Chapter 23

Interfaces with Neighboring Generative Relational Domains

Domain Interfaces and Disciplinary Return

Chapter 23 examines the boundary conditions under which Generative Relational Economics (GRE) can enter sustained inquiry with neighboring Generative Relational domains and established disciplines without converting disciplinary contact into conceptual absorption. Chapter 22 ended by specifying a research-programme interface through which economic findings can generate questions for history, governance, law, education, ecology, political theory, social theory, aesthetics, artificial-intelligence studies, and other domains. The present chapter develops that interface into a disciplinary architecture. Its central concern is the relation among domain identity, translation, non-translation, mutual correction, and the possibility of later cross-domain comparison.

The chapter proceeds from a restrained premise. A relation, constraint, subject, institution, value, form of power, or generative process can be relevant to several domains while carrying different analytical meanings in each. Economic dependence can have legal, political, educational, ecological, or epistemic conditions; legal recognition can alter economic capability; historical reconstruction can change the categories through which an economic process is described; educational and aesthetic processes can affect economic participation while retaining objects that are not exhausted by economic analysis. Cross-domain relevance therefore supplies a reason for interface construction. It does not by itself establish conceptual equivalence or a unified theory.

This distinction matters especially for a project that treats GRE as one domain instantiation of a broader Generative Relational orientation. The possibility of wider Generative Relational Theory (GRT) remains an open research question. It should emerge, if at all, through comparison among independently answerable domain programmes rather than through the premature elevation of economic vocabulary into general ontology. Chapter 23 accordingly treats domain boundaries as revisable but consequential. A boundary may move when inquiry shows that an object, mechanism, or responsibility has been misclassified. Yet revision requires reasons that can be stated within both the originating and receiving domains.

The chapter has four principal objectives. First, it defines a discipline-interface grammar: disciplinary identity, principal problem-spaces, legitimate borrowing, translation, non-translation, and containment. Second, it develops explicit interfaces between GRE and neighboring domains, including Generative Relational History (GRH), Generative Relational Governance (GRG), Generative Relational Law (GR-Law), political theory, education, ecology, artificial-intelligence studies, social theory, and aesthetics. Third, it examines what GRE can export and what it must import, while preserving concepts whose meanings are non-equivalent across domains. Fourth, it uses boundary disputes, failed translations, cross-domain counterexamples, and candidate invariants to clarify the conditions under which later GRT-oriented generalization would be warranted.

The method is comparative and reflexive. Economic claims remain indexed to their evidential, historical, formal, and normative warrant when they cross a disciplinary boundary. The receiving domain is permitted to redescribe the object according to its own categories, to reject the proposed mapping, or to return a correction that changes the economic claim. Shared terminology therefore carries no presumption of shared extension. Conversely, domain-specific language does not make comparison impossible. Translation can be partial, task-relative, asymmetric, historically contingent, and still analytically useful when its preserved structures and losses are recorded.

Three restraints govern the chapter. The first is disciplinary containment: GRE should answer economic questions with economic warrant and should identify where its authority ends. The second is interface reciprocity: neighboring domains are sources of correction rather than repositories from which GRE simply borrows useful vocabulary. The third is generalization restraint: recurrent structures across domains are candidates for wider GR inquiry only after domain-specific evidence, counterexamples, and translation remainders have been examined. Similarity is an invitation to comparison rather than proof of invariance.

The internal sequence begins with disciplinary boundaries, containment, and translation. It then develops domain-specific interfaces, followed by an explicit account of GRE exports, imports, non-equivalent concepts, and boundary disputes. The chapter closes by asking which recurrent structures may deserve cross-domain comparison and which limits of GRE become visible precisely because those interfaces remain open. Section 23.1 establishes the initial architecture by treating disciplinary boundaries as relationally maintained interfaces whose permeability and revision require explicit warrant.

23.1 Relational Interfaces at Disciplinary Boundaries

A cross-domain research programme requires a precise account of what is crossing a boundary and why the boundary matters. The closing architecture of Chapter 22 permits GRE findings to generate questions for neighboring domains, but that permission does not determine where economics ends, which concepts can travel, or when another discipline's categories should replace an economic description. This section establishes the opening boundary grammar for Chapter 23. Its objective is to

characterize disciplinary identity through principal problem-spaces and standards of answerability, then specify interfaces that permit borrowing and mutual correction without collapsing distinct domains into a common vocabulary. The discussion proceeds through disciplinary identity, the principal GRE problem-space, boundary formation, interface discipline, shared and domain-specific concepts, translation, and non-translation. The method is comparative and reflexive: boundaries are treated as historically generated and revisable, while every proposed crossing remains accountable to the objects, questions, evidence, and responsibilities of the participating domains.

Definition 23.1 (Disciplinary interface record)**.** A *disciplinary interface record* identifies an originating domain, a receiving domain, the question or object motivating contact, the originating claim and its warrant, the concepts proposed for transfer, the structures expected to be preserved, anticipated translation losses, domain-specific responsibilities that remain outside the transfer, and the conditions under which the interface should be revised or abandoned.

Definition 23.1 turns disciplinary contact into a traceable research operation. The record is intentionally directional. An economic concept may travel into legal inquiry under one mapping while a legal concept returns to economics under another. The two translations need not preserve the same structures. This asymmetry is analytically useful because disciplinary interfaces often connect different principal questions rather than duplicate formulations of one problem.

Proposition 23.2 (Boundary answerability condition)**.** *A disciplinary boundary is analytically defensible when researchers can state which questions the domain claims responsibility for, what kinds of warrant it recognizes for those questions, where neighboring expertise becomes necessary, and what evidence would justify revising the present boundary.*

Table 23.1 summarizes the boundary operations developed in this section. The table is not a taxonomy of disciplines. It identifies the recurrent operations through which domain identity and cross-domain inquiry can remain jointly accountable.

23.1.1 Disciplinary Identity

Disciplinary identity is often described institutionally through departments, journals, professional associations, degree programmes, and recognized methods. Those structures matter because they distribute authority, training, resources, visibility, and standards of evidence. For the present inquiry, however, institutional location alone is insufficient. GRE requires an analytical account of disciplinary identity that can remain meaningful when institutions change or when one research problem crosses several established fields.

Definition 23.3 (Disciplinary identity profile)**.** A *disciplinary identity profile* records a domain's principal problem-space, characteristic analytical objects, recognized forms of evidence and inference, normative or practical responsibilities, historical lineages, institutional locations, recurrent interfaces with neighboring domains, and acknowledged limits of competence.

