metric can become highly consequential without establishing that the underlying values were intrinsically com-

measurable before the mapping was imposed or negotiated. GRE should therefore distinguish the existence of a functioning conversion interface from the stronger claim that the converted values share a common evaluative structure.

Remark 4.115 (Manifested value and commensuration). A successful symbolic conversion can make heterogeneous values operationally comparable for a specified purpose. The existence of that comparison does not establish complete equivalence among the relational structures from which those values emerge.

This distinction becomes central for later GRE analysis of allocation, return, exploitation, compensation, and justice. An institution can compensate one loss through money because monetary conversion is legally or practically available while the affected subject continues to experience an irreducible remainder. The existence of exchange does not establish that nothing was lost in translation.

4.13.4 Manifestation of Meaning

Meaning likewise becomes manifest through multiple channels. Speech, writing, gesture, image, bodily orientation, narrative, ritual, classification, architecture, interface design, statistical representation, silence, and patterned action can all make significance available. Manifestational plurality is especially important because the same relational meaning can become differently available across subjects and contexts, while similar symbolic forms can sustain different meanings in different histories.

Definition 4.116 (Manifestation of meaning). A *manifestation of meaning* is a form through which relationally generated significance becomes perceptible, interpretable, communicable, recordable, or otherwise available within a particular manifestational configuration.

The definition makes room for both symbolic and non-symbolic manifestations. A facial expression can make distress manifest before it is named. The spatial organization of a courtroom can manifest authority without requiring a verbal proposition. A recurring economic practice can manifest expectations that participants have never written down. A scientific diagram can render a relation visible in a form unavailable to ordinary perception. Symbolization becomes especially powerful because it allows meanings to be stabilized, transmitted, recombined, compared, archived, and recursively reintroduced into later relations.

The mapping from meaning to manifestation remains context-sensitive and non-invertible. The same sentence can carry different meanings in different histories. Different languages can manifest overlapping meanings without exact structural equivalence. Silence can signify consent in one institutional context and resistance in another. A numerical indicator can be interpreted as evidence of performance, risk, failure, or injustice depending on the relational field in which it appears. Reverse inference from manifestation to meaning therefore requires knowledge of the historical and relational conditions through which the manifestation becomes interpretable.

Meaning can also mediate value. A commodity's price can change when its meaning changes from ordinary good to collectible object. A place can acquire economic value after becoming symbolically associated with heritage. A technology can become desirable because it signifies modernity, status, autonomy, or belonging. Conversely, valuation can reshape meaning by directing preservation, repetition, institutional recognition, and educational transmission toward some interpretations rather than others. The relation between value and meaning is therefore recursive and histori-

cally generative.

Aesthetic judgment again offers a useful limiting case. The manifestation of beauty is not reducible to the verbal statement that something is beautiful. Aesthetic salience can appear affectively or perceptually before reflective judgment, while the relational conditions enabling that appearance may have been generated over a much longer history. Once articulated, the judgment can further alter attention, prestige, memory, canon formation, research investment, and transmission. The manifestation therefore both discloses and participates in the future generation of evaluative and meaningful reality.

4.13.5 Historical Transformation of Value and Meaning

Value and meaning are historically transformable because the relations, manifestation mechanisms, representations, subjects, and institutions through which they are generated can change. A value can persist while its manifestation changes. A symbolic representation can persist while the relational value beneath it weakens or shifts. A meaning can survive through translation into new media, or a stable sign can acquire substantially different meanings across periods. Historical analysis must therefore distinguish continuity of representation from continuity of relational structure.

The recursive architecture from Section 4.11 supplies a useful model. At one time, a relationally emergent value or meaning contributes to a manifestation. That manifestation can be represented, recorded, institutionalized, taught, priced, ranked, or contested. The representation then becomes part of the later relational environment in which subjects form new valuations and interpretations. Historical transformation therefore need not occur through replacement of one complete value system by another. It can proceed through gradual changes in the relations among practices, symbols, institutions, subjects, and memories.

Money illustrates the point clearly. Monetary value depends on historically stabilized relations among institutions, legal arrangements, accounting practices, expectations, exchange, and recognition. Monetary symbols then participate in reproducing those relations. A unit of account can persist while its purchasing power, political significance, technological embodiment, and relation to trust change. The representation remains recognizable, yet the relational field through which it is valuable evolves.

The same structure applies to prestige, professional credentials, cultural objects, legal rights, religious symbols, scientific problems, and forms of identity. A credential can remain formally identical while the labor market changes the opportunities it generates. A cultural symbol can retain its visual form while becoming associated with different collective histories. A research problem can acquire greater value after new techniques make it tractable or after a disciplinary community interprets it as theoretically central. Historical change therefore concerns both the objects valued and the relations through which valuation itself becomes possible.

Claim 4.117 (Historical plasticity of value and meaning). *The persistence of a value or meaning across time can coexist with substantial transformation in the relations, manifestation mechanisms, representations, and subjects through which it is generated and reproduced. Apparent continuity at one register therefore does not establish structural continuity across the others.*

Claim 4.117 also clarifies why GRE should preserve records of category change. If an institution measures “merit,” “risk,” “productivity,” “quality,” or “need” across decades, continuity of vocabulary can conceal changing evaluative structures and meanings. A time series may remain numerically continuous even while the social object represented by the variable changes. Conversely, terminology can change while a deeper relational structure remains comparatively stable. Historical comparability therefore requires reconstruction of the manifestation mappings and valuation practices that connect periods.

The three-register view consequently prevents both reification and dissolution. Value and meaning need not be treated as timeless substances in order to be real. Their historical and relational emergence does not make them causally negligible, arbitrarily subjective, or reducible to discourse. When they acquire sufficient persistence, stability, and causal efficacy, they can become relationally real. When they appear through prices, judgments, classifications, emotions, symbols, practices, or institutions, they acquire manifestational forms whose structure can be studied independently. Questions of ultimate value, normative validity, semantic truth, and ontological fundamentality remain distinguishable and can be addressed where the inquiry requires them.

This register-sensitive account prepares the transition to social facts and institutional reality. Values and meanings frequently become durable precisely because institutions stabilize classifications, expectations, obligations, roles, and authorized interpretations across persons and time. Section 103 therefore turns from evaluative and meaningful reality to the institutional structures through which relational realities can become collectively reproducible and causally persistent.

4.14 Social Facts and Institutional Reality

Social facts and institutions provide some of the clearest cases in which the three-register architecture can be applied to economic reality. Money, property, legal status, organizational office, debt, professional qualification, citizenship, contractual obligation, and corporate personality can organize action with considerable durability even though their efficacy cannot be identified with the material objects through which they are manifested. Chapter 2, Section 40 reconstructed several existing accounts of social facts, institutional stabilization, legal constitution, symbolic authority, and historical revisability. The role of the present section is different. Its objective is to specify how such phenomena can possess relational reality within GR, how institutional stabilization alters the persistence and causal reach of social facts, and how legal, monetary, and organizational realities traverse ontological, relational, and manifestational registers. The method is register-sensitive: the section distinguishes the material and other ontological conditions on which institutions may depend, the relational configurations through which institutional objects persist and act, and the texts, records, symbols, performances, classifications, and interfaces through which institutional realities become manifest.

The central claim is modest but consequential. Social construction does not imply diminished reality. When a socially generated object persists with sufficient stability and exerts causal efficacy within the generative-relational system that sustains it, it can satisfy the criterion of relational reality developed in Section 4.5. Its rela-

tional reality does not settle whether it possesses an independent ontological existence, whether its representation is epistemically adequate, or whether the institution is normatively legitimate. A legal status can be relationally real while unjust. A monetary unit can be relationally real without being an ontologically fundamental object. An organizational classification can be causally effective even when it misdescribes the people to whom it is applied. The ontology of institutional life therefore requires several distinctions that become obscured when “socially constructed” is treated either as a synonym for unreality or as a complete theory of what social objects are. (Berger and Luckmann 1966; Searle 1995; North 1990; Ostrom 2005)

Definition 4.118 (Institutional reality). *Institutional reality* denotes the relational reality acquired by socially generated objects, statuses, rules, roles, classifications, procedures, or organized capacities when they are stabilized through sufficiently persistent configurations of recognition, practice, authorization, record, material support, expectation, enforcement, or resource allocation and thereby become causally efficacious within the relevant generative-relational system.

Definition 4.118 intentionally includes several possible stabilizing mechanisms rather than reducing institutions to one source. Some institutional realities depend strongly on formal authorization. Others are sustained primarily through convention, habit, organizational routine, infrastructural dependence, or mutually adjusted expectations. Many combine several of these mechanisms. The definition also leaves open whether the relevant institutional object possesses an ontological status beyond its relational realization. The analytical burden is first to identify how it is generated, how it persists, what stabilizes it, and how it affects subsequent relations.

4.14.1 Social Facts

A social fact, in the present framework, is not defined merely by the existence of a shared belief. Shared representations can contribute to its formation, but the relational reality of a social fact requires more than mental agreement. The fact must become sufficiently stabilized within a social field to organize conduct, expectations, opportunities, obligations, identities, access, or resource flows. The relevant relations may include mutual recognition, legal authorization, customary practice, material infrastructure, records, sanctions, market coordination, professional routines, or repeated interaction. What is socially factual is therefore tied to a configuration capable of making a difference within the system.

Definition 4.119 (Relationally real social fact). A *relationally real social fact* is a socially generated object, status, rule, distinction, or expectation that persists with sufficient stability across a relevant spacetime interval and exercises causal efficacy within the social system through which it is sustained.

This definition preserves the general GR criterion while making the social mode of generation explicit. A marriage, debt, academic credential, property title, rank, office, or currency denomination may be relationally real because actors, organizations, databases, legal procedures, infrastructures, and expectations collectively sustain a configuration through which subsequent action is differentiated. The relevant efficacy may occur even when a particular subject is unaware of the fact. A person can acquire a tax liability without having noticed it, be subject to a legal restriction without understanding its doctrinal basis, or hold a claim recorded in an institutional system before becoming aware that the record exists. Subjective apprehension is therefore

neither a necessary nor a sufficient condition of relational reality.

The same point helps distinguish social facts from manifestational facts. A passport, contract, certificate, database entry, court order, price display, uniform, title, or public ceremony can manifest an institutional status. Yet the manifested object is not automatically identical with the relational structure through which the status persists. A printed certificate can be destroyed while the qualification remains institutionally recognized through other records and practices. Conversely, a visually convincing certificate can exist without the institutional relations required to make its represented status effective. Manifestation can disclose, transmit, stabilize, or transform a social fact, but it does not exhaust the social fact's relational reality.

Social facts can also precede explicit symbolization in a local context. Repeated patterns of deference, exclusion, obligation, entitlement, or informal authority may become sufficiently stable to shape conduct before participants develop a settled vocabulary for them. Once named, codified, measured, or represented, these patterns can enter the recursive dynamics described in Section 4.11. The new manifestation may render an existing relation more legible, but it can also reorganize that relation by enabling contestation, coordination, enforcement, comparison, or institutional redesign.

Claim 4.120 (Social fact without universal awareness). *The relational reality of a social fact does not require universal recognition or simultaneous awareness among the subjects affected by it. It requires a sufficiently stable generative-relational configuration capable of sustaining the fact and mediating causal consequences within the relevant system.*

Claim 4.120 matters for large institutional systems. Modern societies routinely coordinate relations among participants who possess highly unequal knowledge of the rules, databases, classifications, procedures, and infrastructures that shape their actions. Institutional reality can therefore be distributed across persons, documents, software, offices, routines, and material arrangements rather than residing in a single collective representation. The resulting social fact may be real for the system even though no individual actor possesses a complete representation of the relations that sustain it.

Social facts need not be mutually commensurable merely because they share the same relational-reality criterion. A religious office, a financial claim, a kinship relation, a legal title, and an academic credential may all be relationally real while being generated through different mechanisms and embedded in different comparison structures. Even objects bearing similar labels across jurisdictions or historical periods may not be structurally equivalent. Cross-institutional comparison therefore requires an explicitly justified mapping rather than an assumption that shared terminology identifies a common metric space.

4.14.2 Institutional Stabilization

Institutionalization concerns the transition from recurrent social relations toward more durable configurations in which expectations, roles, procedures, classifications, sanctions, and resources become mutually reinforcing. The transition is rarely a single event. It can involve repetition, record keeping, formalization, professionalization, infrastructural investment, legal recognition, routinized enforcement, education, socialization, technological embedding, or the accumulation of precedent. Dif-

ferent combinations can produce different degrees and forms of institutional stability.

Definition 4.121 (Institutional stabilization). *Institutional stabilization* is the historical process through which a socially generated configuration acquires sufficient persistence, reproducibility, and causal reliability that its roles, rules, statuses, procedures, or organized capacities can structure subsequent relations beyond the immediate interactions in which they first emerged.

Institutional stabilization can extend a relational reality across time and space. A bilateral promise can depend heavily on the memory and continued willingness of the two participants. A standardized contract recorded within a legal and administrative system can remain efficacious through changes in personnel, location, ownership, or organizational membership. Stabilization therefore changes not only duration but also the architecture through which persistence is achieved. Memory can be externalized into records; authorization can be attached to offices rather than persons; sanctions can be routinized; procedures can be standardized; and material infrastructures can preserve practical continuity across generations of participants.

This extension of persistence should not be confused with immutability. An institution can be highly stable while remaining historically revisable. Indeed, some institutions stabilize procedures through which their own rules can be amended, offices replaced, assets transferred, or statuses terminated. A constitution, corporate charter, professional code, or monetary regime can therefore include relations of authorized transformation within the institutional reality itself. Stability and revisability are compatible when the procedures governing change are themselves sufficiently stabilized.

Institutional reality can also become recursively self-supporting. A rule shapes behavior; repeated behavior creates expectations; expectations increase the cost of deviation; organizations invest in infrastructure built around the rule; records accumulate; professional roles emerge to interpret and administer it; and these developments make the rule more consequential for later participants. Such recursion can deepen relational reality without converting historical contingency into necessity. What has become difficult to change may still have been generated through a path that could have developed differently.

The three-register architecture helps separate several components of stabilization. A building, server, ledger, biometric device, courtroom, banknote, or communications network may provide material conditions. A role, entitlement, debt, office, legal relation, or monetary claim may be relationally real within the institution. A statute, record, symbol, dashboard, credential, verdict, price, or ceremony may manifest and represent the relevant relation. Institutional persistence often depends on the coupling among these registers rather than on any one of them in isolation.

Remark 4.122 (Institutional object and institutional manifestation). The persistence of an institutional object can survive the loss or replacement of particular manifestations, while changes in manifestation can nevertheless transform the institutional object when the manifestation itself enters the relations that reproduce it.

This remark captures an important asymmetry. A corporation can survive replacement of its logo, offices, employees, directors, databases, or paper records because its relational continuity is distributed across multiple mechanisms. Yet a change in registration, governance rules, legal classification, or ownership records can alter the corporation precisely because these manifestations are institutionally operative. Man-

ifestation is therefore neither merely superficial nor automatically constitutive; its role depends on the generative relations in which it participates.

4.14.3 Legal Reality

Law offers a particularly clear illustration of relational reality mediated through manifestation. Legal systems depend heavily on texts, judgments, filings, signatures, classifications, procedures, and public acts. These are manifestational forms. Their legal efficacy, however, depends on historically stabilized relations among institutions, officials, subjects, records, recognized procedures, interpretive practices, enforcement capacities, and expectations. The written form of a rule is therefore important without being sufficient to explain the reality of law.

Definition 4.123 (Legal relational reality). *Legal relational reality* is the relational reality acquired by legal statuses, rights, duties, powers, disabilities, procedures, and institutional acts when they are sustained through a sufficiently stable legal-institutional configuration and become causally capable of structuring action, authorization, access, sanction, liability, or resource distribution.

A property right illustrates the distinction. The physical object that becomes property does not contain the right as one of its material attributes. The right is sustained through relations among recognized holders, registries, courts, contractual practices, administrative procedures, social expectations, and enforcement capacities. It may be manifested through a title, deed, digital register, possession, boundary marker, or judicial decision. These manifestations can be indispensable to particular legal systems, but the right's relational reality consists in the stabilized configuration through which claims and actions acquire differential consequences.

Legal acts can also generate new relational realities through authorized manifestation. A judgment, registration, marriage declaration, incorporation filing, appointment, or transfer can change what relations exist because the relevant system assigns generative force to the act. The manifestation is then performative in a specific institutional sense: its efficacy arises from its position within an authorized relational configuration rather than from the words or marks alone. The same utterance or document outside the relevant institutional relations may lack the corresponding effect.

This generative feature helps explain why legal reality cannot be reduced either to symbolic representation or to physical enforcement. A court order can remain legally real during an interval in which enforcement has not yet occurred. Conversely, coercive conduct can occur without possessing the legal status claimed for it. Legal reality therefore involves relations of validity, authorization, interpretation, institutional competence, and expected consequence that can be analytically distinguished from both textual manifestation and material force.

The framework also permits a distinction between legal reality and legal justice. A discriminatory status, exclusionary rule, or procedurally valid decision can become relationally real when institutions sustain and enforce it. Its causal reality does not establish moral legitimacy. Conversely, a normatively compelling claim may lack institutional realization and therefore possess little or no legal relational reality within a particular jurisdiction at a particular time. GRE can study the economic consequences of this gap without treating the existing legal order as normatively self-validating.

Claim 4.124 (Legal efficacy without ontological identity). *A legal object can possess substantial relational and causal reality without requiring the analyst to posit a dis-*

tinct ontological substance corresponding to the legal category. Its reality can be traced through the relations that generate, stabilize, manifest, interpret, and enforce it.

This claim illustrates ontological suspension in practice. Competing philosophies of law may disagree about the ultimate nature of legal normativity, institutional facts, or legal obligation. The relational analysis can remain productive across part of that disagreement by identifying how legal objects become effective in historically specific systems. Where deeper ontological commitments alter the explanation, the disagreement becomes operative and should be addressed explicitly rather than prematurely resolved.

4.14.4 Monetary Reality

Money provides an especially useful case because its manifestations are easy to confuse with the relational object itself. Coins, banknotes, account balances, ledger entries, payment messages, and displayed prices are manifestations through which monetary relations become available and actionable. Their material or digital existence is important, but the monetary reality of a unit, balance, or claim depends on a wider relational configuration involving issuers, banks, payment systems, legal rules, accounting practices, expectations, exchange relations, taxation, contracts, and institutional trust.

Definition 4.125 (Monetary relational reality). *Monetary relational reality* is the relational reality acquired by monetary units, balances, claims, prices, and payment capacities when they are stabilized within a generative-relational system sufficiently to coordinate valuation, settlement, obligation, exchange, accounting, or resource allocation and to exert causal effects on subsequent economic relations.

This definition does not require every monetary form to share the same institutional architecture. Commodity money, state-issued currency, bank deposits, community currencies, digital payment balances, and other monetary arrangements can differ in their stabilization mechanisms. The relevant inquiry concerns the relations through which a particular monetary object is recognized, transferred, accounted for, redeemed, taxed, enforced, trusted, or otherwise made consequential. Similar manifestations can conceal different relational structures, just as similar relational functions can be realized through different manifestations.

A banknote therefore offers only a partial view of monetary reality. The note can be materially destroyed without eliminating the currency. A counterfeit note can closely reproduce the manifestation while lacking the institutional relations that normally sustain the represented monetary claim. A digital balance can persist without any particular physical token corresponding to each unit. These examples reinforce the non-invertibility developed in Section 4.9: observation of a manifestation does not by itself reveal the relational structure that gives it monetary efficacy.

Monetary reality also demonstrates manifestational mediation. Prices, balances, ratings, exchange rates, accounting categories, and policy announcements do more than make an antecedent monetary system visible. Once circulated, they can alter expectations, spending, lending, investment, collateral relations, contractual decisions, and institutional responses. A manifested monetary quantity can therefore enter the generative field that helps produce later monetary and economic relations. The symbolic and relational registers remain distinct while becoming recursively coupled.

The familiar question of whether money is “real” is therefore decomposed into

more precise questions. The physical substrate of a note or computer system raises one ontological issue. The stabilized monetary relation raises another. The displayed balance or printed denomination concerns manifestation and representation. The causal effects of monetary recognition concern relational reality. Normative questions concerning distribution, exclusion, monetary governance, or justice require further evaluation. The three-register architecture avoids forcing these questions into one binary judgment.

4.14.5 Organizational Reality

Organizations extend institutional reality through coordinated capacities that exceed the continuity of particular members. A university, corporation, ministry, association, or cooperative can retain identity across changes in personnel, offices, technologies, assets, and internal procedures. This continuity is neither purely symbolic nor reducible to a fixed material substrate. It depends on relations that reproduce membership, authority, decision procedures, ownership, records, routines, responsibilities, resources, and external recognition across time.

Definition 4.126 (Organizational relational reality). *Organizational relational reality* is the relational reality of an organized collective configuration that persists through stabilized relations of membership, authority, procedure, resource control, role differentiation, record, and external recognition, thereby acquiring capacities and causal effects that cannot be identified with any single current participant or manifestation.

The definition does not imply that organizations act independently of people, technologies, infrastructures, or environments. It identifies a level at which organized relations become sufficiently stable that actions can be attributed to an institutional configuration across turnover in the specific relata realizing it. A company can enter a contract before one manager leaves and remain bound after another arrives. A university can award a degree through procedures distributed across departments, registries, committees, information systems, and legal recognition. The organization persists because relevant relations are reproduced, not because an unchanging substance passes through time.

Organizational personality provides a particularly clear example of the distinction among registers. A legal person can be manifested through a registered name, identifier, seal, website, letterhead, bank account, or contractual signature. The legal representation enables coordinated action, but the organization's relational reality includes governance relations, employees, assets, liabilities, routines, authorizations, counterparties, and historical commitments that extend beyond any one symbol. The organization may therefore possess relational continuity even when particular representations change.

At the same time, organizational representations can reshape the organization. A new accounting category can redirect managerial attention. A performance metric can reorganize incentives. A revised organizational chart can redistribute authority if it is institutionally implemented. A mission statement can remain largely ceremonial or become relationally consequential depending on how it enters hiring, budgeting, evaluation, and decision procedures. The causal significance of representation is thus an empirical property of the generative-relational system rather than an automatic consequence of textual existence.

Organizational reality also clarifies why agency attribution requires care. An organization can possess operational capacities that justify treating it as an analytical subject for particular inquiries, while responsibility, experience, intention, and moral standing may remain distributed or contested. Section 4.12 therefore remains relevant: manifestational or operational unity does not establish identity across every dimension of subjecthood. The three-register architecture permits the analyst to study organizational action without assuming that organizational and human subjectivity are equivalent.