The profile treats a discipline as a historically maintained configuration rather

Table 23.1: Principal operations at GRE disciplinary boundaries

Boundary operation	**Primary analytical object**	**Disciplinary requirement**
Disciplinary identity	Principal questions, objects, warrants, and responsibilities	State what makes an inquiry economic without treating present boundaries as timeless
Problem-space specification	Economic relations among resources, capabilities, value, institutions, power, and generative consequences	Preserve the local economic question before importing another domain's categories
Boundary maintenance	Conditions for retaining, moving, or differentiating a domain boundary	Keep boundary claims revisable through evidence and cross-domain correction
Interface construction	Transfer of questions, distinctions, evidence, or models across domains	Record preserved structure, translation loss, and domain-specific remainder
Shared-concept comparison	Similar vocabulary used in multiple domains	Compare meanings and inferential roles before assuming equivalence
Domain-specific concept protection	Concepts whose validity depends on a domain's own institutions, norms, or objects	Preserve the receiving domain's authority to reject reductive translation
Translation	Partial mapping with explicit task and scope	Evaluate adequacy relative to the research purpose rather than lexical resemblance
Non-translation	Material failure or inadmissibility of a proposed mapping	Preserve failure as information about domain structure and limits of generalization

than a fixed essence. Economics has repeatedly changed the objects, methods, scales, and institutions through which it defines legitimate inquiry. Such changes can be substantial without making disciplinary identity arbitrary. Continuity can be carried by recurring problem-spaces, inherited debates, institutional practices, analytical objects, and relations to adjacent fields even when their relative importance changes.

For GRE, disciplinary identity is further complicated by its relation to broader Generative Relational inquiry. GRE uses relational, generative, historical, and multiscale concepts that may also appear in history, governance, law, education, ecology, or social theory. Their recurrence does not dissolve economics. Economic specificity is maintained through the questions for which those concepts are mobilized: how resources and capacities are allocated; how value forms are generated, converted, circulated, captured, returned, and regenerated; how economic institutions structure participation and dependency; how power conditions economically relevant possibilities; and how these processes alter future generative capacity.

Proposition 23.4 (Identity-through-problem-space condition)**.** *GRE retains disciplinary identity when its relational and generative concepts remain organized around economically specific problem-spaces and evidential responsibilities, even if some concepts are shared with neighboring domains.*

This condition avoids two opposite errors. Shared concepts need not be monopolized by one discipline, while the recurrence of those concepts does not imply that every domain studies the same object. A legal right, political authority, educational relation, ecological constraint, and economic capability may all participate in one empirical configuration. Their disciplinary meanings remain differentiated by the questions being asked and the standards under which answers become warranted.

23.1.2 Principal Problem-Space

A boundary becomes clearer when the principal problem-space is stated positively. GRE's principal problem-space concerns the economic conditions and consequences through which resources, capabilities, relations, institutions, value forms, power structures, and historical configurations affect the generation, preservation, conversion, circulation, capture, return, and regeneration of economically relevant possibilities. The formulation is broad because the book has treated economic processes as relationally embedded and temporally extended. Breadth nevertheless differs from disciplinary totalization.

Definition 23.5 (GRE principal problem-space)**.** The *GRE principal problem-space* comprises questions about economically consequential allocation, production, value generation, conversion, circulation, return, capability formation, institutional organization, participation, dependence, power, and transformation, including their historical and relational conditions and their effects on later economic possibility.

The definition is intentionally functional rather than jurisdictional. It does not claim exclusive ownership of any listed object. Power is also political; institutions are legal and social; capability formation is educational and developmental; value can be aesthetic, ecological, moral, juridical, cultural, and epistemic. The economic problem-space begins where these objects enter the organization of economic possibility and remains incomplete where their domain-specific constitution becomes necessary for explanation or evaluation.

This produces a practical test for boundary work. When an inquiry asks how a legal status changes access to productive resources, GRE can study the economic incidence, conversion effects, dependencies, and later generative consequences. When the inquiry asks whether the status is legally valid, how rights and duties are constituted, or what doctrine authorizes recognition, legal analysis becomes indispensable. Similarly, GRE can investigate the economic conditions of education and the later economic effects of learning relations while leaving pedagogical validity, curricular judgment, or the nature of educational flourishing to educational inquiry unless those questions are explicitly reconstructed through an appropriate interface.

Proposition 23.6 (Problem-space anchoring condition)**.** *A cross-domain GRE inquiry should identify the economic question that motivates the interface before importing concepts, methods, or conclusions from a neighboring domain. The imported material should be evaluated by the explanatory or evidential role it plays in that stated problem-space.*

Problem-space anchoring also guards against decorative interdisciplinarity. Borrowing a concept because it appears intellectually adjacent contributes little unless the concept changes the specification of an object, mechanism, evidence, comparison, normative remainder, or research decision. The same discipline applies to formal borrowing. A mathematical structure shared across fields creates an interface only when its preserved relations and analytical role can be stated.

23.1.3 Boundary Formation

Disciplinary boundaries are historically generated through recurring divisions of labor, institutional authority, methods, concepts, data infrastructures, professional training, and normative responsibility. Their historical formation does not make them dispensable. A boundary can protect distinctions that would otherwise be lost, including the difference between economic control and legal ownership, economic dependence and political subordination, educational capability and labor-market productivity, or ecological value and monetized environmental benefit.

Definition 23.7 (Relational disciplinary boundary)**.** A *relational disciplinary boundary* is a historically maintained distinction among domains that allocates principal questions, conceptual responsibilities, evidential standards, and interpretive authority while permitting specified forms of exchange and revision across the boundary.

The definition treats boundaries as maintained relations rather than impermeable walls. Their strength can vary across problems. Some interfaces are routine: economic history, political economy, law and economics, ecological economics, and economics of education already institutionalize cross-domain exchange in different forms. Other interfaces may remain provisional because the relevant concepts or standards of evidence have not stabilized.

A relational boundary also has an incidence structure. Boundary maintenance can distribute authority unevenly. One discipline may define the shared object, supply the accepted measurement architecture, or control publication venues while another contributes context treated as supplementary. Such arrangements can be epistemically productive in some settings and reductive in others. The relevant question is whether the boundary allocation preserves materially necessary distinctions and allows correction to travel in both directions.

Proposition 23.8 (Boundary permeability condition)**.** *A disciplinary boundary is productively permeable when cross-domain exchange can alter questions, concepts, evidence, or conclusions on both sides while each domain retains responsibility for claims whose validity depends on its own specialized objects or standards.*

Permeability therefore differs from boundary erasure. A field can remain open to correction precisely because it can identify which correction comes from outside its present competence. The capacity to defer a question is part of disciplinary maturity when the deferral is explicit and accompanied by a well-specified interface.

23.1.4 Interface Discipline

An interface connects domains while preserving enough separation for disagreement to remain visible. The central risk is collapse: the receiving domain is redescribed using the originating domain's categories until apparent compatibility becomes inevitable. GRE faces this risk whenever economic vocabulary such as allocation, value, resource, capability, incentive, productivity, or return is extended into domains whose constitutive objects differ.

Definition 23.9 (Disciplinary interface)**.** A *disciplinary interface* is a documented relation between domains through which questions, concepts, methods, evidence, models, or corrections can pass while the originating and receiving domains preserve

independently assessable standards for the claims that remain within their competence.