4.14.6 Causal Reality of Social Constructions

The examples above converge on a broader ontological point. A social construction can be causally real because construction refers to a mode of generation rather than to an absence of reality. Once a category, status, institution, or representation becomes embedded in stable relations, it can constrain and enable action, redirect resources, allocate rights, organize expectations, change bodies and environments, reproduce inequality, create capabilities, or alter the conditions under which later relations emerge. The historical contingency of its origin does not cancel these effects.

Claim 4.127 (Causal reality of social construction). *A socially constructed object can possess relational reality when the generative-relational system that sustains it gives the object sufficient persistence, stability, and causal efficacy. Social construction therefore describes a possible history and mechanism of emergence rather than a criterion of unreality.*

This claim does not imply that every social construction becomes relationally real. A proposed category that fails to circulate, an unenforced rule that leaves practice unchanged, an ephemeral rumor, or an institutional reform that remains purely nominal may lack sufficient persistence or causal efficacy. Nor does it imply that the same constructed object has equal reality across systems. A credential can open access in one institutional field and be ignored in another. A currency can be effective within one payment network and practically unusable outside it. Relational reality remains domain-sensitive and historically situated.

The causal effects of social constructions can also outlive the representations through which they were initially generated. A historical classification may disappear from official vocabulary while its accumulated effects remain embedded in property distributions, organizational routines, infrastructures, reputations, or spatial arrangements. Conversely, a representation can survive after the relations that once made it effective have weakened. This temporal divergence between manifestation and relational efficacy is another reason to resist identifying institutional reality with visible symbols alone.

Institutional reality can further alter its own conditions of reproduction. Once a legal category, currency, organization, or administrative classification becomes established, later actors encounter a relational field already structured by it. They invest, learn, comply, resist, innovate, migrate, or organize around the inherited configuration. Their responses can stabilize the institution, transform it, produce new representations, or generate alternative relations. Institutional reality is therefore historical not only because it has an origin, but because each period of reproduction changes the conditions inherited by the next.

This recursive temporality is especially important for GRE. Economic analy-

sis frequently treats institutions as background constraints or parameters. The generative-relational view instead permits institutions themselves to be investigated as historically produced realities that subsequently participate in producing economic subjects, opportunities, values, incentives, resource distributions, and future institutional forms. A property regime, monetary system, labor classification, welfare category, organizational structure, or accounting convention does not merely constrain choices made within an otherwise unchanged field. It can help generate the field within which later choices, relations, and forms of value become possible.

Remark 4.128 (Reality, legitimacy, and truth). The relational reality of an institution establishes neither its normative legitimacy nor the truth of the representations through which it operates. Causal efficacy, epistemic adequacy, legal validity, social recognition, and normative justification remain distinct dimensions that may interact without collapsing into one another.

The remark preserves a central discipline of the three-register architecture. A discriminatory classification may be institutionally real and normatively objectionable. A mistaken risk score may be epistemically poor and causally powerful. An informal norm may be socially effective without legal validity. A legal entitlement may be valid yet weakly realized in practice. A public representation may accurately describe an institution yet have little causal influence. Analytical precision requires these possibilities to remain separately visible.

The ontological significance of social facts and institutions can therefore be stated without metaphysical inflation. Their reality is not diminished by the fact that they emerge historically through relations, and their relational reality does not compel a claim that they exist independently of those relations. They occupy a domain in which stabilized relations acquire causal efficacy, manifestations become operative components of reproduction, and historically generated objects can confront later actors with substantial practical force. This account prepares the next section's turn from relatively stabilized institutional objects toward process, event, and becoming, where persistence itself must be situated within continuing transformation.

4.15 Process, Event, and Becoming

The preceding sections have developed relational reality largely through objects, subjects, values, institutions, manifestations, and representations that achieve sufficient persistence and stability to become causally efficacious. The role of the present section is to clarify the temporal form of such reality. Its objective is to show how GR can analyze processes, events, and becoming without treating persistence as immobility, without reducing events to instantaneous points, and without turning process language into a final metaphysics. The discussion proceeds through five steps. It first specifies processual reality, then develops an account of events, examines stability within becoming, defines relational transformation, and finally considers how historically generated changes can require new ontological categories within an inquiry. The method remains consistent with the chapter's ontological suspension: temporal and processual descriptions are treated as analytically serious claims about organization and causal efficacy while stronger claims about the ultimate temporal constitution of reality remain open unless the inquiry independently warrants them.

The central difficulty is that relational reality requires persistence and stability,

while generative-relational systems are continually changing. These conditions are compatible once stability is understood dynamically. A monetary system persists while transactions, balances, technologies, regulations, and participants change. An organization persists while personnel, routines, assets, and strategies are revised. A sense of self can persist while memory, embodiment, social recognition, and self-description develop. The reality of such configurations lies partly in their capacity to reproduce an organized pattern through change. Processual analysis therefore does not displace the criterion of relational reality developed in Section 4.5; it clarifies one way in which that criterion can be satisfied across time. (Whitehead 1929; Mead 1932; Davidson 2001; Sewell 1996)

Definition 4.129 (Processual reality). *Processual reality* denotes the relational reality of an organized pattern of change whose temporally extended configuration persists with sufficient stability and causal efficacy to participate in the subsequent development of the generative-relational system in which it occurs.

Definition 4.129 makes the process itself, rather than any single temporal slice, the relevant analytical object. A process can include changing components, variable relations, discontinuities, and internal differentiation while remaining identifiable at the scale of inquiry. Its persistence therefore concerns continuity of organization, trajectory, or generative function rather than exact repetition of state. The definition also remains scale-sensitive. What appears as a relatively stable object at one temporal resolution can appear as an active process at another. A firm can be represented as an institutional entity in one model and as a changing configuration of contracts, routines, capacities, expectations, and material flows in another. Both descriptions can be analytically useful when their scale and purpose are explicit.

4.15.1 Processual Reality

Processual reality becomes important whenever the causal significance of an object depends on the organized continuation of change. A market, learning trajectory, supply chain, technological regime, administrative procedure, or relation of trust may be poorly described by a sequence of independent states because later states depend on how earlier configurations were generated. Historical order, memory, accumulated commitments, adaptation, and feedback can therefore be constitutive of the object under study. The process is relationally real when this temporally extended organization persists sufficiently to shape what can occur next.

The distinction between state and process is analytical rather than absolute. A state description compresses a configuration at a selected temporal resolution. A process description retains some of the transformations through which configurations succeed one another. The appropriate representation depends on the research question. A bank balance at a particular time may be adequately represented as a state for one inquiry, while the sequence of transfers, authorizations, interest accruals, obligations, and institutional validations through which that balance was produced may be indispensable for another. GR therefore treats temporal compression as a methodological choice whose omitted relations should remain visible when they matter to explanation.

Processual reality also clarifies why persistence need not mean substrate identity. Some processes persist through turnover in the entities that realize them. A payment network can continue while servers, software versions, account holders, and orga-

nizational personnel change. A legal procedure can retain recognizable continuity while statutes, interpretive conventions, and administrative technologies are revised. A language practice can persist through generations of speakers. In such cases, continuity is carried by a sufficiently stable organization of relations and transformations rather than by an unchanging set of relata.

Claim 4.130 (Dynamic persistence). *A relational reality can persist through substantial change in its constituent states, relata, and manifestations when the organization of transformation remains sufficiently stable to preserve causal continuity at the scale relevant to the inquiry.*

Claim 4.130 is intentionally scale-relative. The same history can support continuity at one scale and rupture at another. A corporation may remain legally continuous through a major restructuring even though employees experience the restructuring as the end of an earlier organizational form. A monetary regime may preserve a currency name while changing the institutions, convertibility rules, settlement technologies, or policy mechanisms that sustain it. The analytical task is therefore to specify which organization persists, for whom or for what system, across which interval, and with what causal consequences.

Processual reality also accommodates rhythms, cycles, and recurrent dynamics without assuming exact periodicity. Many economic processes are reproduced through recurring but variable practices: payroll, taxation, budgeting, maintenance, certification, price revision, inventory replenishment, and contractual renewal. Their relational reality can depend on repeated coordination whose timing and content change within bounded ranges. Stability here is statistical, institutional, or organizational rather than identical repetition. The relevant process persists because enough of its generative structure is reproduced to maintain causal continuity.

Some processes possess several interacting timescales. Regulatory change can occur slowly relative to trading, infrastructural replacement slowly relative to software updates, and demographic change slowly relative to organizational decisions. GR can represent these differences without assuming that one timescale is ontologically fundamental. The important question is how processes operating at different rates constrain, amplify, or reorganize one another. A slowly changing legal framework can stabilize fast transactions; repeated fast transactions can accumulate pressures that eventually transform the legal framework. Temporal structure is therefore relational and potentially recursive.

The processual view has an additional consequence for manifestation. A process may be relationally real before it is manifested as a coherent process to any subject. Individual observations can appear disconnected until a historical pattern becomes recognizable through later comparison, measurement, narration, or modeling. The manifestation of the process can then feed back into it. Once inflation is represented through an index, organizational decline through a performance metric, or ecological change through a monitoring series, subjects may alter behavior in response to the manifestation. The process existed relationally before its explicit representation in such cases, while its later manifestation becomes one of the relations shaping its subsequent development.

4.15.2 Events

Processes unfold through temporally differentiated changes, some of which acquire a distinctive status as events. An event in GR need not be instantaneous, spectacular, or wholly discontinuous. It is better understood as a temporally bounded reconfiguration whose occurrence makes a consequential difference to the development of a relational system. The event can be brief or extended, visible or initially unrecognized, intentionally produced or emergent from distributed interactions. Its analytical importance lies in the reorganization it introduces into subsequent possibilities.

Definition 4.131 (Relational event). A *relational event* is a temporally delimited reconfiguration within a generative-relational system that produces a causally consequential difference in the organization, constraints, capacities, or trajectories of subsequent relations.

Definition 4.131 distinguishes an event from arbitrary temporal segmentation. Any interval can be bounded by an analyst, but eventhood requires a difference that matters to the system under study. Signing a contract can become an event because obligations, permissions, expectations, and future options are reorganized. A payment default can become an event because it changes credit relations, legal possibilities, reputational classifications, and later financing. A policy announcement can become an event when actors reorganize behavior around it. A software release can become an event if it changes operational capacities or participation conditions. The boundary of the event is therefore partly analytical and partly constrained by the causal structure of the system.

Eventhood can be retrospective. A change that initially appears minor can later be recognized as consequential because subsequent relations amplify it. A local technical modification may become a turning point after complementary technologies, regulations, practices, or expectations align around it. Conversely, an occurrence widely represented as momentous can have limited relational consequences if the surrounding system absorbs it without substantial reorganization. Manifestational salience and relational eventhood can therefore diverge.

This divergence matters for historical analysis. Public discourse often privileges events that are visible, narratively convenient, institutionally recorded, or symbolically dramatic. GR allows an analyst to distinguish the manifestational prominence of an occurrence from its relational significance. A highly publicized announcement may remain weakly causal, while a quiet administrative change, altered database schema, revised eligibility rule, or gradual infrastructural threshold may reorganize access and behavior across a large system. Event analysis therefore requires attention to causal consequences as well as to representation.

Events can also emerge without a single author. A financial panic, collective shift in expectations, congestion cascade, labor shortage, reputational collapse, or technological convention may become event-like through distributed interactions. The event is then generated by a relational configuration whose participants may possess only partial knowledge of the overall process. This distributed generation is compatible with the relational-reality criterion because causal efficacy can be system-level even when no actor intends or fully represents the resulting reconfiguration.

Remark 4.132 (Event and manifestation). A relational event can precede its explicit recognition, while a manifested occurrence can acquire additional event-like consequences through the responses its manifestation generates. Eventhood and manifes-

tation therefore interact recursively without being identical.

Remark 4.132 extends the graph architecture developed earlier in the chapter. A threshold crossing may reorganize a system before subjects recognize it. Later measurement, naming, announcement, or narration can then become a second source of causal change. The event's relational reality and its manifestational history should therefore be reconstructed separately when both matter.

4.15.3 Stability within Becoming

The concept of becoming names the continuing production of difference through time. GR uses the term cautiously. It does not require a metaphysical doctrine in which process is declared more fundamental than entity, nor does it imply that every configuration changes at the same rate or in the same manner. Becoming identifies the analytical fact that generative-relational systems can produce new states, relations, capacities, constraints, meanings, manifestations, and objects through their histories. Stability must therefore be understood within this ongoing production of difference.

A stable relational reality is often maintained through active reproduction. Money remains effective because infrastructures settle payments, institutions enforce claims, subjects continue to price and transact, records are maintained, and expectations are reproduced. An organization remains continuous because roles are reassigned, records updated, resources replenished, decisions implemented, and membership boundaries reproduced. Trust can persist because interaction repeatedly confirms or repairs expectations. Stability is therefore frequently achieved through work, adjustment, feedback, repair, and renewal.

This point motivates a distinction between static and dynamic stability. Static stability would describe limited change around a configuration under specified conditions. Dynamic stability describes persistence of organization through continuing transformation. The distinction is analytical; many systems exhibit mixtures of both. A legal rule may remain textually unchanged while its interpretation evolves. A platform may continually update software while preserving a recognizable participation architecture. A household may maintain a pattern of care through changing tasks, needs, and members. The relevant form of stability depends on what must remain sufficiently organized for causal continuity to persist.

Claim 4.133 (Stability within becoming). *Stability in a generative-relational system can consist in the continued reproduction of an organized relational pattern through change. Persistence therefore remains compatible with becoming when the transformations themselves sustain sufficient continuity of structure, constraint, capacity, or causal orientation.*

Claim 4.133 prevents a false choice between stable reality and historical transformation. The same relational reality can be persistent and continually reproduced. At the same time, reproduction is never guaranteed. Small modifications can accumulate, external conditions can change, internal contradictions can intensify, new relations can enter the system, and earlier stabilizing mechanisms can lose efficacy. Dynamic stability can therefore weaken, recover, or pass into transformation.

The temporal extent of stability also matters. A configuration can be stable over a short interval and unstable over a longer one. A speculative price regime may persist long enough to organize investment decisions even if it later collapses. An emergency institution can be relationally real during a crisis despite its intended temporariness.

A temporary identity category can shape access and conduct while it remains institutionally operative. Relational reality therefore does not require indefinite duration. It requires sufficient persistence relative to the causal processes under analysis.

Becoming also complicates identity. If a relational reality changes continuously, the question of whether it remains the same object cannot always be answered by a single invariant criterion. Legal continuity, organizational continuity, functional continuity, experiential continuity, material continuity, and historical continuity may diverge. GR therefore treats identity through change as an inquiry-relative reconstruction. The analyst should specify which continuities matter to the question and which transformations count as preserving or ending the object under study.

This approach is especially relevant to subjectivity. The continuing experience of “I” can be relationally real even though embodiment, memory, social position, commitments, and self-description change. Its reality need not depend on an immutable ontological core. At the same time, ontological suspension prevents the relational account from proving that no such core exists. GR can therefore analyze continuity of self through changing relations while leaving stronger metaphysical conclusions open.

4.15.4 Relational Transformation

Relational transformation occurs when change modifies the organization through which a relational reality is generated, stabilized, or made causally effective. The concept therefore concerns more than variation in the values of fixed variables. A relation may change in strength, direction, meaning, institutional form, temporal ordering, or scale; relations among relations may be reorganized; new relata may enter; earlier ones may disappear; and the mechanisms through which manifestations feed back into the system may themselves change.

Definition 4.134 (Relational transformation). *Relational transformation* denotes a historically situated change in the organization of a generative-relational system that modifies the conditions through which relational realities emerge, persist, interact, manifest, or exercise causal efficacy.

Definition 4.134 distinguishes transformation from ordinary state change. A price change within an otherwise stable market arrangement may alter a state without transforming the relational architecture. A change in settlement rules, ownership structure, access rights, information infrastructure, or category system can transform the relations through which prices are generated and acted upon. The distinction remains scale-dependent, but it directs attention toward changes in generative conditions rather than toward magnitude alone.

Relational transformation can be cumulative. Repeated small changes can modify expectations, routines, infrastructures, and classifications until a system operates under materially different generative conditions. The absence of a single dramatic event does not preclude transformation. Gradual digitization of payment systems, for example, can change the relations among money, identity, privacy, institutions, and access through accumulated infrastructural revisions. Similarly, gradual adoption of algorithmic evaluation can reorganize employment, credit, insurance, education, or welfare relations even when no single deployment constitutes the entire transformation.

Transformation can also be path-dependent. Earlier relations shape which later

changes are feasible, costly, intelligible, or institutionally legitimate. Historical residues can remain operative after the representations associated with them disappear. Infrastructures, legal precedents, accumulated skills, property distributions, organizational routines, and categories can constrain later possibilities. The transformed system therefore carries aspects of its history into new configurations even when its manifestational vocabulary changes substantially.

The recursive architecture of Sections 4.10 and 4.11 becomes especially important here. Representations can become mechanisms of transformation when classifications, measurements, models, narratives, or interfaces alter behavior and institutional response. A newly introduced performance score can reorganize organizational incentives; a legal category can create new rights and duties; a public risk classification can alter investment; an economic indicator can change policy behavior. Once such representations become causally embedded, transformation occurs partly through manifestational mediation.

Relational transformation can also dissolve relational realities. A currency can lose the relations that sustain its practical efficacy. A legal office can be abolished. A social norm can weaken until it ceases to organize conduct. A trust relation can collapse. Dissolution does not imply that the earlier reality was illusory. A relational reality can have been historically real, causally consequential, and later absent. The ontology developed here is therefore temporally indexed: reality within a generative-relational system can emerge, persist, transform, and cease.

Remark 4.135 (Historical reality and dissolution). The later disappearance of a relational reality does not retroactively remove its earlier causal reality. Historical existence and present persistence are distinct questions.

This remark matters for economic history and institutional analysis. Defunct currencies, dissolved corporations, abolished legal statuses, vanished markets, and obsolete technologies can remain causally significant through accumulated effects, inherited infrastructures, debts, memories, distributions, and institutional residues. Their present relational reality may have ended while consequences generated during their persistence continue to structure later systems.

4.15.5 Emergence of New Ontological Categories

Relational transformation can eventually strain the categories through which an inquiry describes what exists. Existing categories may continue to capture some features of a changing system while becoming inadequate for others. New kinds of institutional object, operational subject, property relation, value form, technical agency, or manifestation can arise through combinations of relations that earlier classifications did not anticipate. The emergence of such objects creates an ontological problem for analysis: the investigator must decide whether an existing category can be extended, whether several categories should be distinguished, or whether a new category is warranted.

The phrase *new ontological category* is used here with ontological restraint. It does not mean that the analyst has discovered a new fundamental constituent of reality. It means that the system presents a sufficiently stable and causally consequential form whose existing analytical classification is inadequate for the inquiry. Category formation is therefore a response to emergent reality under specified evidential and methodological conditions. The category can later be revised, divided, merged, or

abandoned as the object and the inquiry develop.

Definition 4.136 (Emergent ontological category). An *emergent ontological category* is an analytically warranted category introduced when a historically generated configuration displays sufficiently distinctive persistence, organization, causal capacities, or modes of manifestation that the categories previously available to the inquiry no longer provide an adequate account of the relevant reality.

Definition 4.136 links ontology to historical inquiry without reducing reality to naming. The category is analytically introduced, but the warrant for introducing it is constrained by the properties and effects of the configuration being studied. A new term alone does not create a new ontological category. Conversely, a novel relational reality may begin to operate before a vocabulary for it exists. This preserves the distinction between relational reality and symbolization established earlier in the chapter.

Contemporary artificial systems offer one illustration. The emergence of systems capable of sustained interaction, autonomous-seeming task execution, representation, coordination, and intervention can strain categories built around tools, agents, organizations, and human subjects. GRE need not settle this difficulty by declaring such systems persons or by reducing them to ordinary instruments. Section 4.12 introduced artificial operational subjecthood precisely as a differentiated analytical category whose scope is narrower than human subjecthood. The category becomes useful when it tracks stable capacities and causal roles that existing descriptions obscure, while ontological and normative questions beyond that scope remain suspended.

Economic institutions can generate similar categorical pressure. Digital assets, platform-mediated labor relations, algorithmically administered claims, hybrid public-private infrastructures, and machine-mediated forms of coordination can combine properties previously distributed across several categories. Whether they warrant genuinely new analytical categories depends on the structure of the inquiry. GRE therefore treats category formation as a disciplined response to emergent configurations rather than as conceptual novelty for its own sake.

The same discipline applies to historical categories. A category that once tracked a stable relational reality can lose adequacy as the system changes. Retaining the old name may conceal transformation if its referent has acquired substantially different generative conditions and causal capacities. Conversely, rapid renaming can exaggerate novelty where relational continuity remains strong. Category revision therefore requires comparison of historical organization, persistence, causal efficacy, manifestation, and transformation rather than lexical difference alone.

Claim 4.137 (Category emergence under ontological suspension). *The emergence of a new analytical ontological category can be warranted by historically generated differences in organization and causal efficacy without requiring a claim that the category identifies a new fundamental kind of being.*

Claim 4.137 connects the present section back to ontological suspension. GR can revise what it counts as an object, process, event, subject, institution, or form of value when reality under inquiry changes or when earlier descriptions prove inadequate. This flexibility is compatible with ontological seriousness because revision responds to evidence about persistence, difference, causal efficacy, and generative structure. It is also compatible with metaphysical restraint because local analytical differentiation does not automatically become a universal ontology.

Process, event, becoming, transformation, and category emergence therefore provide a temporal extension of the chapter's three-register architecture. Relational realities can persist through organized change; events can redirect trajectories before or after they become manifest; manifestations and representations can become causal components of transformation; and new configurations can eventually require revised categories of analysis. Stability and becoming are thus mutually informative rather than mutually exclusive. The result prepares the transition to Section 105, which introduces a category-theoretic view as one possible formal language for describing objects, morphisms, mappings, and equivalences across relational and manifestational domains while preserving the ontological restraint established throughout the chapter.

4.16 A Category-Theoretic View

The preceding sections have developed an ontology in which relational realities emerge, persist, manifest, become represented, and transform through historically structured systems. The role of the present section is to introduce category theory as one possible formal language for describing selected aspects of this architecture. Its objective is not to claim that relational reality is fundamentally categorical. Rather, category-theoretic language can help distinguish objects from mappings, preserve compositional structure, compare different descriptive domains, and make explicit when two paths of mediation are treated as equivalent or when they remain distinct. The section proceeds from objects and morphisms to categories of relational and manifestational reality, then considers functorial manifestation, loss and excess of information, equivalence, symbolic mediation, changing manifestation rules, multiple realization, and diagrammatic path dependence. Throughout, the formal vocabulary is treated as a methodological expedient whose appropriateness depends on whether the relations under study actually support the compositional assumptions imposed by the model.

Category theory is attractive for GR partly because it directs attention away from intrinsic properties alone and toward relations, mappings, transformations, and preservation across descriptions. Yet this attraction requires restraint. A category is a mathematically specified structure with objects, morphisms, identity morphisms, and associative composition. A generative-relational system need not present itself in this form without analytical construction. The investigator must decide what counts as an object, which transformations count as morphisms, when two morphisms are composable, and what form of equality or equivalence is appropriate. These decisions can illuminate structure, but they also select and compress reality. Category-theoretic analysis therefore belongs within the chapter's broader principle of open ontological commitment: it can support rigorous local claims without acquiring metaphysical authority beyond the structures it successfully represents. (Mac Lane 1998; Awodey 2010)

Definition 4.138 (Category-theoretic representation). A *category-theoretic representation* of a generative-relational domain is an analytically constructed category whose objects and morphisms represent selected configurations and admissible relations or transformations in that domain, with identity and composition specified in a manner appropriate to the inquiry.

Definition 4.138 emphasizes representation rather than identity. The category is a model of selected structure. It can preserve relations that matter to the inquiry while leaving other features unrepresented. This makes category theory especially useful for the three-register architecture, where the same object can be described within different domains and where manifestation, representation, and transformation often involve mappings between domains rather than a single common metric space.

4.16.1 Objects, Morphisms, and Relational Description

A category consists, minimally, of objects and morphisms between them. For objects A , B , and C , morphisms can be written

$$f : A \rightarrow B, \quad g : B \rightarrow C, \quad (4.7)$$

Equation 4.7 introduces the basic source–target notation used in this section. A composite $g \circ f : A \rightarrow C$ is defined when the codomain of f matches the domain of g . Each object has an identity morphism, and composition is associative wherever it is defined. These requirements are simple, but their interpretation in a generative-relational analysis is not automatic.

An object can represent a stabilized relational configuration, an institutional state, a manifestation, a symbolic representation, a process considered at a selected scale, or another analytically bounded unit. A morphism can represent a transformation, translation, admissible relation, institutional operation, manifestation process, or structure-preserving map. The same empirical material can support more than one categorical representation because the choice of object and morphism depends on the analytical question.

For example, firms can be represented as objects and contractual transformations as morphisms in one model. In another model, contractual arrangements themselves can become objects, while legal or organizational transformations act as morphisms among them. A third representation can treat manifestations of those firms—financial reports, registrations, ratings, or platform profiles—as objects within a manifestational category. Category theory therefore does not decide in advance what the economically relevant object is. It disciplines relations among whatever objects the inquiry has justified selecting.

Remark 4.139 (Object selection). Categorical objecthood is an analytical role, not a declaration of fundamental ontological objecthood. The same relational reality can occupy different formal roles under different resolutions and research questions.

This point matters because objectification can conceal internal structure. Treating an organization as a single categorical object may be useful for studying interorganizational transformations while suppressing internal power relations, departments, subjects, and material infrastructures. Treating those internal elements as separate objects can recover some of that structure but may suppress other scales. The categorical model therefore inherits the boundary and scale problems already identified in GRE. Formal clarity does not remove the need to justify what has been made visible and what has been compressed.

4.16.2 Relations as Morphisms and Relations among Relations

The language of morphisms is naturally attractive to a relational framework, but GR should resist a simple identification between every relation and every morphism. In an ordinary category, morphisms possess specified domains and codomains and participate in associative composition. Many empirical relations are symmetric, partial, probabilistic, context-sensitive, historically contingent, or difficult to compose. Some can nevertheless be represented categorically by choosing an appropriate category; binary relations, for example, can themselves be treated as morphisms in a category whose composition is relational composition. In other cases, transformations rather than relations in the broad GR sense provide the more suitable morphisms.

The useful methodological question is therefore whether a selected relational domain supports a compositional representation. When it does, composition can expose how relations among relations generate higher-order consequences. If $f : A \rightarrow B$ and $g : B \rightarrow C$ represent two admissible transformations, then $g \circ f$ represents the result of applying them in sequence. The composite can be analytically important even when neither transformation alone determines the final configuration. Contract formation followed by registration, classification followed by allocation, or measurement followed by administrative decision can all be represented through composition when the domain and codomain assumptions are justified.

Relations among relations can also require higher-order structures. A change in the rule by which one morphism is interpreted, a comparison between two mappings, or an intervention on a manifestation rule is not simply another relation among the original objects. Category theory offers several ways to represent such higher-order structure, including functors and natural transformations. GR need not adopt the most elaborate formalism by default. The important insight is that the relation connecting two objects and the transformation of that relation belong to distinguishable analytical levels.

Claim 4.140 (Compositional warrant). *A categorical representation of a relational domain is warranted only to the extent that the selected objects, morphisms, identities, and compositions preserve structures relevant to the inquiry. Formal composability should not be inferred merely from the presence of empirical relations.*

This claim protects the method against decorative formalization. A category-theoretic diagram becomes informative when its compositions correspond to meaningful sequences or transformations in the domain. Where composition is ambiguous, history-dependent, or only partially defined, the model should represent that limitation rather than assume away the problem.

4.16.3 Categories of Relational Reality

The strict criterion of relational reality developed in Section 4.5 can be combined with category-theoretic representation without identifying the two. Let a category $\mathcal{R}$ represent a selected domain of relational realities. Its objects can stand for relational configurations that satisfy the relevant persistence, stability, and causal-efficacy conditions at the scale of inquiry. Its morphisms can represent transformations, admissible relations, or structure-preserving changes among those configurations.

The resulting category does not contain relational reality in its entirety. It contains only those distinctions that the model has made categorical. A monetary relation,

institution, trust relation, self-model, or organization can possess internal histories and causal structures that are absent from the chosen object. The category becomes analytically useful when the omitted features are not required for the question being asked or when they are represented at another level.

A category of relational reality can also be local. Different subsystems can support different object types and transformation rules. A category appropriate to legal relations need not be identical to one used for technological systems, subjective continuity, or financial networks. The possibility of relating these categories through functors can be more informative than forcing all of them into a common metric or a single universal object space.

Definition 4.141 (Relational category). A *relational category* is a category constructed for an inquiry in which objects represent selected relationally real configurations and morphisms represent admissible relations or transformations whose composition preserves structures relevant to that inquiry.

The definition deliberately leaves open what counts as preservation. In one study, preservation can concern legal validity; in another, organizational continuity, causal accessibility, information flow, contractual structure, or some other relation. The category gains explanatory value from the explicitness of these choices rather than from conformity to a single ontology.

4.16.4 Categories of Manifestational Reality

Manifestational reality admits a parallel but distinct categorical treatment. Let $\mathcal{M}$ denote a category whose objects represent manifestations available under a specified manifestational regime and whose morphisms represent admissible transformations, translations, comparisons, or transitions among those manifestations. The objects of $\mathcal{M}$ can include observations, measurements, classifications, reports, symbolic forms, perceptual states, institutional records, or other manifestations selected by the inquiry.

A manifestational category is not merely a category of representations. Section 4.6 distinguished manifestation from symbolization, and Section 4.10 distinguished symbolic representation from manifestational reality more broadly. A bodily response, an observed pattern, a measurement trace, a legal inscription, and a linguistic description can therefore belong to different manifestational subdomains while all remaining manifestations in the broader GR sense.

The categorical distinction between $\mathcal{R}$ and $\mathcal{M}$ provides a disciplined way to express a point developed throughout the chapter: relational and manifestational realities need not share the same objects or the same structure. A relational configuration can support multiple manifestations, and several relational configurations can become manifest in indistinguishable ways under a limited regime. Instead of treating these mismatches as defects in a single space, category-theoretic analysis can represent them as properties of mappings between distinct categories.

Remark 4.142 (Heterogeneous domains). The usefulness of separate relational and manifestational categories lies partly in permitting heterogeneity. A mapping between domains can be studied without presuming that the domains share a common metric, coordinate system, or ontology.

This is especially important for the non-necessary comparability of relational reali-

ties. Two relationally real objects can belong to categories whose internal morphisms, equivalences, and invariants differ substantially. Comparison then requires an explicit functor, correspondence, or other mapping rather than an assumed common scale.

4.16.5 Manifestation through Functorial Mapping

A functor provides one formal model of manifestation across categorical domains. Suppose $\mathcal{R}$ is a relational category and $\mathcal{M}$ a manifestational category. A functor

$$F : \mathcal{R} \longrightarrow \mathcal{M} \quad (4.8)$$

Equation 4.8 names the functor that will serve as the local manifestation model. It assigns each modeled object A in $\mathcal{R}$ an object $F(A)$ in $\mathcal{M}$ and each modeled morphism $f : A \rightarrow B$ a morphism $F(f) : F(A) \rightarrow F(B)$ while preserving identity morphisms and composition.

The preservation of composition is the substantive assumption. If a relational transformation f followed by g is represented by $g \circ f$, functoriality requires the manifestation of that composition to agree with the corresponding composition of manifested morphisms:

$$F(g \circ f) = F(g) \circ F(f). \quad (4.9)$$

Equation 4.9 can be analytically powerful because it identifies a condition under which relational composition is preserved through manifestation. It can also fail. A manifestational regime may erase sequence, reorder operations, introduce threshold effects, or depend on contextual information absent from the source category. Functoriality should therefore be treated as a model property to be investigated rather than a universal fact about manifestation.

Definition 4.143 (Functorial manifestation). *Functorial manifestation* is a model of manifestation in which selected relational objects and morphisms are mapped into a manifestational category while identities and relevant compositional structure are preserved.

This definition does not require manifestation in general to be functorial. It identifies a useful special case. Administrative systems often aspire to such preservation: a legally valid sequence of operations is expected to produce a corresponding sequence of records; an accounting transformation is expected to be reflected in a consistent ledger transformation; a data pipeline is expected to preserve specified relations among inputs and outputs. Failures of preservation can then become analytically visible as breaks between relational process and manifestation.

4.16.6 Non-Faithful Manifestation and Loss of Relational Information

A functor is faithful when it maps distinct morphisms between the same pair of source objects to distinct morphisms in the target. Non-faithfulness therefore provides one precise formal model of relational distinctions that become indistinguishable in manifestation. Suppose $f, g : A \rightarrow B$ are distinct morphisms in $\mathcal{R}$ but

$$F(f) = F(g). \quad (4.10)$$

Equation 4.10 states the relevant collapse: the manifestational category fails, under this model, to preserve the distinction between the two relational transformations.

This formal structure corresponds closely to the relational remainder developed in Section 4.9. Different causal histories, institutional pathways, or social relations can produce the same recorded outcome. Two workers can receive the same wage through substantially different relations of bargaining power and security. Two firms can receive the same credit classification despite different dependency structures. Two subjects can produce the same interface response while differing in histories, capacities, or internal organization. In each case, a manifestational system can preserve an outcome while collapsing distinctions among the morphisms that generated it.

Claim 4.144 (Non-faithfulness and relational loss). *When a manifestation functor is non-faithful, distinct modeled relational transformations can become manifestationally indistinguishable. The resulting loss of distinction concerns the selected manifestation regime and does not imply that the source transformations were relationally identical.*

Faithfulness is only one form of information preservation. A functor can distinguish morphisms while still mapping distinct objects to the same object, depending on the category and model. Conversely, object-level differences can remain visible while important internal relations are lost. GR therefore uses faithfulness as a precise local concept rather than as a complete measure of manifestational adequacy.

The category-theoretic language also clarifies why improving measurement can require more than adding variables. If a regime systematically identifies distinct relational pathways, richer data may leave the collapse intact unless the mapping itself is redesigned. The epistemic problem can therefore reside in the structure of manifestation rather than only in the quantity of manifested information.

4.16.7 Non-Full Manifestation and Unmanifested Relational Possibilities

Fullness requires a different interpretation. A functor $F : \mathcal{R} \rightarrow \mathcal{M}$ is full when every morphism in $\mathcal{M}$ between $F(A)$ and $F(B)$ is the image of at least one morphism in $\mathcal{R}$ between A and B . A non-full functor therefore indicates that the target category contains morphisms between manifested objects that are not induced by morphisms represented in the source category.

This point should be distinguished carefully from an *unmanifested source possibility*. In a strict functor, every source morphism receives an image. Non-fullness therefore does not, by itself, mean that a relational morphism exists but fails to manifest. Rather, it means that the manifestational domain admits transformations or relations that are not accounted for by the modeled source relations. These can arise from measurement procedures, symbolic recombination, institutional processing, artifacts, interpretive operations, or relations introduced by the manifestation system itself.

To represent relational possibilities that are not manifested at all, the model must be modified. One option is to define the manifestation functor only on a subcategory $\mathcal{R}_{\text{vis}} \subseteq \mathcal{R}$ of relational configurations and morphisms that are accessible under the relevant regime. Relational possibilities in $\mathcal{R}$ outside that subcategory remain unmanifested relative to the regime. Another option is to use a partial, lax, stochastic, or

correspondence-based structure where strict functorial assignment is inappropriate.

Remark 4.145 (Fullness and invisibility). Non-fullness and relational invisibility are different structural problems. Non-fullness concerns target morphisms lacking source antecedents in the model; unmanifested relational possibilities concern source structure excluded from, undefined under, or inaccessible to the manifestation mapping.

This distinction is methodologically useful because the two problems call for different interventions. If relevant source relations are invisible, the manifestational regime may require expanded access or a different mapping. If the target generates relations not grounded in the source model, the analyst must study the generative contribution of measurement, classification, symbolic processing, or institutional mediation itself. In GR terms, manifestation can add structure rather than merely transmit it.

4.16.8 Isomorphism, Equivalence, and Manifestational Indistinguishability

Category theory offers several notions of sameness, and GR benefits from keeping them distinct. Two objects A and B in a category are isomorphic when there are morphisms between them whose compositions yield the respective identity morphisms. Isomorphism therefore captures sameness of categorical structure relative to the category, not numerical identity. Two categories can be equivalent even when they are not isomorphic as categories, provided they preserve the relevant structure up to natural isomorphism.

Manifestational indistinguishability is weaker. Section 4.9 defined manifestational equivalence locally to a regime. In categorical terms, two relational objects can satisfy $F(A) = F(B)$ or otherwise become isomorphic or observationally equivalent in $\mathcal{M}$ without being isomorphic in $\mathcal{R}$. Likewise, two source categories can generate equivalent manifestations while differing in relational organization.

Claim 4.146 (Manifestational equivalence is not relational isomorphism). *Equivalence or isomorphism in a manifestational category does not, without additional assumptions on the manifestation mapping, establish isomorphism, equivalence, or identity in the relational category.*

The additional assumptions can be strong. A fully faithful functor preserves and reflects important morphism structure between modeled objects, but even full faithfulness does not automatically settle every ontological question outside the representation. GR therefore treats categorical equivalence as always relative to a selected formal domain.

This discipline is particularly important for economic equivalence. Equal price, equal legal category, equal score, equal statistical profile, or equal platform status can create manifestational equivalence under a practical regime. Such equivalence can have real effects because actors and institutions respond to it. Yet the equality need not erase differences in histories, dependencies, capacities, vulnerabilities, or generative conditions. Category theory provides precise language for separating equivalence under a mapping from identity of what is mapped.

4.16.9 Functors between Symbolic and Relational Descriptions

Symbolic regimes can also be modeled categorically. Let $\mathcal{S}$ denote a category of selected symbolic objects and transformations: classifications, legal codes, identifiers, prices, scores, textual descriptions, or other symbolic forms. An encoding or representation functor can map selected relational configurations into $\mathcal{S}$, while an interpretation or institutional enactment mapping can connect symbolic objects back to relational consequences.

The two directions should not be assumed to be inverses. A symbolic representation can compress several relational realities into one category, and an interpreted symbol can generate relations that were not present before the symbolization. A credit score, legal status, diagnostic category, occupational code, or monetary denomination can therefore be both a representation of prior relations and a causal input into later relations. The categorical picture is consequently recursive rather than merely representational.

One can schematically distinguish a relational category $\mathcal{R}$, symbolic category $\mathcal{S}$, and later relational category $\mathcal{R}'$ with mappings

$$\mathcal{R} \xrightarrow{E} \mathcal{S} \xrightarrow{I} \mathcal{R}', \quad (4.11)$$

Equation 4.11 separates the two mappings explicitly: E represents a selected encoding or symbolization and I represents the institutional, interpretive, or practical mediation through which symbols enter later relations. The notation does not imply that $\mathcal{R}'$ is determined by symbols alone. Other histories, material conditions, subjects, and constraints can contribute to its generation.

The value of the categorical representation lies in its ability to make preservation questions explicit. Which distinctions survive E ? Which symbolic morphisms become causally operative under I ? Which compositions commute, and which depend on the order or path of mediation? These are empirical and theoretical questions, not consequences of the notation itself.

4.16.10 Natural Transformations and Changing Manifestation Rules

The chapter has repeatedly emphasized that manifestation mappings can change historically. Category theory offers a formal language for comparing two functors that map the same source category into the same target category. If $F, G : \mathcal{R} \rightarrow \mathcal{M}$ represent two manifestation regimes, a natural transformation $\eta : F \Rightarrow G$ assigns to each source object A a morphism

$$\eta_A : F(A) \rightarrow G(A) \quad (4.12)$$

in a way compatible with the morphisms of $\mathcal{R}$. Equation 4.12 therefore represents the objectwise component of a change between two manifestation regimes rather than an isolated conversion.

In applications, F and G can represent different measurement systems, classification regimes, institutional reporting rules, interfaces, or symbolic conventions. The components η_A then represent transformations between the manifestations produced under the two regimes. Naturality is a strong structural condition: it requires these transformations to cohere with the modeled relations among source objects rather

than being arbitrary object-by-object conversions.

Definition 4.147 (Coherent change of manifestation regime). *A coherent change of manifestation regime is a model in which two manifestation functors are connected by transformations that preserve the relational compatibility conditions represented by a natural transformation.*

Not every historical change satisfies this condition. A new accounting standard, legal classification, algorithmic interface, or statistical methodology can reorganize categories so substantially that no natural transformation between old and new regimes provides an adequate model. The failure of naturality can itself be informative: it signals that translation between regimes depends on path, context, exception, or reinterpretation not captured by a uniform structural mapping.

This makes natural transformations useful for analyzing comparability over time. A time series constructed under changing measurement systems may appear continuous while the transformation between regimes fails to preserve the relevant relational structure. Conversely, a carefully calibrated change can preserve enough structure to support meaningful historical comparison. Category theory therefore turns the vague question of whether two regimes are “comparable” into a more explicit inquiry about what transformations preserve which relations.

4.16.11 Multiple Realization and Functorial Equivalence

Multiple realization describes situations in which different underlying relational configurations realize the same or sufficiently equivalent higher-level organization, function, or manifestation. The three-register framework already permits this possibility because manifestational equivalence does not imply relational identity. Category theory offers several ways to formalize the relation without collapsing the realizing systems into one object.

Distinct objects A and B in $\mathcal{R}$ can be mapped to the same manifestational object or to isomorphic objects in $\mathcal{M}$. More strongly, distinct subcategories of relational realization can be mapped into equivalent manifestational structures. This can model cases in which different technologies, organizational arrangements, biological substrates, cultural practices, or computational architectures support similar manifested capacities.

Multiple realization should be distinguished from arbitrary substitution. Two realizations count as equivalent only relative to specified functions, relations, or manifestations. A payment service implemented through different technical infrastructures can appear equivalent to users for a selected transaction set while differing in resilience, surveillance, governance, energy use, or legal dependency. An artificial system and a human subject can produce locally equivalent outputs while differing profoundly in relational histories and forms of subjecthood. The relevant equivalence therefore belongs to the specified category and mapping, not to the entities without qualification.

Claim 4.148 (Locality of functorial equivalence). *Functorial equivalence among realizations is always relative to the categories, morphisms, and invariants selected by the inquiry. It does not entail equivalence with respect to omitted relational, causal, normative, experiential, or ontological structure.*

This claim preserves the book’s resistance to premature equivalence. A formal

equivalence can be powerful precisely because its scope is explicit. It identifies what is preserved while leaving open what differs.

4.16.12 Commutative and Non-Commutative Diagrams of Representation

One of category theory's most useful habits is to ask whether different compositional paths yield the same result. A commutative diagram represents paths whose composite morphisms are equal within the model. In a representation problem, commutativity can express consistency between direct and mediated descriptions. If a relational configuration can be manifested directly or first symbolized and then translated into a manifestation, commutativity states that the two modeled paths agree.

Such agreement should not be presumed. Economic and institutional systems are often path-dependent. Classification before valuation can yield a different result from valuation before classification. Legal recognition followed by market participation can generate different relations from market participation followed by later recognition. A symbolic description produced before an intervention can affect the intervention itself, while a description produced afterward has a different causal role. In these cases the relevant diagram is non-commutative: the order and path of mediation matter.

Definition 4.149 (Representational path dependence). *Representational path dependence* occurs when two admissible compositional paths connecting corresponding source and target configurations produce distinguishable outcomes within the modeled domain.

Non-commutativity is particularly important for the recursive architecture of Section 4.11. Once a manifestation or representation becomes causally operative, changing the order of manifestation, classification, recognition, or intervention can change the later relational configuration. Diagrammatic non-commutativity therefore provides one formal language for historical mediation.

At the same time, commutativity can be a normative or engineering objective rather than an empirical fact. An administrative system can be designed so that equivalent procedural paths yield equivalent outcomes; an accounting architecture can seek consistency across transformations; a legal procedure can attempt to preserve rights across different channels. The diagram then encodes a desired invariant whose empirical realization must be tested.

4.16.13 Limits of the Category-Theoretic View

Category theory provides a powerful language of structure, composition, equivalence, and translation, but its usefulness within GR has identifiable limits. First, categorical analysis depends on prior choices of objects and morphisms. These choices can clarify a domain while reifying boundaries that remain contested or historically variable. A category can therefore be internally rigorous and still poorly matched to the relational reality it is intended to represent.

Second, ordinary categories encode composition abstractly but do not automatically represent probability, intensity, duration, geometry, uncertainty, power, cost, or causal strength. Such information can be added through enriched, probabilistic, met-

ric, higher-order, or other categorical structures, but the additional formalism must earn its relevance. GRE should not escalate mathematical complexity merely because a richer category can be defined.

Third, some generative relations admit composition only partially, depend on context, or are themselves transformed through composition. Historical sequence can change the meaning of later operations; institutional exceptions can defeat uniform mapping; stochastic processes can make a single deterministic morphism inappropriate. In these settings, strict categories and strict functors may be approximations. Partial categories, correspondences, profunctors, lax structures, higher categories, or non-categorical models may provide better representations, but no formal family receives automatic priority.

Fourth, categorical equivalence can preserve structure while leaving material, experiential, historical, and normative differences outside the model. A fully faithful representation of selected relations can still omit who bears risk, whose experience is recognized, what resources are consumed, or which histories made the structure possible. Formal invariance therefore does not substitute for substantive economic inquiry.