A useful interface specifies direction, purpose, preserved structure, loss, and return path. Direction matters because the same pair of domains can support different interfaces. GRE may export an economic dependency profile to political theory as evidence relevant to authority or domination, while political theory may return distinctions concerning legitimacy or recognition that reorganize the economic analysis. Purpose matters because a translation adequate for empirical coding may be inadequate for normative evaluation. Preserved structure and loss prevent lexical identity from substituting for conceptual analysis. The return path makes correction possible.

Proposition 23.10 (Interface non-collapse condition)**.** *A cross-domain interface remains analytically valid only while the receiving domain can reject, revise, or partially accept the imported structure without being required to restate its own objects in the originating domain's vocabulary.*

This proposition gives practical content to reciprocity. If ecological inquiry can enter a GRE project only after ecological values are monetized, the interface has already privileged an economic representation. If legal inquiry can contribute only through variables derived from economic incentives, juridical status and normativity may disappear. If education is represented solely through future earnings, learning and educational participation become visible only through one downstream economic manifestation. Interface discipline requires the possibility that such reductions are rejected as inadequate to the target-domain question.

23.1.5 Shared Concepts

Shared concepts create both opportunity and danger. Terms such as relation, subject, institution, power, value, justice, constraint, generation, reproduction, participation, recognition, and history occur across several domains. Their recurrence can support comparison, but lexical recurrence supplies weak evidence of conceptual equivalence.

Definition 23.11 (Shared-concept comparison profile)**.** A *shared-concept comparison profile* records, for each participating domain, a concept's object of application, identity conditions, inferential role, evidential access, normative load, temporal structure, scale, and relationships to neighboring concepts, together with any preserved correspondences and unresolved differences.

Consider power. GRE studies economically relevant power through typed asymmetries, dependencies, control over conversion and circulation, constrained alternatives, and changes in future possibility. Political theory can require distinctions among authority, domination, legitimacy, collective action, and public justification that are not entailed by the economic diagnosis. Law may operationalize power through rights, duties, jurisdiction, enforceability, and standing. Social theory may treat power through field positions, reproduction, symbolic structures, or identity formation. The concepts intersect without becoming interchangeable.

The same discipline applies to value. GRE's heterogeneous value architecture permits several value forms and conversion regimes, yet aesthetic, moral, ecological,

juridical, and educational values may contain evaluative standards that economics cannot establish internally. A shared-concept comparison can reveal structural similarities, translation possibilities, and recurring tensions while preserving the domain in which a particular evaluative warrant must be defended.

Proposition 23.12 (Lexical non-equivalence condition)**.** *Shared terminology across domains warrants conceptual comparison, not presumed equivalence. Equivalence claims require explicit correspondence among the concept's relevant objects, inferential roles, and boundary conditions for the task at hand.*

This condition also protects productive disagreement. A cross-domain project gains information when two fields use the same term differently and can state why. The mismatch may indicate different empirical objects, different levels of abstraction, different normative responsibilities, or a historical transformation that a shared vocabulary conceals.

23.1.6 Domain-Specific Concepts

Cross-domain work also depends on concepts whose domain specificity should be protected. Some concepts are constituted through legal rules, political institutions, educational practices, ecological processes, historical methods, aesthetic judgment, or social meanings in ways that resist immediate economic translation. Their resistance can identify the point at which an economic account becomes incomplete.

Definition 23.13 (Domain-specific conceptual remainder)**.** A *domain-specific conceptual remainder* is a feature of a concept, object, or relation that is material to the receiving domain's inquiry and is not preserved adequately by the proposed cross-domain mapping.

Remainders can be normative, institutional, semantic, temporal, ontological, evidential, or practical. Legal personhood, for example, cannot be inferred from economic agency alone because juridical recognition has constitutive rules and consequences. Ecological regeneration cannot automatically be restated as economic return because ecological processes may have identity conditions and temporalities independent of human valuation. Aesthetic judgment can condition salience, orientation, and value formation without becoming reducible to preference revelation. Educational capability can affect economic possibility while remaining partly constituted through pedagogical relations and learning processes.

Proposition 23.14 (Remainder preservation condition)**.** *A cross-domain analysis should preserve domain-specific conceptual remainders whenever their removal would change the receiving domain's object, evidential standard, normative responsibility, or practical conclusion.*

Remainder preservation does not prohibit abstraction. Comparative research often requires selecting a limited set of features. The discipline lies in stating what has been abstracted away and whether the omitted material can alter the inference. This creates a principled boundary between useful simplification and reduction that invalidates the target-domain question.

23.1.7 Translation

Translation is the principal constructive operation at a disciplinary interface. It connects concepts or structures sufficiently for a specified research task while allowing the mapping to remain partial, directional, and revisable. Chapter 21 used translation to compare economic theories; Chapter 22 extended the operation to research programmes and neighboring domains. Chapter 23 requires a more explicitly disciplinary account because the receiving domain may have different standards of evidence and different responsibilities for what follows from a translated claim.

Definition 23.15 (Cross-domain translation)**.** A *cross-domain translation* is a task-indexed mapping from an originating domain's object, concept, relation, model, evidence, or question into a receiving domain that specifies the structure intended to be preserved, the inferential purpose of the mapping, the transformation performed, the losses introduced, and the conditions under which the mapping remains adequate.

Translation can occur at several levels. A conceptual translation may connect economic capability with an educational account of capability while preserving different constitutive mechanisms. A functional translation can compare institutions by the role they play without claiming identical internal structure. A structural translation may preserve a pattern of dependency or feedback across different domain objects. A formal translation can reuse a mathematical representation under new interpretations. Historical translation may connect categories across periods while recording semantic and institutional change. Each mode preserves different information.

Proposition 23.16 (Task-relative translation adequacy)**.** *A cross-domain translation is adequate only relative to a stated research task. A mapping sufficient for descriptive comparison does not thereby become sufficient for causal explanation, normative judgment, legal classification, institutional design, or ontological generalization.*

This task relativity prevents a successful local mapping from accumulating unearned scope. A common network representation may support comparison of relational position without showing that the relevant ties have the same social or legal meaning. A shared dynamical model may represent feedback while leaving domain-specific causal interpretation unresolved. A common concept of generative capacity may organize questions across economics and education while requiring different manifestations and validation strategies.

Translation also has governance. Researchers decide which concepts travel, which differences receive attention, which language becomes the default, and which failures are recorded. Those decisions affect the visibility of domain-specific knowledge. A mature interface therefore documents who performs the translation, what disciplinary competencies are represented, and how affected or knowledgeable participants can contest the mapping when appropriate.

23.1.8 Non-Translation

A disciplined interface must permit a mapping to fail. Non-translation occurs when the structures required for a research task cannot be preserved with sufficient warrant, when the receiving domain's constitutive distinctions would be erased, when evidential regimes cannot be aligned responsibly, or when the proposed transfer cre-

ates more confusion than explanatory gain. Such outcomes delimit the present programme and provide evidence for later cross-domain comparison.

Definition 23.17 (Cross-domain non-translation record)**.** A *cross-domain non-translation record* documents a proposed mapping, its intended purpose, the point at which preservation failed or became inadmissible, the domain-specific distinction responsible for the failure, alternative mappings considered, the present consequence for the originating and receiving claims, and conditions under which future re-entry may become warranted.

Non-translation has several possible meanings. The concepts may be genuinely non-equivalent. The empirical manifestations available in one domain may have no defensible counterpart in the other. A normative category may resist translation into descriptive economic language. A historical category may be too period-specific for synchronic comparison. A formal correspondence may preserve topology while losing institutional meaning. A proposed interface may also fail provisionally because the required evidence or domain expertise is unavailable.

Proposition 23.18 (Non-translation informativeness)**.** *A well-documented failure of cross-domain translation is a substantive research result when it identifies a material boundary condition, domain-specific remainder, evidential incompatibility, or limitation on a proposed generalization.*

The proposition gives non-translation a constructive role in future GRT-oriented inquiry. Candidate general structures become more credible when they survive comparison with domains capable of rejecting them. Conversely, recurrent failures can show that a concept previously treated as general is specific to economic institutions, particular histories, or one evidential regime. A general theory, if later developed, should therefore be shaped as much by preserved non-equivalences as by recurrent correspondences.

The section's boundary architecture can be summarized through a final interface profile.

Definition 23.19 (GRE disciplinary-boundary profile)**.** A *GRE disciplinary-boundary profile* combines the GRE principal problem-space, the neighboring domain's independently stated problem-space, shared and domain-specific concepts, permitted translations, recorded non-translations, reciprocal correction paths, and explicit criteria for revising the present boundary.

Proposition 23.20 (Relational disciplinary containment)**.** *GRE remains disciplinarily contained when cross-domain inquiry preserves identifiable economic questions and warrants, records domain-specific remainders, allows neighboring domains to correct the economic account, and treats boundary revision as an evidentially and conceptually accountable outcome rather than as automatic expansion of GRE.*

Relational disciplinary containment supplies the opening architecture for Chapter 23. It permits disciplinary boundaries to be porous, historically revisable, and mutually corrective while retaining the distinctions required for substantive disagreement. The next section develops the containment principle more explicitly by specifying legitimate borrowing, limits of borrowing, domain accountability, interface accountability, and the conditions under which a disciplinary boundary should be revised.

23.2 The Disciplinary Containment Principle

Section 23.1 established the boundary grammar through which GRE can remain economically identifiable while maintaining explicit interfaces with neighboring domains. The present section develops the governing principle of that architecture. Its objective is to specify how a domain can borrow concepts, methods, evidence, and questions without extending its authority beyond the warrants it can defend, while remaining sufficiently open to correction that disciplinary identity does not become disciplinary closure. The discussion proceeds through principal questions, legitimate borrowing, limits of borrowing, conceptual imperialism, disciplinary closure, domain accountability, interface accountability, and boundary revision. The method is reflexive and procedural: containment is treated neither as institutional isolation nor as a fixed map of academic jurisdictions, but as an answerability condition on the claims a domain makes and the responsibilities it accepts.

Definition 23.21 (Disciplinary containment principle)**.** The *disciplinary containment principle* requires a domain to keep its principal questions, claim types, evidential warrants, normative responsibilities, and limits of competence identifiable when it imports material from or exports material to neighboring domains. Cross-domain borrowing may enlarge the resources available to inquiry, while authority over the resulting claim remains indexed to the domain-specific warrants required for that claim.

Definition 23.21 gives containment a positive function. It protects the relation between a question and the kinds of reasons that can answer it. An economic analysis can incorporate legal status, historical sequence, ecological constraint, educational practice, political authority, or aesthetic judgment when those elements materially condition an economic process. Their inclusion does not grant economics independent authority to determine juridical validity, reconstruct historical meaning, establish ecological ontology, evaluate pedagogy, justify political legitimacy, or settle aesthetic normativity. The relevant neighboring domain remains capable of correcting the imported description.

Proposition 23.22 (Containment-through-answerability condition)**.** *Disciplinary containment is preserved when each substantive claim can be traced to the principal question it answers, the domain-specific warrant required for that answer, and the interfaces through which external concepts or evidence entered the analysis.*

Table 23.2 summarizes the principal operations through which containment can remain compatible with cross-domain inquiry.

23.2.1 Principal Questions

Containment begins with the question rather than with the institutional affiliation of the researcher. One empirical configuration can support several legitimate inquiries because different domains ask different questions about it. A platform labor arrangement, for example, can be investigated economically through allocation, capability, dependency, conversion, capture, and return; legally through employment status, contractual obligation, rights, remedies, and jurisdiction; politically through authority, collective voice, and public justification; historically through institutional

Table 23.2: Principal operations of disciplinary containment in GRE

Containment operation	**Primary question**	**Required discipline**
Principal-question specification	What is the inquiry principally asking?	Identify the problem-space and the domain whose warrant is required for the answer
Legitimate borrowing	What external concept, method, or evidence is being used?	Preserve provenance, interpretation, validation conditions, and domain-specific remainder
Borrowing limits	Which inferences do not travel with the borrowed resource?	State semantic, evidential, normative, temporal, and institutional limits
Conceptual non-domination	Does one domain's vocabulary predetermine the receiving domain's object?	Permit the receiving domain to reject or redescribe the imported structure
Disciplinary openness	What can external inquiry reveal about local blind spots?	Maintain routes for correction, counterexample, and problem reclassification
Domain accountability	Which claims remain the responsibility of GRE?	Match economic claims to economic evidence and identify claims requiring external warrant
Interface accountability	Who owns each cross-domain inferential step?	Record direction, translation loss, disagreements, and return paths
Boundary revision	What evidence warrants moving or differentiating the boundary?	Version the change and preserve consequences for earlier claims

lineage and category change; and educationally through skill formation and access to learning. The configuration is shared while the principal questions remain distinct.

Definition 23.23 (Principal-question record)**.** A *principal-question record* states the phenomenon under investigation, the principal question being asked, the domain whose concepts and warrants are expected to answer that question, secondary questions generated for neighboring domains, and the conditions under which the principal classification should be reconsidered.

This record reduces a recurrent source of disciplinary confusion. Researchers can begin from an economic concern and discover that the decisive unresolved issue is juridical, political, historical, educational, ecological, or ethical. The appropriate response is not to force the unresolved issue back into economic vocabulary. The research architecture should instead record a question handoff while retaining the economic consequences that motivated the inquiry.

Definition 23.24 (Question-handoff threshold)**.** A *question-handoff threshold* is reached when answering a material subquestion requires constitutive concepts, evidential standards, normative warrants, or professional competencies that GRE does not presently supply with adequate justification.

The threshold does not require discontinuing the economic inquiry. It specifies where a cross-domain interface becomes necessary. An analysis of housing affordability can remain economic while requiring legal inquiry into tenancy rights or political inquiry into legitimate authority over land-use decisions. The outputs of those inquiries can subsequently alter the economic model. Containment therefore organizes a division of epistemic responsibility within an integrated problem rather than dividing the world into isolated objects.