Remark 4.150 (Methodological status of category theory). Within GR and GRE, category theory is best treated as a language for disciplined structural comparison and composition. Its successful application establishes properties of the represented domain under specified modeling assumptions; it does not by itself establish that reality is fundamentally categorical.

The category-theoretic view nevertheless contributes something distinctive to the chapter. It allows relational and manifestational domains to remain heterogeneous while still being connected through explicit mappings. It distinguishes loss of relational distinctions from excess structure introduced by manifestation. It separates isomorphism, equivalence, and manifestational indistinguishability. It provides a formal language for coherent changes of mapping rules, multiple realization, and path-dependent representation. Most importantly, it makes visible the conditions under which a comparison preserves structure and the points at which such preservation fails.

These contributions prepare the move to Section 106. Category theory can relate heterogeneous domains without requiring a shared metric, but it does not eliminate differences of scale or the possibility that similar higher-level realities are realized through different lower-level configurations. Scale-relative reality and multiple realization therefore require separate treatment. The categorical language developed here will remain available as one analytical resource while the next section returns to the ontological problem itself: how reality can be stable and causally efficacious at one scale while being differently constituted at another.

4.17 Scale-Relative Reality and Multiple Realization

The preceding section introduced category theory as one formal language for relating heterogeneous domains without requiring a common metric or an identity of underlying structure. The role of the present section is to address a more general ontological problem that remains even when no categorical formalism is used: the same generative-relational system can present different relatively stable objects, relations,

processes, and functions at different scales, and similar higher-level functions can be realized through heterogeneous lower-level configurations. The objective is to clarify how GR can speak of scale-relative reality without making reality arbitrary, and how it can recognize multiple realization without treating functional similarity as ontological identity. The section proceeds through scale-relative entityhood, scale-relative relationality, multiple realization of similar functions, heterogeneous realization, and cross-scale reality. Throughout, scale is treated as an analytically specified resolution constrained by the organization and causal structure of the system, rather than as a freely chosen perspective detached from what the system can sustain.

Scale enters GR in several forms. It can be spatial, temporal, organizational, institutional, functional, informational, or relational. A household can be treated as an economic subject at one organizational scale while being analyzed as a changing set of interpersonal, legal, affective, material, and monetary relations at another. A firm can appear as a single contracting entity in one model and as a distributed process of governance, routines, assets, labor, software, infrastructures, and expectations in another. A price can be treated as a scalar variable at one analytical resolution while another inquiry reconstructs the market-making, institutional, informational, and symbolic relations through which that price becomes possible. None of these descriptions is automatically more real because it is finer grained. The relevant question is which organization persists and exerts causal efficacy at the scale required by the inquiry. (P. W. Anderson 1972; Bar-Yam 2004; Simon 1962)

This position differs from a simple micro–macro hierarchy. A scale is not defined only by size, and a finer resolution does not necessarily reveal a privileged ontological base. A legal status can operate at an institutional scale that is not reducible to physical size; a norm can persist across many material realizations; a computational function can be implemented through architectures with different internal organizations; and a subject can occupy several overlapping relational scales simultaneously. Scale-relative analysis therefore concerns the resolution at which organization, persistence, constraint, and causal efficacy become analytically distinguishable.

Definition 4.151 (Analytical scale). An *analytical scale* is a specified resolution of a generative-relational system at which selected entities, relations, processes, boundaries, and causal differences are treated as distinguishable for the purposes of an inquiry.

Definition 4.151 makes scale an explicit component of representation. It does not imply that the analyst creates the relevant reality by choosing a scale. The chosen resolution must remain answerable to the system. If a purported object fails to persist, stabilize, or exercise causal efficacy at the selected resolution, treating it as a relationally real entity becomes difficult to justify. Conversely, a configuration can be relationally real even when a finer-grained description reveals continual replacement, turnover, or transformation among its constituents.

4.17.1 Scale-Relative Entityhood

Entityhood in GR is therefore often scale-relative. A configuration can function as an entity when enough of its organization is stabilized to support identification, interaction, and causal participation at a selected resolution. This entityhood does not require that the configuration be simple, internally homogeneous, or materially indivisible. It requires that treating it as a unit preserve causal and relational differences

relevant to the inquiry.

Definition 4.152 (Scale-relative entityhood). *Scale-relative entityhood* denotes the status of a configuration that exhibits sufficient persistence, stability, boundary coherence, and causal efficacy to be treated as a distinguishable relational object at a specified analytical scale, even when finer or alternative scales reveal it as internally heterogeneous, processual, or distributed.

A corporation illustrates the point. At one scale it can enter contracts, own assets, incur liabilities, employ workers, issue securities, and survive changes in membership. At another scale it is constituted through legal rules, governance procedures, organizational routines, technologies, buildings, documents, labor, interpersonal relations, and expectations. The higher-level entity does not disappear because its lower-level realization is heterogeneous. At the same time, the lower-level relations cannot be inferred exhaustively from the fact that the corporation persists as a legal and economic entity. Scale-relative entityhood therefore preserves both the causal reality of the higher-level object and the incompleteness of any single-scale description.

The same pattern appears in money. A unit of account can be analyzed as a stabilized relational object within a monetary system, while its realization depends on material tokens, ledgers, settlement infrastructures, legal rules, central-bank practices, commercial banking, expectations, software, and repeated acts of pricing and payment. A monetary unit is neither reducible to any one of these components nor independent of the system that sustains it. Its entityhood is scale-relative because it becomes causally tractable at the level at which monetary claims, prices, debts, and payments operate.

Scale-relative entityhood also applies to subjects. The continuing sense of “I” discussed in Section 4.12 can possess relational reality at a scale of autobiographical continuity and practical agency while being realized through changing bodily, neural, mnemonic, linguistic, social, and institutional processes. The fact that these lower-level realizations change does not by itself negate the relational reality of the self-model that persists sufficiently to guide action. Conversely, persistence of the practical self does not settle whether an ontologically independent and unchanging self exists. The three-register architecture and ontological suspension remain intact.

Scale-relativity therefore differs from nominalism about entities. GR does not treat entities as mere names imposed on an otherwise undifferentiated flow. Some boundaries are institutionally authorized, materially reinforced, operationally reproduced, or causally consequential. Others are weak, temporary, contested, or analytically convenient. The task is to identify the mechanisms through which entityhood is stabilized and the range over which treating the configuration as an entity preserves explanatory adequacy.

Claim 4.153 (Constraint on scale-relative entityhood). *A scale-relative entity claim is warranted only insofar as the proposed entity exhibits sufficiently stable organization and causal efficacy at the selected scale; changing the scale can alter the adequacy of the entity description without making the underlying inquiry arbitrary.*

Claim 4.153 prevents two opposite errors. One is reductionism, in which a higher-level object is dismissed because it can be decomposed. The other is reification, in which a convenient aggregate is treated as independently real even when its internal heterogeneity materially changes explanation. A national unemployment rate, a firm’s productivity, a household preference, or a platform’s market share can be useful higher-level objects, but the explanatory adequacy of each depends on whether

aggregation preserves the differences relevant to the problem.

Scale-relative entityhood also has a temporal dimension. An entity can be stable at one temporal resolution and transient at another. A coalition can organize a negotiation for several months without becoming a durable institution. A market panic can persist long enough to reorganize credit even if it dissipates rapidly in historical time. A technical standard can remain stable for decades while individual implementations change continuously. Persistence must therefore be evaluated relative to the causal timescales of the relations being studied.

4.17.2 Scale-Relative Relationality

Relations are also scale-relative. A relation observed at one scale can summarize a large number of lower-level interactions, while a lower-level relation can become invisible or irrelevant at a higher resolution. For example, an employer–employee relation can be represented as a contractual relation in one model, while another inquiry decomposes it into wage-setting procedures, supervisory practices, legal rights, informal expectations, technical dependencies, bargaining capacities, and histories of recognition or conflict. Neither representation is automatically superior. Each preserves different relations and suppresses others.

Scale-relative relationality matters because GR places relations at the center of explanation without assuming that all relations must be represented at the finest available resolution. An economic system would become analytically unusable if every molecular, neurological, linguistic, contractual, technological, and institutional interaction had to be represented simultaneously. Relational analysis therefore requires principled compression. The question is whether the compressed relation retains the causal and generative structure relevant to the inquiry.

Definition 4.154 (Scale-relative relation). A *scale-relative relation* is an analytically specified relation whose relata, structure, and causal significance are defined at a selected resolution and whose adequacy depends on whether it preserves the relational differences relevant to the inquiry.

A relation at one scale can itself become a relatum at another. A long-term contractual relation between two firms can be treated as one edge in a supply network even though the relation is internally complex. A local credit network can become a component of a regional financial structure. A household can become a relatum in a tax system. An institution can become a node within an international regime. This nesting is not merely representational convenience when the higher-level configuration develops persistence and causal efficacy of its own.

Relations across scales can also constrain one another. A regulatory regime can shape permissible transactions among individual firms; repeated firm-level practices can gradually alter regulatory expectations; a platform’s architecture can condition interactions among users; accumulated user practices can produce pressures that change the platform’s rules. GR therefore avoids a one-directional picture in which causal explanation always moves from smaller to larger units. Cross-scale causal organization can involve amplification, constraint, feedback, path dependence, and institutional mediation.

The possibility of scale-relative relationality also clarifies why relational realities need not share a common metric. A relation between two persons, a relation between institutions, and a relation between a legal category and an administrative proce-

ture can all be causally important without being distances in one numerical space. Moving across scale can require translation among heterogeneous forms of relation rather than rescaling a single measure. The category-theoretic view of Section 4.16 provides one possible formal language for such translations, but the ontological point is broader: relational connectedness does not imply metric homogeneity.

Remark 4.155 (Relational compression). A higher-scale relation can be analytically legitimate even when it compresses many lower-scale relations, provided that the compression preserves the distinctions necessary for the explanatory or evaluative task and does not conceal lower-scale heterogeneity that materially changes the conclusion.

Remark 4.155 is especially important for GRE. Economic analysis routinely works with households, firms, sectors, markets, institutions, and states. GRE does not reject these units because they are relationally constituted. It asks when their internal constitution matters and when a stabilized higher-scale relation is an adequate object of inquiry. The answer can change across questions. A firm can be a useful unit in a trade model and an inadequate unit in an analysis of workplace power. A household can be useful in a consumption model and inadequate in an analysis of intra-household allocation. Scale selection therefore carries explanatory and normative consequences.

4.17.3 Multiple Realizations of Similar Functions

Scale-relativity becomes especially important when similar higher-level functions are realized through different lower-level configurations. A payment function can be supported by cash, bank deposits, card networks, mobile ledgers, or other infrastructures. A coordination function can be performed through hierarchy, market exchange, professional norms, algorithmic allocation, or combinations of these. A memory function can be distributed across human recollection, written records, databases, institutional routines, and technical archives. Similar manifested capacities can therefore emerge from heterogeneous relational organizations. (Fodor 1974; Kim 1992)

Definition 4.156 (Multiple realization). *Multiple realization* occurs when two or more materially, organizationally, relationally, or otherwise structurally distinct configurations support a sufficiently similar function, capacity, manifestation, or higher-scale relational reality relative to explicitly specified criteria.

Definition 4.156 makes similarity criterion-dependent. Two systems can realize the same payment function for ordinary retail exchange while differing in privacy, settlement finality, resilience, energy demand, governance, legal recourse, accessibility, or exposure to surveillance. Two organizations can produce similar outputs while distributing authority, risk, labor, and recognition differently. Two subjects can produce locally indistinguishable responses while possessing different histories, internal organizations, capacities, or forms of experience. Multiple realization therefore supports local equivalence without implying general equivalence.

This distinction is continuous with the chapter's treatment of non-invertibility. Similar manifestations do not uniquely determine the relational configuration that produced them. Multiple realization provides a structured reason for this underdetermination: different realizations can converge on a similar manifested function. The inverse problem becomes especially difficult when only the higher-level output is observed and the lower-level realization is hidden, changing, or institutionally inaccessible.

sible.

Multiple realization also prevents a simple reduction of function to substrate. If the same higher-level function survives replacement of many lower-level components, the function can acquire a degree of relational autonomy at the scale where it is reproduced. This autonomy is relative rather than absolute. The higher-level reality still depends on realization, but it may not depend on one unique realization. A legal office can persist through changes in officeholders, buildings, record systems, and administrative technologies; a currency can persist through changes in physical tokens and settlement infrastructure; an organization can preserve functions through substantial turnover in members and routines.

Claim 4.157 (Locality of realized equivalence). *When distinct configurations realize a similar function or manifestation, the resulting equivalence is limited to the criteria under which the similarity is established. It does not entail equivalence of causal history, internal relation, normative consequence, material dependence, or ontological status.*

Claim 4.157 gives multiple realization the same discipline that Section 4.16 gave formal equivalence. A comparison must state what is preserved. In economics, this prevents functional substitutability from becoming a claim of social or ethical substitutability. An automated system can substitute for a human worker in a specified productive task while changing employment relations, accountability, knowledge distribution, bargaining power, surveillance, or the meaning of participation. Functional similarity is therefore one relation among many.

Multiple realization can also occur historically within one relational reality. A monetary system, educational institution, welfare programme, scientific practice, or communication network can preserve a recognizable higher-level function while its material and organizational realization changes over time. Historical continuity then consists partly in the reproduction of function across changing realizations. Whether the change constitutes continuity, transformation, or replacement depends on which relations and capacities are treated as constitutive at the scale of inquiry.

4.17.4 Heterogeneous Ontological Realizations

The language of multiple realization can tempt a stronger conclusion: that a higher-level reality is independent of the ontological character of its realizers. GR does not require this conclusion. Realizations can be heterogeneous without being irrelevant. Material, biological, technical, institutional, symbolic, and experiential differences can affect which functions are possible, how reliably they are sustained, what costs they impose, and what forms of causal efficacy they acquire.

For this reason, the phrase *heterogeneous ontological realization* is used cautiously. It does not assert that GR has already established a complete ontology of the realizing domains. It marks cases in which the lower-level configurations supporting a higher-level relational reality require substantially different descriptive vocabularies or ontological commitments. A legal norm can depend on texts, institutions, authorized roles, practices, sanctions, interpretations, and embodied subjects. A digital asset can depend on electrical infrastructure, software states, cryptographic operations, legal recognition, organizational governance, and user expectations. A religious object can depend on material artifacts, ritual practice, collective memory, symbolic systems, embodied experience, and institutional continuity. The higher-level relational reality can span these heterogeneous realizations without being identical to any single

one.

Definition 4.158 (Heterogeneous realization). A *heterogeneous realization* is a realization in which the sustaining components or processes belong to analytically distinct domains whose relevant structures cannot be adequately represented by a single homogeneous descriptive vocabulary without significant loss.

Definition 4.158 does not imply that the domains are metaphysically incommensurable. It states a methodological condition: the inquiry currently requires more than one descriptive register to preserve the organization relevant to explanation. Ontological suspension remains appropriate when stronger claims about the ultimate relation among those domains are unnecessary.

Heterogeneous realization matters for the three-register architecture because manifestation can occur through one domain while relational stabilization depends on several. A monetary balance may manifest as a number on a screen while its relational reality depends on legal claims, institutional records, technical infrastructures, settlement capacities, and expectations. A person's institutional identity may manifest through a credential while its effects depend on legal recognition, database entries, organizational practice, social interpretation, and the subject's own history. A manifestationally simple object can therefore possess a relationally heterogeneous realization.

This point also constrains ontological inference. The fact that a higher-level function is multiply realized does not prove that the realizations are ontologically interchangeable. Conversely, the fact that realizations differ ontologically does not prevent them from supporting a locally similar relational reality. GR therefore separates at least three questions: whether a function is preserved, whether the realizing structures are relationally equivalent, and whether their ontological status is the same. These questions can receive different answers.

Heterogeneous realization has normative consequences as well. Two infrastructures that provide similar user-facing functions can distribute environmental cost, labor burden, vulnerability, control, or exclusion differently. Two organizational forms can produce similar outputs while structuring autonomy and authority differently. Ontological and relational heterogeneity can therefore matter even when manifestationally equivalence is strong. GRE must resist the tendency to treat functional output as an exhaustive description of economic reality.

4.17.5 Cross-Scale Reality

The preceding arguments imply that relational reality can be distributed across scales. A higher-scale object can be realized through lower-scale configurations while becoming sufficiently stable to constrain, enable, or reorganize those very configurations. This reciprocal organization is what the present subsection calls cross-scale reality. The term does not designate a separate fourth register of reality. It describes relations among realities whose persistence and causal efficacy are distinguishable at different analytical scales.

Definition 4.159 (Cross-scale reality). *Cross-scale reality* denotes a configuration in which relationally real structures identified at different analytical scales participate causally in one another's generation, stabilization, constraint, or transformation.

A legal institution provides a simple example. Repeated actions, documents, deci-

sions, records, and recognized roles sustain the institution. Once stabilized, the institution constrains which actions count as valid, who possesses authority, what procedures are available, and which future relations can be formed. The higher-scale institution is realized through lower-scale practices, while the lower-scale practices are reorganized by the institution they sustain. A monetary system similarly depends on transactions and records while simultaneously shaping the terms under which transactions are possible. An organization depends on individual actions while roles, procedures, and collective resources constrain those actions.

Cross-scale reality therefore avoids the assumption that causal explanation must terminate at the finest scale. A finer-grained description can reveal mechanisms through which a higher-level structure is realized, but the higher-level structure can still be causally indispensable because it organizes the space of lower-level possibilities. The statement that a rule is implemented through individual actions does not eliminate the causal significance of the rule when actors orient themselves to it, institutions enforce it, and it structures future choices. The relation between realization and efficacy is recursive rather than eliminative.

This does not require a strong doctrine of “downward causation.” GR can remain neutral about metaphysical debates concerning causal levels. The analytically necessary claim is weaker: descriptions at different scales can capture causally relevant organization that is lost if analysis is restricted to one scale. If changing a higher-level institutional relation systematically changes lower-level possibilities, and if lower-level interactions reproduce or transform that higher-level relation, then a cross-scale account can be explanatorily warranted regardless of how the ultimate metaphysics of causation is later formulated.

Claim 4.160 (Cross-scale causal adequacy). *A cross-scale explanation is warranted when causal differences at one analytical scale cannot be adequately represented without reference to relatively stable organization identified at another scale, and when the relations connecting those scales can be specified sufficiently for the inquiry.*

Claim 4.160 places a burden on cross-scale explanation. Analysts should identify the relations connecting scales rather than invoke “macro” or “micro” levels as unexplained causes. The relevant connectors can include rules, incentives, infrastructures, information, classifications, authority, material dependencies, learning, imitation, resource flows, technical interfaces, or repeated practices. Different problems require different mechanisms.

Scale selection also affects manifestation. A pattern can be manifest at one scale while remaining invisible at another. An individual may experience a series of unrelated administrative decisions while a population-level analysis reveals a systematic distribution. A macroeconomic indicator can display stability while household-level experiences diverge sharply. A platform can appear reliable to users while infrastructural monitoring reveals growing fragility. Manifestational reality is therefore scale-sensitive, and disagreements about “what is happening” can sometimes arise because different observers, institutions, or instruments manifest different scales of the same relational system.

The graph architecture developed earlier in the chapter remains applicable. A manifestation at one scale can enter relations at another scale. A population statistic can reorganize policy; an individual case can become a symbolic event that changes institutional rules; a market index can alter firm behavior; a local failure can trigger system-wide redesign. Scale and register are therefore distinct dimensions. Ontologi-

cal, relational, and manifestational realities can each be investigated at several scales, and mappings among registers can themselves operate across scale.

The consequence for GRE is methodological rather than merely ontological. Economic inquiry should specify the scale at which an object is claimed to be real, the realization relations that sustain it, the higher- and lower-scale structures omitted by the representation, and the conditions under which equivalence across realizations is asserted. A stable aggregate should not be decomposed merely because decomposition is possible, but neither should aggregation conceal heterogeneity that changes causal or normative conclusions. The appropriate scale is therefore part of the argument.

Scale-relative reality and multiple realization also clarify why ontological categories can change historically. New technologies, institutions, infrastructures, classifications, and productive arrangements can stabilize objects and functions at scales that were previously unavailable or analytically insignificant. A platform, digital identity, algorithmic market, multinational supply network, or machine-learning agent can become a relatively stable object only under historical conditions that sustain the relations required for its persistence and efficacy. The categories through which an inquiry describes economic reality can therefore acquire or lose salience as the systems themselves change.

This observation prepares Section 107. The next problem is not only that the same reality can be described at several scales, but that the categories available for identifying subjects, objects, relations, capacities, and institutions are themselves historically formed. Scale-relative analysis preserves a plurality of valid resolutions; historical materiality asks how some resolutions and categories become practically consequential in the first place. Together, the two arguments support an ontology that is structured and causally serious without being frozen into a timeless inventory of entities.

4.18 Historical Materiality of Ontological Categories

The preceding sections have progressively loosened the assumption that an ontology for economic inquiry can be given as a timeless inventory of ready-made entities. Relational realities can emerge and dissolve; manifestations can alter the systems they disclose; representations can become causally operative; subjects, institutions, and values can be stabilized through historically specific relations; and the adequacy of an entity description can vary across scale. The role of the present section is to make the historical consequence of these claims explicit. Its objective is to show that the categories through which GR and GRE distinguish subjects, objects, relations, capacities, institutions, and processes can themselves possess a historical materiality. This does not mean that reality is created at will by vocabulary, nor that every ontological distinction is merely conventional. It means that the kinds of relatively stable realities available to economic analysis, the practical boundaries through which they are reproduced, and the categories adequate to describing them can change as productive capacities, institutions, infrastructures, classifications, and forms of social organization change. The discussion proceeds through historical category formation, productive forces and ontological salience, institutional stabilization, transformation of subject and object categories, and the disciplined revisability of ontological categories.

Historical materiality therefore concerns more than the history of ideas about what exists. It also concerns the history of the relational systems within which some distinctions become materially reproducible and causally consequential. The category of a corporation, for example, is not only a word used by analysts. It is connected to legal personality, accounting, ownership, contracting, record keeping, governance, and organizational continuity. The category of a wage worker is similarly connected to historically specific relations of labor, property, contract, production, and reproduction. A category can thus be historically constituted at two levels at once: as a conceptual distinction within inquiry and as a distinction stabilized in the organization of the world being investigated. Keeping these levels distinct is essential. A historically formed concept can refer badly to reality, while a historically stabilized relational object can remain causally real even when existing concepts represent it inadequately.

Definition 4.161 (Historical materiality of an ontological category). The *historical materiality of an ontological category* denotes the dependence of a category's practical applicability, boundaries, salience, or causal relevance on historically formed generative-relational conditions, including productive capacities, institutions, infrastructures, classifications, practices, and modes of representation.