Proposition 23.25 (Principal-question priority)**.** *When several domains can describe the same empirical configuration, disciplinary responsibility should be assigned by the principal question and its required warrant rather than by the mere presence of a domain-associated object or vocabulary.*

This proposition prevents a legal institution from becoming exclusively a legal ob-

ject, a monetary relation from becoming exclusively an economic object, or a historical event from becoming exclusively a historical object. Disciplinary identity attaches to the inquiry being conducted and the warrant claimed for its answer. The same object can therefore support multiple domain-specific analyses without implying that the domains are interchangeable.

23.2.2 Legitimate Borrowing

Cross-domain borrowing is indispensable to a relational economic programme because economic processes are constituted partly through institutions, meanings, histories, ecologies, legal categories, political arrangements, educational capacities, technologies, and social relations. Borrowing becomes legitimate when the external resource is used under conditions that preserve the reasons for which it was warranted in its originating domain and expose the transformation involved in bringing it into GRE.

Definition 23.26 (Cross-domain borrowing record)**.** A *cross-domain borrowing record* identifies the borrowed concept, method, evidence, distinction, model, or research practice; its originating domain; its original analytical role and warrant; the economic task for which it is being borrowed; any reinterpretation performed; the structures preserved; the structures omitted; and the validation required in the GRE setting.

Borrowing can take several forms. GRE may borrow a historical periodization to reconstruct the emergence of an economic institution, a legal category to identify recognized forms of ownership, an ecological measure to represent a material constraint, an educational distinction to study capability formation, or a political-theoretical concept to formulate a question about authority that economics alone cannot resolve. It can also borrow methods, such as archival reconstruction, ethnography, network analysis, comparative institutional interpretation, or formal representations. Each form of borrowing carries a different transfer burden.

Proposition 23.27 (Borrowed-warrant preservation condition)**.** *A borrowed resource is methodologically admissible in GRE when its economic use preserves the features material to its original warrant or explicitly revalidates the transformed resource under the new task.*

The condition allows adaptation. A method developed elsewhere need not remain unchanged when used economically. Its transformation should, however, be visible. A legal classification used as an empirical variable retains a different status from an economic proxy inferred from behavior. An ecological indicator produced through a specific measurement regime should not silently become a general measure of economic value. A historical category developed for one period may require reconstruction before being compared with another.

Definition 23.28 (Borrowing depth)**.** *Borrowing depth* describes how deeply an imported resource enters the receiving analysis: as contextual information, measurement input, explanatory mechanism, constitutive category, normative premise, or structural component of the model.

The deeper the borrowing, the stronger the requirement for domain competence

and interface documentation. Contextual information may require accurate attribution and scope control. A constitutive legal category or normative premise can reorganize the entire economic analysis and therefore demands stronger engagement with the domain that supplies it. Borrowing depth provides a practical way to scale the burden of interdisciplinary justification.

23.2.3 Limits of Borrowing

Borrowed resources can retain usefulness while carrying limits on the inferences that travel with them. These limits arise when a concept depends on institutions absent in the receiving case, when a measure changes meaning across populations or periods, when a method assumes a form of evidence unavailable in GRE, or when a normative conclusion requires justificatory premises that an economic analysis cannot establish.

Definition 23.29 (Borrowing-limit profile)**.** A *borrowing-limit profile* records the semantic, evidential, institutional, temporal, normative, and practical limits that constrain the use of an imported resource in GRE, together with the claims that remain permissible and those that require additional domain-specific warrant.

A borrowing-limit profile is especially important when an imported term becomes familiar. Familiarity can conceal changes in meaning. Capability, recognition, resilience, agency, legitimacy, care, sustainability, personhood, and participation can all appear in economic research while retaining domain-specific structures that are not captured by an economic operationalization. The purpose of the profile is not to prohibit use. It prevents a useful partial representation from acquiring the status of a complete account through repetition.

Proposition 23.30 (Inference non-transfer condition)**.** *The successful transfer of a concept, measure, method, or formal representation does not by itself transfer the originating domain's full set of conclusions. Each downstream inference requires its own warrant in the receiving task.*

This is particularly important for formal and quantitative borrowing. The same network statistic can describe structurally similar positions while the social meaning of the ties differs. A dynamical representation can preserve feedback structure while leaving causal interpretation open. A legal category can predict economic behavior without its normative validity becoming an economic conclusion. A historical analogy can organize comparison without establishing recurrence of the underlying mechanism.

Definition 23.31 (Borrowing saturation point)**.** A *borrowing saturation point* is reached when further importation from a neighboring domain changes the principal question, required warrant, or explanatory responsibility enough that the inquiry should be reclassified, jointly governed, or handed off rather than treated as an expanded GRE analysis.

The saturation point guards against indefinite disciplinary expansion. An economic project can deepen until its decisive claims are legal, political, educational, ecological, or otherwise external to economics. At that stage, continued labeling as GRE can obscure where the intellectual responsibility actually lies. Joint work

can remain strongly connected to GRE while assigning the relevant claims to the appropriate domain.

23.2.4 Avoiding Conceptual Imperialism

A cross-domain programme also requires protection against conceptual imperialism: the tendency for one domain's vocabulary to become the default language through which neighboring objects are permitted to appear. In an economic context, this can occur when legal status is redescribed only as incentive structure, education only as human-capital formation, ecology only as externality or resource stock, political authority only as strategic control, care only as labor input, or aesthetic judgment only as preference. Each translation can illuminate one relation while suppressing others that are constitutive to the receiving domain.

Definition 23.32 (Conceptual dominance test)**.** A *conceptual dominance test* asks whether the receiving domain can formulate its object, disagreement, and correction in its own terms; whether those terms can alter the imported analysis; and whether a failed mapping remains admissible as an outcome rather than being reformulated until compatibility is achieved.

The test shifts attention from vocabulary sharing to authority over description. Cross-domain collaboration is structurally asymmetric when one domain supplies the default ontology, variables, success criteria, and interpretation while the other contributes only contextual detail. Such asymmetry can sometimes be warranted for a narrowly defined task, but it should be identified rather than treated as neutral interdisciplinarity.

Proposition 23.33 (Non-domination condition for disciplinary interfaces)**.** *A disciplinary interface satisfies a minimal non-domination condition when each participating domain can preserve material distinctions, reject inadequate translations, and return corrections that can change the originating analysis.*

The proposition gives practical meaning to reciprocity. An ecology interface is stronger when ecological inquiry can reject monetization as insufficient for a particular claim. A law interface is stronger when juridical status can alter the economic identification of an actor, asset, or obligation. An education interface is stronger when pedagogical and developmental evidence can revise an economic capability model. Cross-domain inquiry becomes more informative when the possibility of such correction is designed into the interface.

Definition 23.34 (Default-vocabulary asymmetry)**.** A *default-vocabulary asymmetry* exists when one domain's categories are treated as the unmarked description of the shared object while another domain's categories appear only as optional qualifications, annotations, or downstream consequences.

Default-vocabulary asymmetry is not inherently illegitimate. Every inquiry needs a working language. It becomes methodologically significant when the default determines which objects are observable, which questions count as primary, or which disagreements can be expressed. Recording the asymmetry makes it possible to test whether the research conclusion depends on that linguistic architecture.

23.2.5 Avoiding Disciplinary Closure

Containment can fail in the opposite direction when boundary protection becomes disciplinary closure. A field that refuses external correction can preserve terminological purity while losing contact with constitutive conditions of its own objects. GRE is especially exposed to this risk because economic relations are historically and institutionally embedded. Changes in law, governance, education, ecology, technology, culture, or social organization can alter what counts as an economic subject, resource, capability, institution, or feasible action.

Definition 23.35 (Disciplinary-closure signal)**.** A *disciplinary-closure signal* is evidence that a domain systematically excludes external concepts or findings that materially affect its principal questions, lacks a procedure for question handoff, or protects a claim from revision by classifying adverse evidence as outside the discipline without independent justification.

Closure can be methodological as well as conceptual. A discipline can recognize the relevance of another domain while admitting only evidence that has already been converted into its preferred method. Historical evidence can be accepted only after quantification; qualitative evidence only after coding into predetermined categories; legal analysis only when reduced to observable incentives; normative argument only when translated into preferences. Such practices can be useful within a particular design, but they become closure signals when alternative forms of warrant are excluded by default despite their relevance to the principal question.

Proposition 23.36 (Openness-with-containment condition)**.** *A contained discipline remains open when it maintains explicit procedures for receiving external correction, reclassifying questions, revising local concepts, and acknowledging constitutive conditions that it cannot establish internally.*

Openness therefore does not require unrestricted borrowing. The more disciplined form of openness is selective and answerable: the field can explain why an external contribution is relevant, what role it plays, how it is validated, and what changes if the neighboring domain rejects the proposed use. This form of openness protects the research programme from both conceptual expansion and self-insulation.

Definition 23.37 (External-correction path)**.** An *external-correction path* specifies how a finding or objection from a neighboring domain can enter GRE, which claims it can modify, who evaluates the correction, what additional evidence may be required, and how the resulting change is recorded.

External-correction paths make interdisciplinary learning cumulative. Without them, cross-domain engagement can remain rhetorical: neighboring disciplines are cited or consulted while the economic architecture remains immune to revision. A versioned correction path creates an observable relation between interface activity and conceptual change.

23.2.6 Domain Accountability

Domain accountability concerns the claims for which GRE itself accepts responsibility. The broad scope of the book makes this requirement important. GRE can study

the economic effects of legal recognition, political authority, educational inequality, ecological constraints, social norms, and AI-mediated capabilities. It should distinguish those economic claims from claims about the validity, legitimacy, pedagogical adequacy, ecological meaning, social identity, or ethical permissibility of the external structures involved.

Definition 23.38 (Domain-accountability ledger)**.** A *domain-accountability ledger* records each material claim in a cross-domain inquiry, the principal domain responsible for warranting it, supporting evidence or argument, imported dependencies, unresolved external questions, and the consequences of later correction for the GRE analysis.

The ledger can expose mixed claims that otherwise appear seamless. Consider the proposition that a regulatory change increased generative opportunity. The legal fact that a rule changed, the economic evidence concerning capabilities or options, the historical interpretation of the change, and the normative evaluation of the resulting distribution may require different warrants. A single sentence can therefore contain several disciplinary responsibilities. Making them explicit improves both rigor and collaboration.

Proposition 23.39 (Claim-to-domain matching condition)**.** *A cross-domain GRE claim is adequately contained when the domain responsible for each material inferential step can be identified and the claim's strength does not exceed the strongest warrant available across those steps.*

This condition introduces a weakest-link discipline without requiring every project to become fully interdisciplinary. A study can bracket a neighboring-domain question when the bracket is explicit and immaterial to the present conclusion. When the bracketed issue is constitutive to the conclusion, the required warrant becomes part of the research burden.

Definition 23.40 (Domain-responsibility remainder)**.** A *domain-responsibility remainder* is a material component of a research claim whose justification lies outside GRE and remains unresolved, contested, or only provisionally imported within the present analysis.

Responsibility remainders should remain visible in conclusions. They do not automatically invalidate a result. They specify the condition under which the result may later need reinterpretation. This practice is especially valuable in policy-facing work, where economic findings can otherwise acquire legal or normative implications that were never independently warranted.

23.2.7 Interface Accountability

Domain accountability concerns who warrants a claim. Interface accountability concerns the quality of the relation through which claims, concepts, evidence, and corrections move between domains. A well-defined interface should make the transfer inspectable by participants from both sides and should preserve the possibility of disagreement about the mapping itself.

Definition 23.41 (Interface-accountability record)**.** An *interface-accountability record* identifies the participating domains, direction of transfer, task, borrowed

or exported object, translation procedure, preserved structures, losses, domain-specific remainders, validation responsibilities, disagreements, decision authority, return path, and revision history of the interface.

The record adds governance to translation. Cross-domain work often fails through unrecorded decisions about terminology, variable construction, aggregation, authorship, evidential priority, or whose expertise settles a dispute. These are not merely interpersonal matters. They can affect the resulting object of knowledge. Interface accountability therefore includes the architecture through which disagreement is handled.

Proposition 23.42 (Two-sided contestability condition)**.** *A cross-domain interface is strongly accountable when both originating and receiving domains can contest the mapping, require clarification of losses, and trigger revision of claims that depend on the interface.*

Two-sided contestability does not imply symmetrical expertise or equal authority over every issue. The relevant symmetry is procedural: each domain can challenge claims that depend on its own objects or warrants. In a legal-economic project, legal researchers need not determine an econometric specification merely because law is relevant, and economists need not determine the validity of a juridical classification merely because it has economic consequences. The interface allocates authority by claim type.

Definition 23.43 (Interface burden of proof)**.** The *interface burden of proof* is the justificatory burden carried by the party proposing that a concept, method, evidence type, or formal structure travels across a disciplinary boundary with sufficient preservation for the stated task.

This burden matters because translation often benefits the originating framework by extending its reach. Requiring the receiving domain to prove non-equivalence can privilege the proposed mapping. A more balanced procedure asks the proposer to state what is preserved, why the mapping is useful, and what evidence would show that the transfer is inadequate. The receiving domain can then contest a documented claim rather than an implicit assumption.

23.2.8 Revisable Boundaries

Disciplinary containment remains compatible with historical change only if boundaries can be revised. New objects, methods, institutions, technologies, and cross-domain findings can alter the distribution of questions and competencies. GRE itself is evidence that disciplinary programmes evolve: its relational, historical, formal, and normative interfaces differ from narrower conceptions of economic analysis. Revision therefore belongs inside the containment principle rather than appearing as an exception to it.

Definition 23.44 (Boundary-revision record)**.** A *boundary-revision record* documents the previous disciplinary allocation, the anomaly or accumulated evidence motivating revision, the proposed new allocation, concepts and responsibilities affected, gains and losses produced by the change, consequences for earlier claims, dissenting interpretations, and conditions for later reassessment.