Definition 4.161 is deliberately weaker than the claim that all ontological reality is historically produced. GR does not need that stronger metaphysical thesis. The definition instead identifies a property of inquiry and of relational reality: some categories become adequate because historical processes stabilize objects or relations that satisfy the category's conditions; some lose adequacy because those objects or relations transform; and some acquire new meanings because the systems through which they operate change. Ontological suspension therefore remains compatible with historical materiality. One can investigate how a category becomes materially and institutionally operative without claiming that every aspect of the reality to which it refers is exhausted by that history.

4.18.1 Historical Formation of Categories

Economic categories have histories because economies have histories. Property, labor, money, household, firm, market, commodity, debt, employment, platform, data, and capital are not analytically interchangeable across all social formations. Some of these terms can be used at high levels of abstraction across long periods, but their concrete relations, legal forms, technical infrastructures, and causal roles can differ substantially. Historical political economy has long emphasized that economic categories can be specific to forms of production and social organization rather than natural kinds that retain an invariant content across history (Marx 1867; Polanyi 1944). GR adopts this historical discipline without requiring that every later ontological claim be reduced to a single theory of historical development.

A category can form historically in several ways. New relational objects can emerge. Existing objects can acquire new causal roles. Institutional boundaries can stabilize distinctions that were previously fluid. Measurement and recording systems can make previously diffuse differences operational. Technical infrastructures can connect dispersed processes into a new functional whole. Political and legal arrangements can create statuses with durable consequences. Repeated representation can also reorganize the object represented, producing recursive stabilization of

the category itself. These pathways often overlap, but they should not be collapsed into one mechanism.

Consider the modern firm. Treating the firm as an economic subject is analytically useful because legal, accounting, organizational, technological, and contractual relations make it possible for a changing population of persons and assets to persist as a recognizable unit. The category becomes materially consequential because contracts are signed in its name, liabilities are assigned to it, accounts are kept for it, and future action is coordinated through it. Yet the category does not have one invariant realization. A family enterprise, public corporation, cooperative, platform company, and multinational group can differ sharply in governance, ownership, scale, internal authority, and technical organization while remaining recognizable under a broader category of firm for some inquiries.

The same applies to labor. “Labor” can designate human activity at a high level of abstraction, but wage labor, coerced labor, unpaid care, self-employment, professional service, platform-mediated work, and machine-assisted production occupy different relational structures. A historical change in the organization of production can therefore alter which distinctions matter to explanation. An ontology of economic activity that treats all productive contribution as one homogeneous object may remain useful for one aggregate calculation while becoming inadequate for questions about authority, reproduction, dependency, or distribution.

Historical category formation should also be distinguished from simple linguistic change. A new word can appear without a corresponding new relational reality, and a relational reality can emerge before a stable vocabulary exists for it. Section 4.5 established that relational reality does not require prior perception or symbolization. The historical formation of an ontological category can therefore lag behind the formation of the reality it later names. Conversely, institutional naming can precede and help stabilize the object named. Legal recognition of a corporate form, administrative classification of a population, or technical standardization of a digital object can contribute to the relations through which the corresponding reality subsequently persists.

Claim 4.162 (Dual historicity of ontological categories). *The historicity of an ontological category can arise both from changes in the reality to which the category is applied and from changes in the conceptual, institutional, and representational practices through which that reality is distinguished; these two histories can interact without being identical.*

Claim 4.162 prevents two reductions. One would treat categories as passive labels that simply follow changes in an independently organized world. The other would treat the world as if it were produced entirely by classification. GR instead permits recursion. A changing economic system can demand new categories, and an institutionalized category can later reorganize the relations it classifies. Hacking’s historical ontology and work on classificatory practices provides a useful precedent for this latter possibility, particularly where classifications interact with the persons and practices organized around them (Hacking 2002). The present argument extends the point cautiously to a wider range of economic objects while preserving the distinction between classificatory mediation and the full generative structure of those objects.

This dual historicity also means that category boundaries can be contested. Disputes about whether a worker is an employee or independent contractor, whether a digital token is money, property, security, or access credential, whether a platform is

a marketplace or an employer, or whether an artificial system counts as an economic agent can be partly conceptual and partly institutional. Such disputes often matter because different classifications activate different rights, liabilities, measurements, expectations, and causal pathways. The contest is therefore not merely semantic. Once linked to institutions, a category can become a mechanism through which resources and possibilities are distributed.

4.18.2 Productive Forces and Ontological Salience

Historical materiality becomes especially visible when productive capacities change. The term *productive forces* is used here in a broad and deliberately non-exclusive sense to include techniques, skills, infrastructures, tools, scientific knowledge, organizational capacities, energy systems, computational resources, and other means through which production and coordinated activity become possible. Marxian traditions give productive forces a central place within historically specific relations of production, but GRE need not adopt a deterministic sequence in which technical development alone explains institutional or ontological change. Productive capacities interact with law, ownership, culture, ecology, political authority, knowledge, and social reproduction. Their relevance in this section is narrower: changes in productive capacity can alter which objects, relations, and scales become stable enough to acquire ontological salience for economic inquiry.

Definition 4.163 (Ontological salience). *Ontological salience* denotes the degree to which a kind of object, relation, process, or capacity becomes sufficiently persistent, causally consequential, and differentiable within a historical system that distinguishing it materially improves explanation, intervention, or evaluation.

Ontological salience is not identical to ontological reality. Something can be real while remaining marginal to the inquiry, and something can be highly salient in representation while its underlying reality is weak or mischaracterized. Salience concerns why a distinction becomes difficult to omit without explanatory loss. When railways, electrical grids, telecommunications networks, digital platforms, or large computational systems become infrastructures of economic coordination, categories corresponding to network position, interoperability, platform access, computational capacity, or data dependency can acquire a practical importance that was absent under earlier productive arrangements.

Technical change can also create new scales of stable organization. A geographically dispersed supply chain becomes a tractable economic object only when transport, communication, contracting, standards, finance, and information systems sustain coordination across distance. A real-time algorithmic market presupposes technical and institutional infrastructures through which orders, prices, identities, risk controls, and settlement can be processed at speeds and scales unavailable to earlier markets. A machine-learning agent can become an operationally significant economic object only when computational infrastructures, training processes, interfaces, institutional permissions, and organizational practices support sustained action. These objects are not made real by technology alone; technology participates in the generative-relational configurations that allow them to persist and act.

Productive forces can also alter the salience of older categories. Mechanization changes the relation between labor time, skill, machinery, and output. Automation can separate productive contribution from direct human execution. Digital replica-

tion changes the relation between use and scarcity for some informational goods. Remote communication changes the spatial organization of work. Large-scale data processing changes the practical role of classification and prediction. None of these transformations automatically invalidates categories such as labor, property, commodity, or firm, but each can change what must be specified for those categories to remain analytically adequate.

The relation between productive forces and ontological salience is therefore generative rather than deterministic. New capacities can open a possibility space without fixing the institutional form that will stabilize within it. Similar technologies can be embedded in different ownership structures, legal regimes, organizational forms, cultural practices, and normative orders. Conversely, institutions can delay, redirect, or selectively amplify technical possibilities. GR therefore treats productive forces as one set of historically material conditions among several, not as an autonomous engine that determines the ontology of the economy.

Remark 4.164 (Material possibility and historical stabilization). A productive capacity can make a relational form possible without making that form inevitable. Ontological salience emerges when technical possibility becomes joined to sufficiently stable institutional, organizational, symbolic, ecological, and practical relations to produce durable causal effects.

Remark 4.164 is particularly important for contemporary AI. The existence of a model capable of generating language does not by itself settle whether it constitutes an economic subject, an instrument, an organizational component, an autonomous service, or some combination of these under different conditions. Those categories depend on the relations through which the system is authorized, controlled, represented, contracted with, integrated into workflows, and made responsible or non-responsible for consequences. Technical capability changes the category problem; institutional stabilization helps determine which category becomes operative.

4.18.3 Institutions and Stabilized Reality

Institutions give historical categories durability by linking distinctions to recurrent practices, rules, records, sanctions, rights, expectations, and authorized procedures. Section 4.14 treated institutions as relationally real when they satisfy the full criterion of persistence, stability, and causal efficacy. The present concern is how institutionalization contributes to the historical materiality of the categories through which such realities are recognized and reproduced.

Institutional categories do more than describe. A property title establishes a recognized relation among persons, objects, claims, and authorities. A corporate registration makes a legal subject available for contracting and liability. An employment classification can activate wage rules, insurance obligations, tax treatment, bargaining rights, or exclusions. A national-accounting category can shape how economic activity is measured and compared. A technical standard can determine which objects interoperate. Once these classifications are embedded in durable procedures, their consequences extend beyond the moment of naming.

North's institutional analysis emphasizes that formal rules, informal constraints, and enforcement characteristics structure incentives and economic interaction (North 1990). Searle's account of institutional facts likewise draws attention to how socially recognized statuses can support powers, rights, duties, and functions that

are not reducible to the physical properties of the objects involved (Searle 1995). GR need not adopt either framework as a complete ontology of institutions to retain the insight that institutional recognition can stabilize relational realities and make category boundaries causally consequential.

Institutional stabilization can produce what might be called category infrastructure. Registries, legal codes, accounting systems, databases, credentials, standards, forms, identifiers, professional practices, and administrative routines make categories reproducible across time and across many local interactions. They reduce the need to renegotiate the existence and meaning of a category in each encounter. A corporation need not be recreated conceptually whenever it enters a contract; a recognized currency unit need not be redefined in each payment; a credential can travel across organizations because institutional infrastructures preserve enough of its meaning to make it actionable.

Definition 4.165 (Category infrastructure). A *category infrastructure* is a relatively persistent assemblage of rules, records, standards, practices, technologies, and authorized interpretations through which a classificatory distinction is reproduced and made causally operative across situations.

Category infrastructure helps explain why some classifications become relationally real while others remain ephemeral. A spontaneous label may influence a local interaction but disappear quickly. A classification linked to records, eligibility rules, technical interfaces, and repeated organizational practice can persist and reorganize future relations. Its materiality lies partly in the infrastructures that carry it. This does not make the classification epistemically correct or normatively legitimate. A mistaken, discriminatory, or obsolete category can remain causally powerful when institutions continue to act upon it.

Institutional stabilization also produces inertia. Once organizational routines, contracts, software systems, forms, statistical series, and legal rights are built around a category, revising that category can become costly. Historical categories can therefore outlive the conditions under which they were initially useful. A classification may persist because infrastructures presuppose it, even as the underlying relational reality becomes more heterogeneous. This lag creates a recurring epistemic and political problem: the category remains materially real in its effects while becoming increasingly inadequate as a description.

The recursive architecture of Sections 4.10 and 4.11 is visible here. A category becomes symbolized and institutionalized; institutions then act through the category; those actions reshape subjects, resources, and opportunities; the altered relations generate new manifestations; and subsequent representations may either reinforce or challenge the category. Historical materiality therefore includes the accumulated consequences of prior classifications. Categories carry histories not only because their meanings change, but because earlier meanings leave infrastructures and distributions behind.

4.18.4 Historical Transformation of Subject and Object Categories

The distinction between subject and object is itself historically articulated within economic systems. GR does not imply that every subject is reducible to a role or that every object is created by institutions. It does, however, treat practical subjecthood and

objecthood as potentially relationally stabilized. Section 4.12 already distinguished ontological subjecthood, relationally effective subjecthood, manifestational subjecthood, and institutionally represented subjecthood. Historical materiality adds that the conditions under which particular forms of subjecthood become economically operative can change.

The wage worker, consumer, shareholder, debtor, insured person, welfare recipient, platform user, data subject, content creator, contractor, and machine operator are not simply different names for a timeless economic individual. Each role selects different relations, rights, obligations, capacities, vulnerabilities, and forms of representation. A person can occupy several of these positions simultaneously, and the same person can move among them over time. Historical change can create new subject positions or reorganize the causal importance of old ones.

Classifications of persons can also be recursive. Hacking's analysis of interactive kinds is especially relevant where classifications enter institutions and self-understanding, although GR does not assume that every economic category behaves in this way (Hacking 2002). A credit category can alter borrowing opportunities and future financial behavior. An employment category can alter legal protection and bargaining position. A professional credential can alter access to institutions and the subject's own expected trajectory. A platform reputation score can mediate visibility and opportunity. In each case a representation of the subject becomes part of the relational system through which later subjecthood is produced.

Objects undergo analogous transformations. Land can be a lived environment, territory, ecological system, taxable parcel, commodity, collateral, commons, sacred site, or development asset under different relational configurations. Data can be treated as record, evidence, asset, input, personal information, property-like resource, public infrastructure, or object of governance. A digital account can become an access credential, payment instrument, identity proxy, contractual interface, or bundle of institutional claims. The physical or informational substrate can remain partly similar while the relational object changes because different institutions and practices stabilize different causal roles.

Claim 4.166 (Historical transformation of economic objecthood). *An economic object's relational reality can transform when the relations that stabilize its boundaries, capacities, rights, uses, or causal roles change, even where some underlying material substrate remains continuous.*

Claim 4.166 helps avoid two extremes. One would assume that the stable material substrate fixes the economic object once and for all. The other would imply that a change of description alone creates a new object. GR instead asks whether the change in relations is sufficient to alter persistence, causal capacities, recognized boundaries, or the possibilities generated by the object. Reclassification matters most when it becomes embedded in relations that materially change what can happen next.

Subject and object categories can also exchange analytical roles. A firm can be a subject in a market model and an object of regulation. A worker can be an agent in a labor-supply model and an object of algorithmic classification. An algorithm can be treated as an object owned by a firm, a process embedded in organizational decision making, or an operational subject when it performs sustained actions within authorized interfaces. These shifts do not by themselves settle metaphysical subjecthood. They show that the subject/object distinction used in economic inquiry is partly task- and relation-dependent, and that historical changes can make previously marginal

orientations practically important.

This point becomes particularly significant under automation and AI. A system can manifest outputs associated with human economic agency while remaining embedded in ownership, infrastructural dependence, governance, and technical realization that differ substantially from human subjecthood. GRE therefore needs categories capable of recognizing artificial operational agency without inferring experiential, moral, juridical, or ontological equivalence from functional similarity. The historical emergence of such systems makes the inadequacy of a simple human-agent/tool dichotomy increasingly visible, but the appropriate replacement categories remain open to empirical and normative development.

4.18.5 Ontological Categories as Historically Revisable

If ontological categories possess historical materiality, they must also be revisable. Revisability, however, should not be confused with conceptual voluntarism. Analysts cannot simply redefine an inconvenient reality out of existence. A useful revision must respond to changes in causal organization, evidential access, institutional structure, explanatory purpose, or normative problem. Historical revisability is disciplined by the realities the categories are intended to track.

Definition 4.167 (Historical revisability of ontological categories). The *historical revisability of an ontological category* is the requirement that its boundaries, criteria, and explanatory role remain open to modification when changes in relational organization, manifestation, evidence, institutional practice, or analytical purpose materially alter the adequacy of the category.

Several forms of revision are possible. A category can be subdivided when previously compressed differences become causally significant. Several categories can be joined for a particular higher-scale analysis when their differences cease to matter to the inquiry. A category can change its defining criteria. Its temporal or spatial scope can be narrowed. A formerly central category can become secondary while another becomes more salient. A category can also remain in use while its ontological interpretation becomes more restrained. Revisability therefore does not imply constant replacement; it includes refinement, rescaling, qualification, and explicit limitation.

Historical revisability is especially important where administrative and analytical categories have become infrastructures. Because institutional categories can shape the reality they classify, revision can change the object of inquiry as well as the representation of that object. Altering an employment classification can change rights and organizational incentives. Revising a monetary definition can change reported aggregates and policy interpretation. Changing a diagnostic or eligibility category can reorganize access to resources. The epistemic act of revision can thus become an intervention in relational reality.

This recursive possibility makes provenance important. Analysts should be able to ask when a category was introduced, through which institutions it became operative, what relations it compresses, which populations or objects it excludes, what technical or legal infrastructures depend on it, and how its meaning has changed. Historical ontology in this sense is not an antiquarian supplement to economic analysis. It is part of understanding what present categories do.

Claim 4.168 (Discipline of historical revision). *Revision of an ontological category is warranted when an alternative distinction preserves or improves causal, relational,*

manifestational, or evaluative adequacy for the inquiry, and when the reasons for altering the category can be traced to changes in evidence, organization, scale, purpose, or historically material conditions rather than to terminological preference alone.

Claim 4.168 gives revisability a burden of argument. A new category should show what explanatory difference it makes. An old category should not be discarded merely because it is historically constituted; historical constitution is compatible with durable causal reality. Money, firms, legal persons, markets, and institutional roles can remain indispensable objects of analysis even when their forms are historically specific. Conversely, long use does not guarantee continuing adequacy. A category can be deeply institutionalized and still fail to represent emerging relations that have become causally significant.

The distinction between relational reality and normative validity is again essential. A historically stabilized category can be unjust, exclusionary, or misleading while remaining causally real. Its normative criticism does not erase its effects. Likewise, a normatively attractive category does not become relationally real merely because it would be desirable for institutions to recognize it. GRE must therefore be able to analyze categories that ought to change without pretending that they have already changed, and to analyze emergent categories without treating emergence as justification.

Historical materiality also places a limit on claims of universal ontology within economics. Categories that function well in one historical configuration may require translation elsewhere. “Household,” “property,” “employment,” “market,” or “firm” can refer to relationally different arrangements across institutional and cultural contexts. Comparative analysis therefore needs to establish which structural correspondences justify using a common category and which differences require separate treatment. Shared terminology should not silently produce equivalence.

At the same time, historical materiality does not eliminate the possibility of cross-historical abstraction. Some categories can be useful precisely because they capture recurring relational forms at a sufficiently general level. Exchange, constraint, dependency, production, reproduction, coordination, obligation, and causal efficacy can sometimes travel across contexts more readily than narrower institutional categories. The appropriate level of abstraction depends on the question. GR’s methodological primitives and the three-register architecture are intended to support this movement across levels without claiming that every concrete economic object has a timeless form.

The resulting position is a historically responsive ontology rather than either a fixed catalogue or unrestricted constructivism. Reality constrains categories; categories can mediate reality; institutions can stabilize categories; productive capacities can change what becomes materially possible and salient; and historical transformation can require new distinctions. Ontological suspension remains active throughout: the historical emergence of a relational object does not decide whether it possesses some stronger ontological status, while the absence of a final metaphysics does not weaken the claim that historically formed objects and categories can be causally real.

This historical perspective prepares the next methodological step. If categories, scales, and even some objects of inquiry are historically conditioned, relational-generative analysis should be treated as a disciplined analytical expedient rather than as a declaration that all reality possesses one final relational form. Section 108 therefore turns from the historical materiality of categories to the methodological

standing of relational-generative analysis itself: what it enables, when it is warranted, and where its use should remain provisional.

4.19 Methodological Standing of Relational-Generative Analysis

The preceding sections have developed an ontological architecture in which relational realities can emerge, persist, stabilize, and exercise causal efficacy; manifestations can disclose and transform those realities; representations can become operative within subsequent relations; categories can vary across scale and history; and formal languages can clarify selected structural features without exhausting the realities they represent. The role of the present section is to state the methodological consequence of that architecture for Generative Relational Theory (GR) and Generative Relational Economics (GRE). Its objective is to clarify the standing of relational-generative analysis as a disciplined analytical expedient: a way of selecting relations, histories, transformations, and downstream consequences for inquiry when those selections improve explanation, without converting the analytical selection into a universal metaphysical thesis. The discussion proceeds through relational selection, generative selection, methodological economy, ontological plurality, and the limits of relational-generative abstraction.

The term *expedient* is used here in a technical and non-pejorative sense. An analytical expedient is a constructed mode of access whose adequacy depends on the problem, scale, evidence, and explanatory purpose. Scientific and interpretive inquiry routinely proceed through such constructions: a boundary is drawn around a system, a variable is selected, a comparison class is defined, a temporal interval is chosen, a mechanism is isolated, or a representation is adopted because the resulting description makes some pattern or causal relation intelligible. The construction can be highly disciplined and empirically constrained while remaining different from a claim that reality possesses exactly the same boundaries or form independently of inquiry. (Fraassen 1980; Giere 2004)

Definition 4.169 (Relational-generative methodological expedient). A *relational-generative methodological expedient* is an explicitly scoped analytical construction that represents an object, process, or domain through selected relations, generative histories, constraints, transformations, and downstream effects in order to improve explanation, comparison, interpretation, or intervention, while leaving stronger ontological claims open unless they receive independent warrant.

This definition preserves two commitments simultaneously. Relational-generative analysis can make substantive claims about causal organization, persistence, historical formation, and transformation. At the same time, the analytical grammar through which these claims are organized remains answerable to the inquiry rather than automatically elevated into the final structure of reality. Relation and generativity therefore function as strong analytical commitments where they carry explanatory work and as revisable selections where another representation better addresses the problem.

This position extends the open ontological commitment established in Section 4.1. Ontological suspension concerns the strength of reality claims; methodological expedience concerns the form through which inquiry approaches those realities. The two

disciplines reinforce one another. A researcher can take relations seriously enough to explain causal organization while suspending the stronger proposition that relations are metaphysically prior to every relatum. A researcher can analyze generative histories without assuming that every relevant property is best explained by tracing its production. GR therefore gains explanatory depth from relational and generative reasoning while retaining room for substance-oriented, process-oriented, phenomenological, institutional, formal, or domain-specific descriptions when those descriptions are locally adequate.

4.19.1 Relational Selection

Relational analysis begins by selecting relations as explanatory objects. This selection directs attention toward dependence, coupling, positioning, mediation, recognition, exchange, constraint, coordination, conflict, transmission, inheritance, and other structures through which the capacities or trajectories of an object depend partly on its situation within a wider configuration. The selection is especially useful where isolating an entity would conceal the mechanisms through which its apparent properties are produced or maintained.

A firm provides a familiar example. Treating the firm as a unit can be entirely appropriate for questions about aggregate output, accounting performance, or contractual liability. A relational analysis becomes useful when the inquiry concerns how the firm's capacities depend on employees, suppliers, legal rules, infrastructures, creditors, platforms, customers, data flows, ownership, organizational routines, and political conditions. The relational description does not abolish the firm as an entity. It changes the resolution of the inquiry so that some of the relations constituting or conditioning the entity become analytically explicit.

The same principle applies to subjects. Section 4.12 distinguished ontological, relationally effective, manifestational, and institutionally represented subjecthood. A relational analysis of a worker, consumer, debtor, citizen, researcher, or artificial operational subject asks which capacities are produced, recognized, constrained, or amplified through relations. Such analysis can reveal dependencies that are obscured when the subject is treated as a self-contained bearer of fixed preferences or capabilities. Yet the usefulness of the relational view does not require the stronger claim that the subject possesses no reality apart from relations. The analytical question is whether relational organization contributes materially to the phenomenon under investigation.