Boundary revision can take several forms. *Expansion* brings a question into GRE because economic inquiry has developed sufficient concepts and warrant to answer it responsibly. *Contraction* transfers a question outward after evidence shows that its decisive structure lies elsewhere. *Differentiation* divides a previously unified question into components with distinct disciplinary responsibilities. *Joint governance* treats a problem as persistently cross-domain because no single field can answer the principal question without constitutive contributions from another.

Proposition 23.45 (Boundary-revision warrant)**.** *A disciplinary boundary should be revised when the proposed change improves answerability to the relevant questions, preserves material domain-specific distinctions, and produces a clearer allocation of evidential or normative responsibility than the existing boundary.*

This proposition keeps revision from becoming automatic expansion. The discovery that GRE can model a neighboring phenomenon does not itself make that phenomenon an economic object. Conversely, evidence that economic conditions constitute part of a legal, educational, ecological, political, or aesthetic process does not require GRE to withdraw from studying those conditions. Revision concerns the allocation of explanatory and justificatory responsibility rather than possession of the object.

Definition 23.46 (Containment revision cycle)**.** A *containment revision cycle* consists of principal-question specification, domain allocation, cross-domain borrowing where necessary, interface testing, external correction, identification of unresolved responsibility remainders, and versioned revision of the boundary when warranted.

Proposition 23.47 (Revisable containment)**.** *Disciplinary containment is sustainable when it constrains present claims while preserving procedures through which later evidence, concepts, and cross-domain disagreements can alter the boundary itself.*

The disciplinary containment principle therefore provides a middle architecture between conceptual expansion and disciplinary closure. GRE can remain economically identifiable because its principal questions and warrants are explicit; it can remain relationally open because borrowed concepts retain provenance, neighboring domains can reject inadequate mappings, and boundary revision has a documented path. The next section examines the translation problem at greater resolution by comparing relational, generative, ontological, epistemic, methodological, and normative compatibility across GR domains and by specifying the losses and domain-specific remainders that can persist even when translation is productive.

23.3 Translation across GR Domains

Sections 23.1 and 23.2 established a disciplinary boundary grammar and a containment principle for cross-domain inquiry. The present section examines the translation operation itself. Its objective is to specify when concepts, distinctions, models, evidence, and research practices can travel between GRE and neighboring Generative Relational domains without converting resemblance into identity or borrowing into disciplinary absorption. The discussion proceeds through shared relational and generative vocabularies, ontological, epistemic, methodological, and normative compatibility, translation loss, and domain-specific remainders. The method is compara-

Table 23.3: Principal compatibility dimensions in translation across GR domains

Compatibility dimension	Primary translation question	Required restraint
Relational vocabulary	Do terms such as relation, position, dependence, field, or institution retain comparable analytical roles?	Compare semantic and inferential use rather than assuming identity from shared terminology
Generative vocabulary	Do generation, capacity, emergence, reproduction, return, or transformation refer to comparable processes and horizons?	Preserve process, temporal, and source–outcome structure
Ontological compatibility	Can the domains use compatible analytical objects without making contradictory ontological commitments?	Distinguish representational compatibility from ontological identity
Epistemic compatibility	Can evidence and warrants travel with the claim being translated?	Preserve provenance, observability, uncertainty, and domain-specific standards of support
Methodological compatibility	Can a method address the receiving domain's object without silently changing it?	Revalidate units, boundaries, categories, and inference rules in the receiving domain
Normative compatibility	Can evaluative concepts cross domains without transferring normative authority by default?	Keep reasons, standing, affected subjects, and justificatory responsibility explicit
Translation loss	What semantic, inferential, temporal, institutional, or evidential structure is omitted or transformed?	Record loss before treating the mapping as adequate
Domain-specific remainder	Which material structures resist transfer for the stated task?	Preserve the remainder as part of the result rather than forcing completion

tive and task-relative: translation is evaluated against the specific research function it is meant to serve, and compatibility is treated as a property of a proposed interface under stated conditions rather than as a global property of two domains.

Definition 23.48 (Cross-domain translation specification)**.** A *cross-domain translation specification* identifies an originating domain, a receiving domain, the source object or claim, the target research task, the concepts or structures proposed for transfer, the meanings and inferential roles expected to be preserved, the compatibility conditions required for the task, anticipated losses, domain-specific remainders, validation responsibilities, and stopping conditions for the translation.

Definition 23.48 treats translation as a research design object rather than a lexical operation. A term can have the same surface form in several GR domains while playing different explanatory, evidential, normative, or institutional roles. Conversely, different words can perform structurally comparable work. The adequacy of a translation therefore depends on what the translation is being asked to preserve.

Proposition 23.49 (Task-indexed translation condition)**.** *A cross-domain translation is adequately specified only relative to a stated task, because a mapping that preserves enough structure for descriptive comparison may remain inadequate for causal explanation, formal modeling, institutional design, legal classification, normative judgment, or ontological inference.*

Table 23.3 summarizes the principal compatibility dimensions developed in this section. The dimensions are analytically separable. Compatibility on one dimension does not automatically establish compatibility on another.

23.3.1 Shared Relational Vocabulary

Generative Relational domains are likely to share terms such as *relation*, *position*, *constraint*, *subject*, *institution*, *field*, *dependence*, and *configuration*. Shared vocabulary can lower the cost of comparison, but it also creates a particular risk: the same word can conceal different units, directions of explanation, evidential requirements, and normative consequences. A legal relation, an economic relation, an educational relation, and a historical relation need not be interchangeable simply because each is relational.

Definition 23.50 (Relational-vocabulary alignment profile)**.** A *relational-vocabulary alignment profile* records, for a term used in two or more domains, its local definition, analytical object, relata, directionality, temporal scope, scale, constitutive conditions, observable manifestations, inferential role, and domain-specific remainder.

The profile prevents a common form of false equivalence. Consider *institution*. In GRE, an institution may be analyzed through the economic relations it stabilizes, the allocation and conversion rules it mediates, and the generative consequences it produces. In law, the relevant institutional object may depend on recognized authority, jurisdiction, competence, validity, procedural form, or legal standing. In political theory, institutional analysis may center legitimacy, authority, participation, or public justification. The same empirical organization can participate in each analysis while the relevant institutional relation differs.

Definition 23.51 (Relational translation unit)**.** A *relational translation unit* is the smallest relational structure that must remain identifiable for a proposed cross-domain mapping to perform its stated task. It may include the relata, relation type, direction, temporal condition, scale, institutional embedding, or dependence structure required by the target inference.

The translation unit is task-dependent. If the purpose is to compare whether two domains recognize asymmetric dependence, the unit may be relatively simple. If the purpose is to transfer a claim about legally enforceable dependence into economic analysis, the translation unit may also require the legal source of obligation, enforceability, standing, remedies, and temporal validity. Translation becomes weaker when the receiving domain retains only a generic statement that one position depends on another.

Proposition 23.52 (Relational non-equivalence under shared vocabulary)**.** *Shared relational terminology supports a presumption of comparability only at the level of the specified translation unit; it does not by itself establish equivalence of the relation's constitution, evidence, causal role, or normative significance across domains.*

This proposition allows relational language to function as an interface without becoming a hidden general ontology. Cross-domain research can ask whether several domains distinguish dependence from interaction, position from attribute, or institution from isolated event. Yet the answer should be recorded at the level actually supported. A recurrent distinction can become a candidate cross-domain structure while domain-specific conditions remain visible.