Claim 4.170 (Relational selection). *A relational representation is methodologically warranted when differences in relations, positions, interfaces, or configurations make a material explanatory difference to the capacities, persistence, manifestation, or transformation of the object under study.*

Claim 4.170 places a burden on relational vocabulary. Merely redescribing an entity with the word “relation” adds little. The analysis should identify which relations are relevant, how they are distinguished, what evidence supports their relevance, and what explanatory difference follows from including them. A relation can be direct or mediated, persistent or transient, symmetric or asymmetric, material or symbolic, institutional or interpersonal, observable or inferred. The selection should match the mechanism and scale of the inquiry.

Relational selection also involves boundary choice. Any empirical analysis in-

cludes some relations while treating others as background. A study of labor relations may foreground contract, supervision, wage dependence, household reproduction, or platform mediation while leaving distant ecological or geopolitical relations outside the immediate model. The excluded relations do not thereby become unreal. They remain outside the chosen analytical boundary unless evidence shows that they materially alter the phenomenon being explained. The adequacy of a relational analysis therefore depends partly on whether its boundary captures the relations that make a consequential difference to the local question.

This boundary discipline matters because an indefinitely expanded relational description can become analytically empty. Every object can be placed within an enormous history of material, biological, social, institutional, linguistic, and ecological relations. Inquiry requires selection. GR contributes by making the selection explicit and revisable rather than by demanding maximal relational inclusion. The relevant relation is the relation that carries explanatory, interpretive, evaluative, or intervention significance at the scale being studied.

The three-register architecture further constrains relational selection. An analyst should distinguish relations inferred from manifestations from the relational reality being inferred, and should identify where symbolic or institutional representations mediate the evidence. Section 4.9 showed that reverse inference from manifestation can remain underdetermined. Relational analysis therefore gains rigor when it states which relations are directly observed, which are institutionally recorded, which are reconstructed historically, and which are hypothesized as latent generative structures.

4.19.2 Generative Selection

Generative analysis introduces a second selection. It asks how a configuration produces, enables, constrains, stabilizes, transforms, or dissolves subsequent objects, capacities, relations, manifestations, meanings, and possibilities. The focus therefore extends beyond the description of a present relational structure toward the consequences and historical trajectories that the structure helps generate.

Generativity is particularly useful when an apparently static allocation has dynamic consequences. A distribution of income, ownership, educational access, computational capability, legal status, or institutional authority can alter what actors are later able to learn, build, negotiate, represent, preserve, or contest. The initial configuration may therefore matter not only because of what is distributed at one moment but because it changes the field of later generation. GRE uses this perspective to investigate trajectories of capability, value, power, knowledge, institutional formation, and relational reproduction.

The generative perspective should remain scoped. Some questions are adequately answered by description, classification, or equilibrium comparison. Others require historical explanation of formation. Still others require causal analysis of what follows from a configuration. The value of generative analysis appears when downstream production or transformation is part of the substantive problem. It is therefore a methodological choice oriented toward a class of questions rather than a requirement that every analysis be converted into a genealogy of everything that preceded it.

Definition 4.171 (Generative relevance). A relation, configuration, event, or repre-

sentation has *generative relevance* for an inquiry when its presence, organization, persistence, or transformation contributes materially to the production, stabilization, modification, or suppression of later states, capacities, relations, manifestations, or possibilities that fall within the inquiry's explanatory scope.

Definition 4.171 connects generativity to causal and historical significance while preserving scale. A minor interaction may have generative relevance for a local relation and little relevance for a national institution. A legal classification may reorganize one market while leaving another largely unaffected. A technological infrastructure may generate new operational capacities without substantially altering some normative relations. The analyst therefore specifies the downstream object and timescale rather than treating generativity as an undifferentiated property.

Generative selection also introduces temporal asymmetry into analysis. A present structure can be understood partly through the trajectories it opens and closes. This does not imply deterministic prediction. Generative systems can contain contingency, feedback, path dependence, critical transitions, heterogeneous responses, and interactions with conditions outside the analytical boundary. The claim that a configuration generates possibilities is therefore compatible with multiple future trajectories. GRE's interest lies in how the configuration changes the distribution, accessibility, or organization of those possibilities.

This distinction is useful for intervention. A policy may improve a manifest outcome at one moment while weakening capacities required for later adaptation. Another intervention may have modest immediate effects while changing institutional relations that support later generation. A generative analysis brings these temporal consequences into view. It remains possible that another method captures the same phenomenon more efficiently; the methodological status of generativity therefore depends on the explanatory gain it provides for the problem at hand.

Generative analysis also requires attention to the history of the mechanisms it studies. Section 4.18 established that categories and causal organizations can themselves possess historical materiality. A generative mechanism observed in one institutional configuration may change when legal rules, productive capacities, classifications, infrastructures, or symbolic regimes change. The method therefore treats mechanisms as potentially historical objects rather than assuming invariant laws merely because a recurrent pattern has been identified.

4.19.3 Methodological Economy and Provisional Use

A useful analytical framework should explain enough while assuming only what the inquiry requires. Relational-generative analysis follows this principle of methodological economy. It introduces relations when relational organization changes the explanation, generativity when downstream formation matters, and stronger formal or ontological commitments only when they provide additional warranted explanatory value. This economy protects the framework from accumulating conceptual machinery that exceeds the question.

Proposition 4.172 (Local sufficiency of relational-generative analysis). *For a specified inquiry, relational-generative analysis is locally sufficient when the selected relations, generative mechanisms, boundaries, scales, and temporal horizons support the explanatory or interpretive task without requiring stronger commitments whose addition would not materially improve the analysis.*

Proposition 4.172 parallels the principle of local ontological sufficiency developed earlier in the chapter. The aim is neither theoretical minimalism for its own sake nor maximal formal completeness. The aim is proportionality between the analytical apparatus and the problem. A study of institutional trust may need historical relations, symbolic mediation, and recursive feedback without requiring category theory. A study of manifestation mappings may benefit from category-theoretic language without requiring a field-theoretic model. A study of pricing dynamics may use quantitative causal models while leaving questions about ultimate social ontology suspended.

Provisional use follows from this proportionality. An analytical representation can be adopted because it works well for a defined purpose and later revised when the purpose, evidence, or system changes. Provisionality concerns the standing of the representation rather than the seriousness of the inquiry. A provisional model may support strong local findings when its assumptions and scope are explicit. Conversely, a model presented with metaphysical confidence can remain weak if its empirical or conceptual fit is poor.

This stance is particularly important for interdisciplinary work. GR draws on economics, political economy, sociology, philosophy, law, complex systems, computation, history, and other domains. Each discipline carries characteristic objects and methods. Methodological economy allows GRE to borrow a representation for a specified task without absorbing the entire ontology of the source discipline. A network can represent interaction structure; a dynamical system can represent temporal evolution; an institutional analysis can represent rule-bound organization; a phenomenological account can clarify manifestation; a historical reconstruction can establish path-dependent formation. Their local contributions can coexist even where their background assumptions differ.

Provisionality also protects cumulative research. A framework that requires every contribution to settle the full ontology of its objects would impose an unrealistic burden and discourage empirical work. Researchers can instead state the level of commitment required by their study. One contribution may establish that a classification has relational reality because it is persistent and causally efficacious. Another may investigate the manifestation mechanisms through which that classification becomes salient. A third may contest its normative legitimacy. A fourth may propose a stronger ontology. The contributions can accumulate because the shared analytical distinctions remain clear even where metaphysical commitments differ.

Methodological economy therefore favors modularity. Claims about relational reality, manifestation, representation, value, subjecthood, scale, and historical category formation can be connected without requiring that every module be used in every study. GRE functions more effectively as a research programme when investigators can select the components required by the question while preserving compatibility with the larger architecture.

4.19.4 Relational Analysis and Ontological Plurality

Treating relation as an analytical choice also guards against relational reductionism. Relational reductionism would arise if a successful relational explanation were taken to establish that entities, properties, experiences, material structures, or domain-specific mechanisms possess no analytically independent significance. GR has no methodological need for that extension. An entity can be relationally

constituted in some respects and still require description at the level of its internal organization. A process can depend on relations while retaining material constraints that are poorly represented through relational vocabulary alone. A manifestation can be relationally generated while possessing phenomenological features that require another mode of access.

The three-register architecture itself supports this plurality. Ontological reality exceeds what any one manifestation or representation captures. Relational reality identifies one criterion of causal reality within generative-relational systems. Manifestational reality identifies conditions of availability. These distinctions already imply that one analytical vocabulary is unlikely to exhaust every relevant question. Relational-generative analysis therefore operates within an ontology that permits plural modes of access.

Caution 4.173 (Relational reductionism). Relational reductionism occurs when explanatory success at the level of relations is extended into the unsupported conclusion that other analytically relevant structures, properties, experiences, or domain-specific mechanisms can be fully replaced by relational description.

Caution 4.173 is distinct from the ontological inflation identified in Section 4.1. Ontological inflation concerns movement from analytical success to stronger reality claims. Relational reductionism concerns compression of heterogeneous explanatory objects into one preferred vocabulary. The two can occur together, but each requires separate discipline.

Consider monetary reality. A relational analysis can explain how legal recognition, expectations, accounting, payment infrastructures, state capacities, and exchange practices stabilize money. This does not make the material and technical properties of payment systems irrelevant. A banknote has physical constraints; a digital payment system depends on hardware, energy, code, security, and communication infrastructure; monetary policy operates through institutionally specific mechanisms. Relational explanation is strongest when it articulates these components rather than translating them into an abstract relation that loses their causal specificity.

The same applies to subjectivity. The relational reality of a continuing sense of self can be analyzed through memory, recognition, bodily continuity, narrative, institutional identity, and interaction. Such analysis leaves room for psychological, neurological, phenomenological, and philosophical accounts that address different dimensions of the same subject. Relational analysis can identify coupling among these dimensions without claiming jurisdiction over every question they raise.

Ontological plurality also preserves the possibility of domain-specific primitives. Physics, biology, law, economics, and phenomenology may require different operational distinctions. GR can investigate relations across those domains while allowing each to retain objects that are locally indispensable. Cross-domain translation therefore becomes an empirical and conceptual task. Similar relational patterns can support analogy without implying that the underlying objects are of the same ontological kind.

This position is consistent with the non-necessary comparability established in Section 4.5. Two relationally real objects can remain structurally incommensurable. A methodological commitment to relation does not create a common metric merely because both objects are represented relationally. The analyst must establish the mapping, equivalence criterion, or comparison space independently. Relational vocabulary supplies a grammar for asking about correspondence; it does not guarantee

correspondence.

4.19.5 Limits of Relational-Generative Abstraction

The final methodological task is to identify where relational-generative abstraction loses information or explanatory traction. Every abstraction suppresses detail. The relevant question is whether what has been suppressed matters to the inquiry. GR therefore treats limitations as part of the specification of an analysis rather than as an external objection added after the model is complete.

Several limits recur. First, relation selection can omit materially consequential internal structure. A network representation may capture who interacts with whom while missing the content, temporality, embodiment, or institutional meaning of the interaction. Second, generative analysis can become overly expansive if every remote historical antecedent is treated as part of the mechanism. Third, system boundaries can hide external dependencies that later prove causally important. Fourth, manifestation data can underdetermine the relational structure from which they arose. Fifth, symbolic representations can impose commensuration on realities whose differences matter. Sixth, scale selection can stabilize an entity that dissolves when examined at another resolution. These are not reasons to abandon relational-generative analysis; they are conditions under which its claims require qualification or supplementation.

Definition 4.174 (Abstraction boundary). An *abstraction boundary* specifies the relations, internal structures, scales, timescales, manifestations, and contextual conditions that an analysis treats as outside its active explanatory representation while recognizing that some excluded elements may remain real and potentially causally relevant.

Definition 4.174 gives methodological exclusion a positive form. An analysis can say what it brackets. A model of market transactions may bracket household care relations; a study of household reproduction may bracket global financial structure; a formal manifestation mapping may bracket embodied phenomenology; an institutional analysis may bracket molecular mechanisms. The boundary becomes problematic when excluded elements materially change the results while remaining unacknowledged. Explicit abstraction boundaries make such revision easier.

A second limit concerns normative inference. Generative success, relational stability, persistence, and causal efficacy remain descriptive or explanatory properties until a normative argument is supplied. A highly stable institution can generate severe exclusion. A powerful symbolic regime can coordinate activity while distorting recognition. A generative process can expand one form of value while destroying another. GRE therefore keeps evaluative judgment distinct from the fact that a system reproduces itself effectively.

A third limit concerns epistemic access. Relational-generative models often infer structures from traces, outcomes, records, classifications, or manifestations. Sections 4.8 and 4.9 established that manifestation mappings can be relationally real and still non-invertible. An analytically elegant relational structure can therefore remain underdetermined by available evidence. Methodological expedience does not license filling this gap with preferred theory. The model should mark where inference depends on assumptions, priors, idealizations, or inaccessible historical conditions.

A fourth limit concerns performativity and recursion. Once a relational-generative

representation enters institutions, it can begin to alter the reality it describes. A risk model can change lending; a labor classification can change rights and incentives; a measure of productivity can reorganize work; a theory of markets can influence market design. The analytical expedient can therefore become a manifestational or relational object within the system. Reflexive monitoring is required when representation changes the generative field.

Claim 4.175 (Revisability of abstraction). *A relational-generative abstraction should be revised, supplemented, or replaced when excluded structures, alternative scales, changing historical conditions, new manifestations, or competing representations materially alter the explanatory conclusions for which the abstraction was adopted.*

Claim 4.175 gives methodological pluralism an operational criterion. The question is not whether relational-generative analysis is universally correct. The question is whether it remains adequate for the inquiry and whether another representation captures consequential structure that it omits. Revision can deepen the relational model, combine it with another method, change scale, alter boundaries, or suspend the relational-generative representation altogether for a particular task.

The resulting methodological position is therefore strong without being exclusive. GR and GRE use relations to investigate dependence, organization, mediation, and position; they use generativity to investigate emergence, reproduction, transformation, and future possibility. These selections support substantive claims when the relevant structures are evidenced and causally consequential. Their success does not require a final declaration that reality consists only of relations or that every phenomenon is best understood through its generative history. Relational-generative analysis earns its place through explanatory performance, explicit scope, and capacity for revision.

Section 108 thus clarifies the methodological standing of the framework developed throughout Chapter 4. Relation and generativity function as disciplined analytical selections; ontological suspension preserves room for stronger or alternative ontologies; methodological economy limits conceptual machinery to what the question requires; and explicit abstraction boundaries make the costs of simplification visible. The next section develops the positive implication of this position by examining compatibility with alternative ontological commitments, including substance-oriented, process-oriented, relation-oriented, and domain-specific ontologies.

4.20 Compatibility with Alternative Ontological Commitments

The ontological architecture developed in Chapter 4 is intended to support substantive inquiry without requiring every investigation to adopt one comprehensive metaphysical doctrine. The role of the present section is to specify how Generative Relational Theory (GR) and Generative Relational Economics (GRE) can remain compatible with alternative ontological commitments while preserving the analytical distinctions already established among ontological reality, relational reality, manifestational reality, representation, scale, and historical emergence. Its objective is to replace a vague appeal to pluralism with explicit conditions of compatibility. The discussion proceeds through ontological pluralism, substance-oriented, process-oriented, relation-oriented, and domain-specific ontologies, followed by criteria for translation, coexistence, and operative disagreement.

Compatibility in this context is weaker than identity and stronger than mere tolerance. Two ontological frameworks can be compatible for a specified inquiry when their commitments can coexist without contradiction at the level required by that inquiry, when their vocabularies can be related through an explicit translation or division of explanatory labor, or when disagreement concerning stronger claims remains non-operative for the local analysis. Compatibility can therefore be partial, asymmetric, scale-dependent, or question-dependent. A framework may be compatible with GR for one class of claims while conflicting with it for another. (Whitehead 1929; Quine 1948; Archer 1995)

Definition 4.176 (Local ontological compatibility). Two ontological commitments are *locally compatible* with respect to a specified inquiry when their jointly retained claims do not generate an operative contradiction for the objects, scales, causal relations, manifestations, or explanatory tasks under study, and when any translation between their terms is stated at the level actually warranted.

Definition 4.176 places scope at the center of compatibility. It avoids treating ontological frameworks as packages that must be accepted or rejected in their entirety. A substance-oriented account may provide a useful specification of relatively enduring entities while a process-oriented account explains their transformation. A relation-oriented account may clarify dependence among those entities while a legal ontology specifies institutionally recognized persons, offices, rights, and obligations. The resulting analysis can be coherent when the commitments are assigned clear roles and when a local translation does not silently become a claim of universal equivalence.

This position extends the methodological standing established in Section 4.19. Relational-generative analysis earns its place through explanatory performance, explicit scope, and revisability. Compatibility with alternative ontologies follows from the same discipline. GR can use an ontology strongly where its commitments matter and suspend stronger disputes where they do not. Such suspension preserves disagreement rather than dissolving it. A physicalist, phenomenological, processual, institutional, or relation-oriented account can therefore remain distinct even when each contributes to a shared analysis.

4.20.1 Ontological Pluralism

Ontological pluralism, as used here, concerns the possibility that different domains, scales, questions, or modes of access require different ontological vocabularies. It does not entail that every ontology is equally adequate, that contradictions are harmless, or that reality changes freely with description. Pluralism instead recognizes that an inquiry can encounter heterogeneous kinds of object and that one vocabulary may illuminate some structures while obscuring others.

The three-register architecture already creates a disciplined form of plurality. Ontological reality concerns what obtains independently of a particular manifestation; relational reality concerns what emerges, persists with sufficient stability, and exercises causal efficacy within a generative-relational system; manifestational reality concerns what becomes available under a specified manifestational configuration. These distinctions do not determine whether the ultimate constituents of a domain are substances, processes, relations, fields, events, organisms, informational structures, or something else. They organize questions that can be posed across several such commitments.

Pluralism also appears across scale. Section 4.17 showed that a configuration can be represented as an entity at one scale and as a distributed process or relation at another. The availability of both descriptions does not imply that each is equally useful for every task. A corporation may be treated as a juridical entity for contract and liability, as an organizational process for internal coordination, as a network for supply-chain dependence, and as a historical institution for long-run transformation. Each view can identify real features while selecting a different resolution.

Claim 4.177 (Plurality with constraint). *Ontological plurality is analytically productive when each adopted vocabulary identifies a specified object or scale, preserves the causal and evidential constraints relevant to that object, and exposes rather than conceals the points at which translation across vocabularies becomes uncertain or fails.*

Claim 4.177 makes pluralism answerable to evidence and explanation. A plurality of models does not provide a license to move opportunistically among incompatible claims. Where two ontologies produce different causal expectations, different identity criteria, or different accounts of persistence, the disagreement becomes operative and should be investigated. Where they differ only in stronger metaphysical commitments that do not change the local analysis, ontological suspension can preserve both possibilities.

This approach also guards against premature synthesis. A translation between two ontologies can be useful without establishing that they refer to the same structure in the same way. The category-theoretic language introduced in Section 4.16 offers one formal illustration: a mapping can preserve selected structures while leaving other structures unmapped. Ontological comparison should be treated similarly. The analyst should identify what is preserved, what changes, and what remains outside the translation.

4.20.2 Substance-Oriented Ontologies

Substance-oriented ontologies give analytical priority to entities that possess some degree of persistence, identity, or bearer-like continuity across change. GR can accommodate such entities when their identification is empirically or conceptually useful. Relational-generative analysis does not require every object to dissolve into relations. It asks whether the capacities, persistence, or transformation of the object depend materially on relations and generative histories.

This compatibility is especially important in economics. Persons, firms, assets, commodities, contracts, infrastructures, and states are frequently treated as units with relatively stable identities. Many economic questions require precisely such units. Accounting, ownership, liability, inventory, demographic measurement, and contractual analysis become difficult when every entity is redescribed at every moment as a fully decomposed relational configuration. A substance-oriented representation can therefore provide an appropriate local ontology for a specified task.

GR adds two questions to that representation. First, what supports the persistence and identity criteria by which the entity remains identifiable? Second, which capacities attributed to the entity are generated or transformed through relations? These questions can deepen a substance-oriented analysis without invalidating the entity. A firm can remain a firm while its productive capacity depends on labor, law, finance, technology, suppliers, and customers. A person can remain an embodied individual while economic agency depends partly on education, recognition, legal status, infras-

tructure, and social reproduction.

Remark 4.178 (Entity persistence and relational constitution). A relatively enduring entity can be treated as an analytical bearer of properties while some of those properties, capacities, or identity conditions are explained relationally. Compatibility therefore depends on distinguishing the persistence of the entity from the provenance of every feature attributed to it.

This distinction prevents two opposite reductions. Entity-centered analysis can become insufficient when it treats relationally generated capacities as intrinsic and history-free. Relational analysis can become insufficient when it treats the identification of entities as analytically dispensable even where persistent units carry causal, legal, biological, or institutional significance. Local compatibility permits the two descriptions to coexist when their scopes are explicit.

A stronger metaphysical substance doctrine may eventually conflict with a stronger metaphysical relational doctrine. GR need not resolve that conflict in advance. Under ontological suspension, the operative question is whether the dispute changes the causal, historical, or manifestational claims required by the inquiry. If it does, the disagreement should be made explicit. If it does not, the analysis can proceed while preserving the stronger disagreement for another level of inquiry.

4.20.3 Process-Oriented Ontologies

Process-oriented ontologies emphasize becoming, transformation, activity, event, and temporal organization. Section 4.15 already established that GR can treat processes and events as analytically primary where extended transformation carries the explanatory burden. This orientation is highly compatible with generative analysis because generativity concerns how configurations produce, reproduce, transform, and dissolve subsequent configurations over time.

Compatibility nevertheless requires precision. A generative account need not claim that process is metaphysically prior to every object. An entity can be analyzed through the processes that sustain it while retaining an entity-level identity for other purposes. Dynamic persistence provides one bridge. A phenomenon can remain sufficiently stable to count as a relationally real object even when its stability depends on ongoing processes of maintenance, repair, reproduction, recognition, or exchange.

Economic institutions illustrate this point. Money, organizations, markets, property arrangements, and occupational categories persist through repeated practices, legal acts, accounting routines, infrastructural operations, and expectations. Their persistence can therefore be processually sustained. A process-oriented view helps explain how stability is achieved rather than treating stability as a primitive fact. GR can adopt that explanation while continuing to refer to money, organizations, or institutions as relationally real objects at the scale where their causal efficacy is coherent.

Process orientation also supports the historical dimension of GRE. Generative consequences may unfold across multiple timescales, and later relations can incorporate the products of earlier processes. The recursive architecture of Section 4.11 becomes especially useful here: manifestations and representations can enter subsequent processes and alter the conditions of later emergence. Historical becoming is therefore compatible with temporary stabilization.

Claim 4.179 (Process-compatible persistence). *The persistence required for relational reality is compatible with process-oriented ontology when stability is produced through sufficiently continuous or recurrent processes that preserve an object's causal efficacy over the relevant spacetime interval.*

Claim 4.179 avoids equating persistence with immobility. It also preserves the strict relational-reality criterion. A transient process can be manifestationally real without yet constituting a persistent relational object; a recurrent or self-maintaining process may itself satisfy the persistence, stability, and causal-efficacy conditions required for relational reality. The relevant analytical unit can therefore be an enduring object, an organized process, or a coupled object-process description.

4.20.4 Relation-Oriented Ontologies

Relation-oriented ontologies assign strong explanatory or metaphysical significance to relations, relational positions, or structures of dependence. GR has an obvious affinity with this family of views because relational emergence is central to its analytical vocabulary. The affinity remains deliberately limited by ontological suspension. Relational analysis can be indispensable without establishing that relations are universally prior to relata or that every domain is exhaustively relational.

A relation-oriented ontology becomes especially useful where objects acquire capacities through position, coupling, recognition, dependence, or interaction. Trust, authority, institutional office, market access, indebtedness, legal standing, and organizational role provide examples in which the relevant reality cannot be adequately specified through isolated intrinsic properties alone. The relational configuration contributes directly to what the object can do and to how it affects subsequent processes.

GR's definition of relational reality, however, is more selective than a general declaration that everything is relational. An object becomes relationally real when it emerges within a generative-relational system, persists with sufficient stability over a relevant region or interval of spacetime, and exercises causal efficacy within that system. The criterion therefore identifies a mode of reality within a system rather than asserting a complete metaphysical inventory of the world.

This selectivity allows GR to remain compatible with weaker and stronger relation-oriented ontologies. A weak relational ontology may claim that some properties are essentially relational. A stronger version may treat relations as ontologically fundamental. GR can work with either where the local analysis concerns structures both frameworks recognize. The stronger dispute can remain suspended until it becomes operative.

The distinction between relational reality and manifestationally real is also important here. A relation can be causally operative before a subject perceives or symbolizes it. Conversely, manifestations and symbols can enter the relation and reshape it. Relation-oriented ontology therefore gains a historical and recursive dimension without requiring manifestation to constitute all relational reality. The graph architecture among the registers remains available under several strengths of relational metaphysical commitment.

4.20.5 Domain-Specific Ontologies

Many inquiries rely on ontologies whose terms are specific to a domain. Law distinguishes persons, offices, rights, duties, jurisdictions, instruments, procedures, and recognized acts. Economics distinguishes assets, liabilities, commodities, firms, households, prices, contracts, and forms of capital. Biology, psychology, computation, ecology, and engineering each employ their own objects and identity criteria. These domain ontologies can carry substantial explanatory and practical force even when their relations to ultimate ontology remain unsettled.

GRE therefore requires a disciplined interface between domain-specific ontology and GR's broader analytical architecture. Domain terms should retain the distinctions that make them operationally meaningful. A legal person should not be translated automatically into a network node; a price should not be reduced automatically to a symbol; a corporation should not be reduced automatically to a set of interpersonal relations; an artificial operational subject should not be assumed to share the ontology of a human subject because both can occupy similar economic interfaces.

The three-register architecture can organize these domain terms without replacing them. A legal status can be analyzed as relationally real when institutional relations stabilize it and it causally affects what actors can do. Its certificates, registry entries, judgments, and identifiers belong to manifestational and representational processes. Questions about the ultimate ontology of personhood, normativity, or institutional facts can remain open where the economic analysis does not require their resolution.

Domain-specific ontologies also matter for intervention. Institutions act through operational categories. Tax systems, courts, firms, welfare agencies, payment networks, and computational platforms require classifications that determine eligibility, ownership, responsibility, access, or transfer. Such categories can become relationally real because they structure subsequent action. Their practical necessity does not guarantee epistemic adequacy or normative legitimacy. GRE can therefore study the generative effects of domain categories while keeping their truth, justice, and ontological fundamentality distinct.

Definition 4.180 (Domain-ontology interface). A *domain-ontology interface* is an explicit mapping between a domain's operational objects and GR's analytical distinctions that preserves the domain-specific identity conditions required for the inquiry while identifying where relational emergence, manifestation, representation, scale, or historical transformation materially affect those objects.

Definition 4.180 treats translation as selective. The objective is to preserve enough structure for cross-domain inquiry without erasing what makes the source domain distinctive. Some translations may be close; others may preserve only a few relations; still others may fail because the relevant objects lack a warranted common comparison space. The non-necessary comparability developed earlier in the chapter therefore applies equally to ontological vocabularies.

4.20.6 Conditions of Compatibility

The compatibility developed in this section can be summarized through a set of conditions. These conditions are methodological criteria for joint use rather than axioms of a final ontology. They specify when alternative commitments can enter a GR or GRE analysis without conceptual collapse.

First, the object and scale of each ontology should be explicit. A vocabulary suited to embodied persons may operate differently from one suited to organizations, legal offices, or computational agents. Second, identity and persistence criteria should be stated where they matter. What counts as the same firm, subject, institution, process, or relation can vary across domains and scales. Third, causal claims should remain attached to the mechanisms recognized by the relevant ontology rather than being translated into a generic relational idiom that loses mechanism-specific content.

Fourth, mappings across ontologies should specify what they preserve. A translation may preserve causal ordering, functional role, legal status, manifestational form, organizational position, or selected relational structure while losing other dimensions. Fifth, residual structure should remain visible. A successful local correspondence does not imply global equivalence. Sixth, stronger disagreements should be classified by whether they are operative for the inquiry. Ontological suspension is appropriate where disagreement does not alter the retained claims; explicit adjudication becomes necessary where competing commitments generate different expectations, identity conditions, or interventions.

Claim 4.181 (Compatibility discipline). *Alternative ontological commitments can be jointly used within GR or GRE when their scopes, identity criteria, causal roles, translation rules, and residual disagreements are explicit, and when stronger metaphysical disagreements are suspended only to the extent that they remain non-operative for the inquiry.*

Claim 4.181 makes compatibility an active analytical task. It requires more than placing several vocabularies side by side. The analyst must specify how they interact and where they diverge. This requirement is especially important in interdisciplinary research, where the same term can carry different identity criteria across law, economics, computation, psychology, or political theory.

Compatibility also has temporal conditions. An ontology that is locally adequate at one historical stage may become less adequate when new entities, infrastructures, practices, or manifestations emerge. Section 4.18 showed that ontological categories can possess historical materiality. The compatibility relation among ontologies can therefore change as well. A distinction that once aligned across institutional and technical domains may later fracture; new interfaces can create forms of subjecthood or organization that require revised mappings.

A final condition concerns normativity. Ontological compatibility does not settle normative compatibility. Two frameworks may describe the same institution coherently while supporting different judgments about legitimacy, justice, welfare, or responsibility. GRE should preserve that distinction. The ontological question concerns what kinds of objects and relations the analysis recognizes and how they persist or act. Normative evaluation requires additional premises and arguments.

The resulting position is a constrained ontological pluralism. GR offers a common analytical architecture for distinguishing ontological, relational, and manifestational reality; tracing generative histories; identifying causal efficacy; and examining recursive mediation. That architecture can interface with substance-oriented, process-oriented, relation-oriented, and domain-specific ontologies without treating them as interchangeable. Compatibility is earned locally through explicit scope, preservation of relevant structure, and disciplined treatment of residual disagreement.

Section 109 therefore extends ontological suspension into a positive method of interdisciplinary coexistence. Alternative ontologies can contribute different resolu-

tions of the same domain, or address different domains altogether, while GR provides a vocabulary for asking how those resolutions connect, where they fail to connect, and when their disagreements become causally or analytically operative. The next section narrows the chapter's claims by specifying the limits of GRE's ontological commitments and the kinds of metaphysical, empirical, and normative conclusions that the present architecture does not by itself establish.

4.21 Limits of GRE Ontological Claims

The ontological architecture developed in this chapter makes substantive claims about emergence, persistence, stability, causal efficacy, manifestation, representation, scale, and historical transformation. Its usefulness depends equally on specifying the claims that do not follow from those commitments. The role of the present section is therefore to establish the boundary of GRE's ontological claims before the chapter turns from reality to knowledge. Its objective is not to weaken the three-register architecture, but to distinguish what the architecture warrants from stronger conclusions that require additional metaphysical, empirical, epistemic, or normative argument. The discussion proceeds through the boundary of established claims, ontological underdetermination, the limits of formal ontology, limits of cross-domain generalization, and openness to ontological revision.

A theory can become less precise when the scope of its strongest concepts expands faster than the evidence supporting them. This risk is particularly important for a framework that uses terms such as *reality*, *emergence*, *causal efficacy*, and *subjecthood*. GRE therefore treats explicit limitation as part of ontological discipline. A claim that money, an institution, a self-model, a form of trust, or another object is relationally real says something substantive: the object has emerged within a generative-relational system, persists with sufficient stability over a relevant spacetime region or interval, and exercises causal efficacy within that system. The claim does not by itself determine the object's ultimate ontological constitution. Similar restraint applies to manifestational reality, symbolic representation, formal modeling, and cross-scale analysis. (Fraassen 1980; Giere 2004; Longino 1990)

Definition 4.182 (Ontological claim boundary). An *ontological claim boundary* is the explicitly stated limit separating the commitments warranted by a GR or GRE analysis from stronger claims concerning ultimate constitution, exhaustive classification, universal applicability, epistemic truth, or normative validity that require additional argument.

Definition 4.182 makes limitation internal to the method rather than an afterthought. A strong local claim can coexist with restraint concerning stronger questions. GRE can, for example, assert the causal reality of a monetary institution while suspending the question of whether institutional reality is reducible to physical, psychological, informational, legal, or other structures. It can analyze the relational reality of an experienced continuity of self without claiming to have settled the ontology of consciousness. It can treat a religiously mediated object as relationally real within a system when the persistence, stability, and causal-efficacy conditions are satisfied without inferring from that relational reality either the independent ontological existence or non-existence of the object in question.

This distinction is also important for the architecture of the three registers. Onto-

logical reality, relational reality, and manifestational reality organize different questions. They are not asserted to be an exhaustive partition of everything that can exist, nor are they three substances from which reality is composed. Their graph-like relations are likewise analytical commitments rather than a universal causal diagram imposed on every domain. The framework earns explanatory force by preserving these distinctions while allowing their concrete realization to remain open.

4.21.1 Boundary of Established Claims

The first limit concerns what the chapter has actually established. The three-register architecture distinguishes ontological, relational, and manifestational questions; it specifies a strict criterion for relational reality; it treats manifestation as condition-dependent and potentially recursive; and it allows representations, mappings, institutions, categories, and subjects to become causally operative within generative-relational systems. These commitments provide a disciplined ontology for GRE inquiry. They leave several stronger questions unresolved.

GRE does not establish that relation is the fundamental substance of reality. Relational-generative analysis can be indispensable for a specified economic object while stronger metaphysical questions remain suspended. Section 4.19 therefore treated relational-generative analysis as a scoped methodological commitment, and Section 4.20 showed how this commitment can coexist locally with substance-oriented, process-oriented, relation-oriented, and domain-specific ontologies. The explanatory importance of relations does not by itself establish their metaphysical priority.

The chapter also does not establish that every persistent pattern is relationally real. Persistence and stability are necessary components of the criterion developed in Section 4.5, but causal efficacy within the relevant generative-relational system remains essential. A regularity that merely recurs in an analyst's description may lack the causal participation required for relational reality. Conversely, a relational reality can be dynamically maintained rather than static. Stability concerns maintained organization over an inquiry-relevant region or interval, not immobility.

Causal efficacy does not establish epistemic truth. Section 4.10 showed that representations can become relationally real through their consequences even when they are partial, inaccurate, or false concerning their targets. A classification can alter eligibility, a mistaken belief can reorganize conduct, and an inaccurate metric can redirect resources. Their effects are real without making their representational content true. The same distinction applies to manifestational salience: what becomes strongly visible or institutionally legible need not provide an exhaustive or privileged disclosure of the underlying relational configuration.

Causal efficacy also does not establish normative validity. Money, legal categories, institutional hierarchies, identities, classifications, and value regimes can become highly stable and causally powerful while remaining ethically contested or unjust. Persistence can indicate successful reproduction rather than justification. The ontology developed here therefore supplies objects for normative analysis but does not convert historical survival, institutional recognition, or generative power into moral endorsement.

Nor does relational reality require prior perception, awareness, or symbolization. This point creates a limit in the opposite direction: the absence of manifestation to

a particular subject does not justify the conclusion that no relationally real structure exists. Contingency provides an important example. A historical-generative configuration through which a contingent encounter becomes possible can already be relationally organized before that contingency is consciously recognized, aesthetically judged, or symbolically articulated. The later manifestation may reveal, select, amplify, or transform part of that structure without creating the entire relational reality at the moment of perception.

Claim 4.183 (Non-entailment discipline). *Within GRE, persistence does not by itself entail relational reality; relational reality does not entail ontological fundamentality; manifestation does not entail exhaustive disclosure; causal efficacy does not entail episodic truth; and historical stabilization does not entail normative validity.*

Claim 4.183 is a compact statement of the chapter's claim boundary. Its purpose is not skeptical. Each term remains capable of supporting strong conclusions within its appropriate domain. The discipline lies in resisting movement from one kind of warranted claim to another without an explicit bridge.

The same restraint applies to comparison. Two objects can both satisfy the criterion for relational reality without occupying a common metric space, a common ordering, or even a justified common comparison domain. The hallucinatory flower discussed earlier and an ordinarily perceived physical flower may each be relationally real in relevant systems while differing radically in generative structure. Shared reality-status therefore establishes neither structural similarity nor commensurability. Any comparison must specify what relation, mapping, invariant, or practical criterion makes the comparison meaningful.

4.21.2 Ontological Underdetermination

The second limit arises because the evidence available to an inquiry may support several ontological interpretations. The non-invertibility of manifestation developed in Section 4.9 provides one route to this result. Different relational configurations can generate similar manifestations, while similar relational configurations can manifest differently under changing conditions. Even when an observed pattern is robust, reconstruction from manifestation toward underlying organization can remain underdetermined.

Ontological underdetermination is broader than manifestational non-invertibility. The same relationally effective organization can sometimes be described through different ontological vocabularies. A firm can be modeled as a juridical entity, an organizational process, a contractually structured nexus, a network of dependencies, or a historically reproduced institution. These descriptions need not be equivalent, and each can reveal structures hidden by the others. Yet available evidence may fail to determine which vocabulary, if any, captures the ultimate constitution of the object.

Definition 4.184 (Ontological underdetermination). *Ontological underdetermination obtains when the evidence, causal regularities, manifestations, and successful explanatory relations available within a specified inquiry remain compatible with more than one materially distinct ontological interpretation.*

Definition 4.184 is inquiry-relative. Additional evidence, a different scale, a new intervention, or a stronger explanatory demand can reduce underdetermination. The concept therefore differs from a permanent declaration that ontological questions are undecidable. It identifies a present relation between evidence and claim strength.

Underdetermination is especially relevant to the examples that motivate ontological suspension. Consider the continuity of the experienced “I.” GRE can investigate how bodily continuity, memory, recognition, narrative, institutional identity, and repeated action participate in stabilizing a relationally real self. Such analysis can explain important causal consequences of selfhood while several ontologies of consciousness and personal identity remain compatible with the retained evidence. The relational analysis is not empty because the metaphysical question remains open; neither does explanatory success in the relational domain settle that question automatically.

A similar point applies to money. Monetary reality can be studied through institutional authority, legal designation, accounting systems, expectations, payment infrastructures, conventions, and material tokens. These relations can sustain an object with substantial persistence and causal efficacy. Several ontological interpretations of institutional facts can nevertheless remain available. GRE needs to resolve among them only when their differences become operative for the economic question under study.

Underdetermination also explains why the ontological register cannot be identified with whatever remains after relational and manifestational analysis. Ontological reality is not a residual box containing an unknown substrate. It names the question of what obtains beyond the commitments licensed by a particular manifestation or relational model. In some inquiries, stronger ontological claims can be justified; in others, suspension remains the more disciplined position.

Claim 4.185 (Strength calibration under underdetermination). *When materially distinct ontological interpretations remain compatible with the evidence and explanatory relations available to an inquiry, GRE should calibrate its claims to the structure jointly supported by those interpretations unless the stronger disagreement becomes operative for explanation, prediction, intervention, or evaluation.*

Claim 4.185 preserves both explanatory ambition and metaphysical restraint. It permits the analysis to advance where common structure is well supported while keeping stronger disagreements visible for later investigation.

4.21.3 Limits of Formal Ontology

Formal languages can sharpen ontological reasoning by making identity criteria, mappings, compositional rules, invariants, state spaces, constraints, and transformation structures explicit. This chapter has used such resources selectively, including dynamical language, mapping notation, scale-relative descriptions, and a category-theoretic view. Their precision can expose assumptions that ordinary prose leaves implicit. Their limits are equally important.

A formal representation does not establish that its mathematical objects are the literal constituents of the domain. A graph can represent relational dependence without implying that a society is fundamentally a graph. A state space can represent possible configurations without implying that the represented system possesses that space as an independent metaphysical object. A category can encode objects and morphisms relevant to an inquiry without establishing categorical ontology. A field model can capture distributed interaction without proving that the social domain is fundamentally a field.

This distinction follows from the chapter’s treatment of mappings. Formalization

selects objects, relations, equivalence criteria, boundaries, and admissible transformations. Those selections can be analytically justified while remaining choices of representation. Different formalisms can preserve different structures of the same domain. Their comparative success is an empirical and explanatory matter rather than a direct route from mathematical elegance to ontological truth.

Formal ontology also encounters the problem of representation-induced identity. Once an analyst chooses a state description or category of objects, elements that differ outside that formalization may become identical inside it. This can be useful. An economic model may intentionally treat two heterogeneous realizations as equivalent because they perform the same relevant function. Section 4.17 described such local equivalence under multiple realization. The loss of distinction should nevertheless remain visible. Formal equality inside a model can represent a justified abstraction without entailing ontological identity outside it.

Remark 4.186 (Formal exactness and ontological strength). Greater exactness within a formal representation increases clarity concerning the commitments of that representation. It does not, by itself, increase the ontological strength of the claim connecting the representation to the world.

Remark 4.186 is especially important in interdisciplinary work. Mathematical sophistication can make assumptions more precise while leaving the empirical warrant for those assumptions unchanged. A beautifully defined equivalence relation, functor, potential function, attractor, or metric still requires a defensible interpretation linking it to the domain.

Formal systems can also create commensurability that the source domain did not possess in advance. Section 4.10 described symbolic commensuration; mathematical representation can perform an analogous operation. Assigning values to a common coordinate, metric, utility, score, or latent space can make comparison possible for a specified purpose. The resulting comparison may be operationally powerful and even institutionally consequential. Its existence inside the formalism does not prove intrinsic commensurability among the represented realities.

GRE therefore treats formal ontology as an instrument for disciplined representation, inference, and comparison. It can contribute to ontological inquiry by exposing structure, generating testable implications, and revealing invariant or transformational relations. It remains answerable to the domain and to the evidential conditions under which its objects are interpreted.

4.21.4 Limits of Cross-Domain Generalization

A further limit concerns the transfer of ontological categories across domains. GR is intentionally broad enough to support inquiry into economic, legal, political, educational, technological, ecological, and other relational systems. Breadth creates the temptation to assume that concepts established in one domain transfer unchanged to another. GRE resists that inference.

The criterion for relational reality is deliberately general, but its operationalization is domain-sensitive. Persistence for a market convention can have a different temporal scale from persistence for an ecological relation, a legal office, a computational process, or an interpersonal trust relation. Causal efficacy can also take different forms: changing resource flows, altering legal possibilities, constraining behavior, reorganizing attention, modifying biological processes, or transforming symbolic expectations.

The general criterion gains content only through domain-specific mechanisms.

The same limitation applies to subjecthood. Human persons, corporations, states, algorithms, animals, and collective organizations can occupy causally important positions in economic systems. Similarity in economic function or manifestational output does not establish identical forms of subjecthood. Section 4.12 therefore distinguished human subjecthood from artificial operational subjecthood and treated manifestational equivalence as local. Cross-domain generalization should preserve such differences rather than elevate a shared interface into universal identity.

Value and meaning provide another case. A common symbolic scale can create practical commensuration among heterogeneous values, while the underlying value structures remain non-equivalent. Likewise, a concept of meaning developed for linguistic interpretation cannot automatically be extended to every biological, computational, or institutional process that exhibits patterned response. Domain transfer requires an explicit account of what is preserved and what changes.

Definition 4.187 (Cross-domain transfer condition). A *cross-domain transfer condition* specifies the properties, relations, causal roles, identity criteria, scales, and evidential assumptions that must be preserved for an ontological or relational concept to be used across distinct domains without silently changing its meaning.

Definition 4.187 makes generalization a constructive task. A concept can travel, but its travel requires a map. Sometimes the transfer will preserve a substantial common structure. Sometimes only an analogy survives. Sometimes the domains lack a warranted common space of comparison. The possibility of failure is part of disciplined generalization.

This restraint also protects GR from becoming a vocabulary that redescribes everything in the same terms. If every phenomenon is called a relation, field, attractor, emergence, or generative process without domain-specific criteria, explanatory content diminishes. A broad framework remains useful when its general concepts constrain inquiry while allowing local sciences and disciplines to supply mechanisms, measurements, categories, and evidence that cannot be derived from the framework alone.

For GRE, the economic domain remains primary. Connections to law, politics, ecology, psychology, computation, education, and other domains can be necessary because economic relations cross those boundaries. The ontological interface should nevertheless respect the concepts through which those domains identify their own objects. Cross-domain synthesis is warranted where the interfaces are explicit; conceptual annexation is not.

4.21.5 Openness to Ontological Revision

The final limit is temporal. GRE's ontological categories are intended to remain revisable when new evidence, new forms of organization, new scales, new modes of manifestation, or new conceptual distinctions alter what the framework can adequately describe. This openness follows from the historical materiality developed in Section 4.18 and from ontological suspension developed in Section 4.3. A historically situated research programme should not treat its present ontology as immune to the processes it studies.

Ontological revision can occur at several levels. A previously useful object category

can become inadequate when its internal heterogeneity becomes causally important. A relation once treated as background can become a central mechanism. A manifestational distinction can cease to track the relational structure it was designed to represent. A new technological or institutional configuration can generate objects for which existing identity criteria are unstable. A formal model can reveal overlooked invariants, while empirical evidence can show that an assumed invariant is historically contingent.

Revision does not require abandoning earlier concepts whenever novelty appears. Many categories remain useful across substantial historical change. The relevant question is whether the retained category continues to preserve the distinctions needed for explanation, intervention, and evaluation. Revision becomes warranted when anomalies are systematic, when causal mechanisms fall outside the existing object structure, when previously excluded differences become consequential, or when alternative ontological descriptions achieve materially stronger explanatory adequacy.

Claim 4.188 (Ontological revisability). *GRE should revise an ontological commitment when sustained evidence or explanatory failure shows that the commitment no longer preserves distinctions necessary for identifying relevant objects, causal relations, persistence conditions, manifestations, scales, or transformations within the inquiry.*

Claim 4.188 makes revisability conditional rather than fashionable. Ontological novelty is not inferred merely from new terminology, new technology, or a new representation. Revision should answer to changes in explanatory adequacy and to the realities under investigation.

The three-register architecture itself is subject to this principle. Ontological reality, relational reality, and manifestational reality currently provide a productive set of distinctions for the GR research programme. Their usefulness does not grant them immunity from criticism. Future inquiry may require finer subdivisions, different mappings among registers, domain-specific extensions, or alternative concepts that preserve relevant phenomena more adequately. Such revision would be compatible with the framework's present commitments because openness has been built into those commitments from the beginning.

This openness also prevents ontological restraint from becoming intellectual passivity. Suspension is provisional where inquiry can proceed, and stronger ontological questions can be reopened when they become operative. Formalization can be strengthened when measurement and mechanism justify it. Cross-domain concepts can be generalized when preservation conditions are demonstrated. Alternative ontologies can be compared more sharply when they generate different empirical or practical consequences. The boundary established in this section therefore marks a frontier for further inquiry rather than a prohibition against stronger claims.

Section 110 completes the chapter's explicit account of ontological scope. GRE commits to enough reality to analyze generative systems seriously: relations can produce stable and causally efficacious objects; manifestations and representations can participate recursively in later reality; subjects, institutions, value, meaning, processes, and categories can acquire historically situated forms of reality; and these structures can be compared across scales when warranted. The framework simultaneously leaves ultimate constitution, exhaustive ontology, universal commensurability, complete formal capture, and unrestricted cross-domain transfer open to additional argument. With that boundary in place, the remaining problem

is epistemic: given realities that can exceed, precede, and be transformed by their manifestations, how can an inquiry responsibly know them? Section 111 turns to that transition.

4.22 Reality, Access, and Epistemic Reconstruction

The ontological work of this chapter produces an epistemic problem rather than an epistemic solution. GR has distinguished ontological reality, relational reality, and manifestational reality; specified the conditions under which an object may be treated as relationally real; shown that manifestation is generated through historically and relationally formed conditions; and established that manifestations and representations can recursively alter subsequent relational reality. These commitments clarify what kinds of realities an inquiry may address, but they also make clear why knowing those realities cannot be reduced to reading their visible expressions at face value. The role of this final section is therefore to state the epistemic consequences of the three-register architecture and to prepare the research programme developed in Chapter 5. Its objective is not to provide a complete epistemology in advance, but to identify the structure of the problem: reality can exceed manifestation, manifestation can disclose without exhausting, representation can mediate without transparently copying, and inference must reconstruct relations through historically situated traces.

This transition matters because ontological restraint changes what counts as an adequate epistemology. Once GRE suspends stronger claims about ultimate constitution where they are unnecessary, knowledge cannot be defined as possession of a final metaphysical description. At the same time, ontological suspension does not license a retreat to unconstrained interpretation. Relational realities remain capable of persistence, stability, and causal efficacy; manifestations remain constrained by the configurations through which they emerge; and representations can be compared with evidence, revised, and tested against subsequent consequences. The epistemic task is consequently neither transparent access nor arbitrary construction. It is the disciplined reconstruction of realities whose accessibility is mediated, partial, historical, and potentially recursive. (Giere 2004; Longino 1990; Hacking 2002)

The chapter's preceding distinctions also imply that epistemology must preserve the difference between an object and the conditions under which that object becomes knowable. A monetary relation is not identical to an accounting entry that records it. A legal position is not exhausted by the administrative category through which it becomes legible. A configuration of trust may already be relationally real before it is explicitly acknowledged. A contingent structure can shape what later becomes aesthetically salient before a subject recognizes the encounter as contingent or beautiful. In each case, evidence may arise through manifestation, but the evidential form and the relational reality to which it refers remain analytically distinct. Knowledge therefore requires attention not only to what appears, but also to the relations that make appearance possible and to the transformations introduced by observation, symbolization, measurement, and representation.

Claim 4.189 (Epistemic consequence of the three-register architecture). *If relational reality can precede particular manifestations, if manifestation is generated through condition-dependent relations, and if manifestations and representations can alter sub-*

sequent relational reality, then knowledge of a generative-relational system requires inquiry into both the realities under study and the relations through which evidence of those realities becomes available.

Claim 4.189 gives the transition its basic form. The manifestation relation is not an invisible channel that epistemology can ignore. It becomes part of the object of inquiry. A trace can be informative because of how it was generated; a classification can be evidentially limited because of what its institutional production excludes; a repeated manifestation can acquire diagnostic value because the relevant mapping is sufficiently stable; and the same manifestation can become misleading when the mapping changes historically. Epistemic evaluation therefore extends from the manifested content to the generative conditions of manifestation itself.

4.22.1 Reality and Access

The first epistemic consequence concerns access. The three-register architecture does not assume that what is real is immediately available to inquiry. Ontological reality may remain partly or substantially under suspension. Relational reality can exist without having been perceived, named, measured, or symbolized by a particular subject. Manifestational reality marks a mode in which some aspect of a configuration becomes available under specified conditions, but availability itself is selective. What becomes accessible depends on embodiment, instrumentation, institutions, categories, interfaces, histories of attention, scales of observation, temporal position, and other relations that condition manifestation.

Access is therefore better treated as a relation than as a binary possession. An inquiry can have strong access to one aspect of a relational configuration and weak access to another. It can observe current outcomes while lacking historical trajectories. It can possess detailed administrative records while missing informal relations that organize those records' production. It can measure transactions precisely while having limited access to care, coercion, tacit obligation, fear, trust, or unrecorded exchange. It can encounter a stable manifestation while remaining uncertain about the multiplicity of relational structures compatible with it. The epistemic problem is shaped by the configuration of access rather than merely by the amount of information accumulated.

Definition 4.190 (Relational epistemic access). *Relational epistemic access* denotes the historically and materially situated set of relations through which an inquiry can obtain, preserve, compare, interpret, or intervene upon manifestations and traces relevant to a specified epistemic target.

Definition 4.190 treats access itself as analyzable. It can be widened by new instruments, archives, institutions, languages, computational methods, or relationships of trust. It can be narrowed by secrecy, destruction of records, strategic concealment, exclusion from institutions, measurement design, linguistic barriers, unequal resources, or the disappearance of the relevant manifestations. Access can also be distributed. Different actors can hold different traces of the same relational configuration, while no single observer possesses a complete view. The conditions under which evidence is collected thus become part of the history of what can later be known.

This conception also separates absence of access from absence of reality. A relation can be hidden, latent, weakly manifested, or manifest through forms unavailable to a particular inquiry. The absence of a recorded manifestation may therefore have sev-

eral possible interpretations. The relevant relation may not exist; it may exist without producing the expected trace; the trace may have been produced but not preserved; the observer may lack access to it; or the manifestation rule itself may have changed. The epistemic significance of absence depends on the manifestation and recording relations that connect the target to the evidential field.

The converse problem also matters. Abundant access to manifestations does not necessarily yield correspondingly strong access to relational structure. A platform can generate billions of behavioral observations while leaving motivations, external relations, unobserved constraints, institutional conditions, and counterfactual possibilities underdetermined. Administrative systems can accumulate detailed categories whose precision exceeds the adequacy of the ontology they presuppose. Computational abundance can increase the resolution of a manifestational field while reproducing the same blind spots at greater scale. Epistemic strength therefore depends on the relation between evidence and target, not merely on the volume of evidence.

Ontological suspension intensifies rather than weakens this requirement. When GRE declines to settle what an object ultimately is, it must be particularly explicit about what is actually accessible and what inferential bridge connects that access to the claim being made. The framework can know a relational reality through its persistence, causal consequences, historical traces, responses to intervention, or convergent manifestations without pretending that such knowledge exhausts the object's ontology. Knowledge can therefore be substantive while remaining scoped.

4.22.2 Manifestation and Evidential Access

Manifestation supplies a principal interface through which relational realities become evidentially accessible. The term *interface* is useful only if it is not mistaken for a neutral screen. Section 4.7 showed that manifestations emerge through generative-relational conditions, while Section 4.8 showed that sufficiently stable manifestation mappings can themselves become relationally real. An evidential manifestation therefore carries information about a target through a process whose own structure, stability, and history can affect what the evidence means.

Definition 4.191 (Evidential interface). An *evidential interface* is a manifestation relation, or organized set of manifestation relations, through which features of a specified epistemic target become available for observation, recording, comparison, interpretation, or intervention.

An evidential interface can be bodily, linguistic, institutional, legal, statistical, computational, material, or composite. Pain may become accessible through speech, gesture, physiology, clinical examination, or patterns of action. Monetary relations may become accessible through prices, account balances, contractual records, settlement systems, observed exchanges, or institutional interventions. Trust may become accessible through repeated cooperation, expressed commitments, vulnerability, withdrawal, testimony, or responses under changing conditions. None of these manifestations is identical to the relational reality under study, and each preserves some distinctions while transforming or omitting others.

The evidential value of a manifestation consequently depends partly on knowledge of its production. A stable thermometer reading is informative because a sufficiently understood relation connects relevant physical conditions to the displayed value under specified conditions. A legal registry is informative because institutions generate,

preserve, and update entries according to rules whose operation can be investigated. A survey answer is informative under a different manifestation regime involving question wording, interpretation, memory, incentives, social desirability, sampling, and response conditions. Treating all three simply as “observations” would conceal important differences in their generative pathways.

This approach also clarifies why directness is often a poor measure of epistemic quality. A manifestation can feel immediate while being generated through complex learned, embodied, institutional, or technological mediation. Conversely, a highly mediated trace can provide strong evidence when the relevant mapping is well characterized and independently tested. GRE therefore gives priority to reconstructing the evidential relation over ranking evidence by an intuitive scale from direct to indirect. The important questions concern what generates the trace, under what conditions, with what stability, and which relational differences the interface can preserve.

Manifestational plurality can strengthen inquiry when partially independent interfaces constrain the same target from different directions. Testimony, behavior, administrative records, historical documents, material traces, and intervention responses may each preserve different features and possess different failure modes. Convergence among them can reduce the compatibility set described in Section 4.9. Yet convergence is not automatic confirmation. Several manifestations can share the same upstream classification system, institutional incentive, database, or cultural convention and therefore reproduce a common error. Epistemic plurality requires attention to dependence among evidential interfaces rather than merely counting the number of observations.

The historical character of interfaces is equally important. The same symbol, indicator, behavior, or institutional record can change meaning when its manifestation relation changes. A category can persist linguistically while its legal criteria are revised. A price series can span periods in which market institutions, currencies, quality standards, or reporting practices differ. An expression of identity can operate differently after new institutions make that expression consequential. Historical epistemology therefore requires reconstruction not only of traces but of the changing rules through which those traces became possible.

Remark 4.192 (Evidence and manifestation). A manifestation becomes evidence for a specified claim only through an inferential account linking the manifestation, its generative conditions, and the epistemic target. Manifestational reality is therefore broader than evidence, while evidence is manifestation interpreted within a warranted epistemic relation.

Remark 4.192 prevents the ontology of manifestation from silently becoming an epistemology. A manifestation can be real without being evidentially useful for a particular question. It can also be causally powerful while epistemically misleading. The transition to epistemology begins when inquiry asks what a manifestation licenses us to infer.

4.22.3 Representation and Inference

Representation introduces another layer of mediation. Section 4.10 distinguished symbolization from manifestation and showed that symbolic forms can stabilize categories, produce practical commensurability, and become causally effective in their own right. For epistemology, the central problem is that representations do

not merely store already settled knowledge. They select variables, categories, units, scales, boundaries, temporal resolutions, equivalence relations, and conventions through which manifestations become inferentially tractable.

An economic model, statistical indicator, legal category, archival description, qualitative code, graph, narrative, database schema, or computational state representation therefore participates in the structure of inference. Each makes some distinctions explicit and leaves others implicit or unavailable. A representation can preserve the relations relevant to one problem while distorting those relevant to another. The adequacy of representation is consequently task-sensitive without becoming arbitrary: the relevant question is whether the representation preserves, transforms, or suppresses differences that matter for the claim under investigation.

The non-entailment discipline of Section 4.21 applies directly here. Formal exactness does not establish ontological identity. Predictive success does not by itself establish unique causal reconstruction. Institutional uptake does not establish truth. A representation can become relationally real because decisions, expectations, rights, or resource allocations are organized around it while remaining epistemically inadequate concerning its target. This possibility is particularly important in economics, where prices, ratings, rankings, risk scores, classifications, forecasts, and models can feed back into the systems they describe.

Inference must therefore distinguish at least three relations: the relation between a relational reality and its manifestations, the relation between manifestations and their representations, and the relation between those representations and the conclusions drawn from them. Weakness or transformation can enter at each stage. A model can faithfully encode a dataset whose measurement process is biased. A dataset can accurately preserve recorded manifestations while those manifestations are weak indicators of the target. A representation can preserve relevant evidence while an inferential procedure overstates what the evidence supports. Epistemic assessment requires locating uncertainty rather than compressing it into a single undifferentiated confidence judgment.

Claim 4.193 (Layered inferential accountability). *An epistemic claim concerning relational reality should remain accountable to the conditions that generated the relevant manifestations, the operations that represented those manifestations, and the inferential rules through which the representation supports the claim.*

Claim 4.193 does not require every inquiry to reconstruct an unlimited chain of mediation. It requires the chain to be extended far enough that omitted transformations are unlikely to reverse or materially alter the conclusion. This boundary is itself inquiry-relative. A descriptive task may require only a stable reporting relation. A causal claim may require intervention, temporal ordering, mechanism, or comparison among competing generative accounts. A normative decision may additionally require explicit value assumptions, legitimacy conditions, and treatment of affected subjects whose realities are poorly represented by the available data.

Representation can also change the object of inference. Once a category is published, a score assigned, a forecast circulated, or a model institutionalized, agents can respond. The representation then becomes part of the generative-relational system and can alter later manifestations. An epistemology adequate to GRE must therefore track performativity and recursion. Evidence generated after a representation becomes operative may partly reflect the representation itself. The line between observation and intervention can become historically entangled.

This entanglement is not an exceptional defect of social inquiry. It is a structural possibility wherever manifestational and representational forms enter subsequent causal relations. The epistemic task is to identify when that recursion is material. Chapter 5 will therefore treat representation not only as a medium of knowledge but also as a possible generator of later reality.

4.22.4 Inverse Reconstruction

The preceding points converge on an inverse problem. Inquiry commonly encounters manifestations, traces, records, behaviors, symbols, and outcomes and seeks to reconstruct the relational realities, histories, and generative mechanisms compatible with them. Section 4.9 established that manifestation can be non-invertible: multiple relational configurations may produce similar manifestations, while one relational configuration may produce different manifestations under changing conditions. Epistemology must determine what can responsibly be reconstructed despite that non-uniqueness.

The inverse problem is not simply a technical difficulty produced by insufficient data. Additional data can narrow a compatibility set, but non-invertibility can arise from the structure of the manifestation relation itself. Distinct histories may converge on the same current state. Different institutional arrangements may produce the same aggregate statistic. Different motivations can yield the same observed action. Different causal pathways can generate the same outcome. A single relation can manifest differently across cultural, historical, technological, or bodily conditions. Even an extremely detailed manifestational description may therefore leave relational structure underdetermined.

Definition 4.194 (Relational inverse problem). A *relational inverse problem* arises when an inquiry seeks to reconstruct one or more relational configurations, histories, or generative mechanisms from available manifestations and traces for which more than one materially distinct reconstruction remains compatible with the evidence and maintained assumptions.

Definition 4.194 shifts the epistemic aim away from an automatic demand for unique inversion. Sometimes unique reconstruction can be achieved under strong and justified constraints. In other cases, the appropriate epistemic object is a set of plausible relational configurations, an equivalence class, a partially ordered family of explanations, a distribution over possibilities, or a set of invariants shared across competing reconstructions. The form of knowledge should match the identifiability permitted by the evidence.

This point is especially important for historical and social inquiry. A surviving archive is not the past itself. It is a historically generated manifestational field shaped by preservation, destruction, classification, institutional power, material durability, access, and later interpretation. A current institution can preserve traces of earlier relations while also reorganizing them. A subject's present testimony can carry memory, reinterpretation, later categories, and current stakes. Reconstruction therefore requires attention to the history of the evidential interface, not only the content of surviving evidence.

Intervention can sometimes strengthen inverse reconstruction because different candidate relational structures can respond differently when conditions change. Comparative cases, natural variation, experiments, policy changes, historical dis-

continuities, and perturbations can expose differences hidden under ordinary conditions. Yet intervention itself can transform the system, and the relation between intervention response and antecedent structure requires argument. GRE therefore treats intervention as one epistemic resource among others rather than a universal solution to non-invertibility.

The inverse problem also explains why heterogeneous methods can be epistemically complementary. Historical reconstruction can identify trajectories concealed by cross-sectional data. Ethnographic or interpretive inquiry can recover meanings and relations compressed by administrative categories. Statistical methods can estimate regularities across cases. Network and dynamical models can expose structural dependencies. Computational simulation can test whether proposed mechanisms are capable of generating observed patterns. Legal analysis can reconstruct institutional rules that shape manifestational regimes. None of these methods possesses automatic priority. Their contribution depends on which dimensions of the compatibility set they constrain and which assumptions they introduce.

Claim 4.195 (Epistemic adequacy under non-invertibility). *When unique reconstruction is not warranted, epistemic adequacy consists partly in preserving the plurality of materially compatible relational explanations, identifying the evidence that distinguishes among them, and calibrating claims to the invariants or differences that the available access can support.*

This claim makes uncertainty structurally informative. Multiple compatible explanations indicate where manifestation fails to preserve distinctions, where access is limited, or where additional assumptions are carrying the inference. The objective is not to celebrate indeterminacy but to locate it. An explicit compatibility set can guide new observation, archival search, intervention, comparison, or model revision more effectively than a premature single reconstruction.

The inverse problem also returns us to the example of relational realities that need not share a common metric space. If two objects are both relationally real, epistemic comparison still requires a warranted comparison relation. Reconstruction cannot assume in advance that heterogeneous domains can be reduced to one metric, one ranking, or one common representation. Sometimes the relevant knowledge concerns structural correspondence; sometimes temporal dependence, functional equivalence, causal interaction, or qualitative difference; sometimes no defensible comparison is yet available. Epistemology must justify the comparison structure rather than inheriting it from the convenience of representation.

4.22.5 Relational Epistemology

The resulting epistemic orientation can now be stated provisionally. GRE requires an epistemology capable of knowing relationally generated, historically changing, multiply manifested, and recursively represented realities without assuming transparent access or final ontological settlement. Such an epistemology must treat evidence, observation, categories, models, archives, and methods as situated within relations while still allowing disciplined claims about realities that exceed those relations of access.

Definition 4.196 (Relational epistemology in GRE). *Relational epistemology in GRE* denotes the study and practice of warranted knowledge concerning relational and generative realities through situated manifestations, traces, representations, compar-

isons, interventions, and historical reconstructions, together with explicit analysis of the relations that make those forms of access possible and consequential.

Several commitments follow from Definition 4.196. First, knowledge claims are situated without being reduced to perspective. The position of an observer, institution, instrument, archive, or model affects access, but relational reality can constrain and correct the account produced from that position. Second, mediation is epistemically constitutive rather than merely contaminating. Instruments, languages, institutions, categories, and representations can make otherwise inaccessible realities knowable; their mediation must be analyzed rather than imagined away. Third, historical change applies to epistemic relations themselves. Methods, categories, observation systems, and standards of evidence can acquire histories, and their adequacy can change as the realities under study and the interfaces of manifestation change.

Fourth, epistemic plurality can be productive when methods preserve different dimensions of the relational configuration and expose one another's blind spots. This plurality does not mean that all interpretations are equally warranted. Claims remain answerable to evidence, causal structure, internal coherence, historical reconstruction, comparative performance, and the consequences of intervention where relevant. Fifth, uncertainty should be located and structured. The inquiry should distinguish uncertainty about the target, uncertainty about the manifestation relation, uncertainty introduced by representation, uncertainty arising from missing evidence, and uncertainty created by competing explanations.

Sixth, epistemology in GRE is recursively connected to praxis. Research can change what it studies by classifying, measuring, publishing, intervening, allocating attention, or altering institutional expectations. The production of knowledge can therefore generate new relational realities. This fact does not eliminate the possibility of knowledge; it adds another causal relation that must sometimes be included in the analysis. Epistemic responsibility includes attention to how inquiry enters the generative field.

The three-register architecture developed in this chapter consequently supplies neither a metaphysical closure nor a simple ladder from reality to knowledge. It supplies a structured problem-space. Ontological reality marks questions whose final settlement can remain open. Relational reality identifies emergent, sufficiently persistent and stable, causally efficacious objects within generative-relational systems. Manifestational reality identifies modes through which aspects of those realities become available under particular conditions. Manifestation can precede neither relation nor ontology by conceptual necessity, and manifestation can recursively reshape the relational field once it becomes operative. Symbolic representations can stabilize, compare, compress, transform, and institutionalize manifestations while acquiring causal efficacy of their own. Across these registers, mappings can be partial, plural, historically variable, and non-invertible.

The epistemic problem follows directly. How can an inquiry identify relations that are only partly manifest? How can it distinguish traces from the structures that generate them? How can it learn manifestation rules and detect when those rules change? How can it reason across boundaries and scales, reconstruct the identity and persistence of relations, analyze higher-order or field-like organization, attribute generative effects, and preserve historical trajectories? How should it treat unequal access, strategic concealment, missing records, performative classifications, computational representations, and evidence that changes because the system has learned to

respond to observation? These are not secondary methodological details. They are consequences of the ontology developed here.

Chapter 5 takes these consequences as its starting point. It begins with the epistemic problem created by ontological suspension, then develops the inverse problem of manifestation, knowledge of manifestation relations, the distinction between relation and trace, symbolization and representation, performative representation, partial observation, boundary and scale, relational identity, higher-order relations, relational fields, generative relations, attribution, trajectories, uncertainty, comparison, and epistemic revision. The movement of Part II is therefore complete at the level required for transition: Chapter 4 has clarified the kinds of reality GRE permits itself to discuss and the limits of those claims; Chapter 5 asks how warranted knowledge of those realities can be constructed under conditions of mediation, plurality, history, and incomplete access.

The transition can be stated compactly. GRE begins neither with the expectation of transparent reality nor with the conclusion that mediation makes reality inaccessible. It begins with a more demanding proposition: reality and access are related but distinct; the relations between them are themselves historically generated and potentially knowable; and responsible knowledge requires reconstructing those relations with the same care that GRE brings to the economic realities they disclose.

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