23.3.2 Shared Generative Vocabulary

A second family of shared terms concerns generation: *generative capacity*, *emergence*, *reproduction*, *transformation*, *return*, *maintenance*, *adaptation*, and *future possibility*. These terms can create an even stronger appearance of unity because they refer to change through time. The relevant processes, however, may differ substantially across domains. Economic generativity can concern later capability, value, relations, knowledge, or options; educational generativity can involve learning, judgment, curiosity, or participation; ecological generativity can involve regeneration of biophysical conditions; historical generativity can concern how earlier configurations condition later events and categories.

Definition 23.53 (Generative-vocabulary transfer record)**.** A *generative-vocabulary transfer record* identifies the source process, generating configuration, generated object or capacity, temporal horizon, mediating conditions, maintenance requirements, possible failure modes, and the corresponding elements proposed in the receiving domain.

The record is intended to prevent a weak use of *generative* as a synonym for productive, beneficial, creative, or merely causal. A process is more strongly comparable across domains when the source of generation, the downstream object, and the temporal or relational pathway can be stated in each domain. Similar language without such a pathway may still be heuristically useful, but it supplies a weaker basis for translation.

Proposition 23.54 (Process-preservation condition)**.** *A translation of generative vocabulary is stronger when it preserves the distinction among generating conditions, generative process, generated outcome, maintenance or reproduction, and the time horizon over which the claimed generation is evaluated.*

The condition matters because cross-domain translation can otherwise compress distinct processes into a single positive label. A legal institution can enable economic generativity without legal validity itself being reducible to economic generative performance. An educational arrangement can expand later economic capabilities while its educational value also depends on learning, autonomy, judgment, or participation that economics does not exhaust. Generative vocabulary can identify an interface while still preserving multiple domain-specific criteria of success.

Definition 23.55 (Generative correspondence level)**.** A *generative correspondence level* records whether a cross-domain comparison concerns lexical resemblance, process analogy, functional correspondence, mechanism correspondence, or a stronger candidate structural invariance supported by domain-specific evidence.

This ordered distinction allows recurring structures to be studied without prematurely classifying them as invariants. A feedback loop observed in economic and ecological settings may support functional comparison. A stronger claim that the same formal mechanism is present would require a defensible mapping among states, transitions, constraints, observables, and failure conditions. Cross-domain generalization should therefore follow the evidence available at the relevant correspondence level.

23.3.3 Ontological Compatibility

Ontological compatibility is especially sensitive because the present book operates under ontological suspension. GRE uses relational, field, dynamical, spacetime, algebraic, and other representations where they clarify economic analysis, while refraining from treating those representations as direct descriptions of ultimate social ontology. Cross-domain translation should preserve that restraint.

Definition 23.56 (Ontological compatibility profile)**.** An *ontological compatibility profile* records the analytical objects presupposed by each domain, the level at which those objects are treated as real, constructed, recognized, represented, or suspended, the dependencies among those commitments, and the strongest ontological claim required for the proposed translation.

Several kinds of compatibility are possible. Two domains may be *representationally compatible* when the same formal structure can be used without requiring agreement about what ultimately exists. They may be *object compatible* when each can identify sufficiently corresponding relational beings or configurations for a given task. They may remain *ontologically non-committal* when neither translation requires a stronger metaphysical claim. These forms should not be conflated with ontological identity.

Proposition 23.57 (Compatibility without ontological identity)**.** *Cross-domain translation can be analytically adequate when the participating domains can coordinate their objects and representations for the stated task even though their deeper ontological interpretations remain different, suspended, or unresolved.*

This proposition is particularly important for candidate GRT development. Recurrent use of relations, fields, trajectories, or 2-complex-like representations across several domains can motivate comparison. It does not establish that the domains instantiate one common ultimate ontology. The generalization burden rises when a proposed cross-domain theory requires stronger ontological identification than the domain-specific research programmes themselves require.

Definition 23.58 (Ontological escalation threshold)**.** An *ontological escalation threshold* is reached when a proposed translation can no longer perform its stated task through representational or object-level correspondence and instead requires a stronger claim that the participating domains instantiate the same underlying kind of being, relation, process, or structure.

Crossing this threshold is not prohibited. It changes the epistemic status of the inquiry. The resulting claim belongs to a stronger metaphysical or GRT-oriented programme and should receive independent argument rather than inheriting warrant from the success of a domain-specific model.

23.3.4 Epistemic Compatibility

Translation also depends on how a domain can know what it claims. GRE can use prices, accounts, institutional records, surveys, interviews, archives, observational data, experiments, formal models, and interpretive evidence. A neighboring domain can rely on partly overlapping materials while assigning them different epistemic roles. A legal text can be evidence of a recognized rule, an historical artifact, an

economic constraint, a political settlement, and a social symbol, but the inferences licensed by the text differ across those uses.

Definition 23.59 (Epistemic interface profile)**.** An *epistemic interface profile* identifies the claim being translated, the source evidence and its provenance, the source-domain warrant, the receiving-domain manifestation or evidential bridge, uncertainty, missingness, contestation, and the additional validation required before the receiving domain can rely on the translated claim.

Epistemic compatibility is therefore stronger than shared access to data. A dataset created for administrative eligibility may be highly relevant to economic allocation while failing to capture informal access, hidden exclusion, or historical category changes. An ethnographic observation may reveal relational dependence that a legal classification does not recognize. An archived institutional record can illuminate formal rules while remaining silent about actual practice. Translation should preserve these asymmetries in observability.

Proposition 23.60 (Warrant non-substitution)**.** *Evidence that warrants a claim in one domain does not automatically warrant the translated claim in another domain when the receiving inference depends on additional objects, manifestations, or standards of validation.*

This proposition prevents evidence from traveling more strongly than the claim. A legal determination that an actor possesses a right may be economically relevant, but it does not establish effective capability to exercise that right. An economic measure of control over a resource may identify practical influence while not establishing legal title. Historical evidence that a category emerged at a particular time can revise economic periodization without directly proving a causal economic mechanism.

Definition 23.61 (Epistemic revalidation requirement)**.** An *epistemic revalidation requirement* specifies which parts of a translated claim must be newly observed, reconstructed, interpreted, or tested because the receiving domain asks a different question or requires a different evidential bridge.

Revalidation can be minimal when the receiving domain uses an externally established fact only as a boundary condition. It becomes more substantial when the external claim is constitutive to the receiving domain's explanation. The depth of epistemic revalidation should therefore track the role played by the translated material.

23.3.5 Methodological Compatibility

Methods often travel more easily than concepts because archival inquiry, ethnography, network analysis, surveys, experiments, comparative analysis, simulation, and formal modeling are already used across disciplines. Yet methodological portability can obscure a change in the object being measured or modeled. The same statistical or formal procedure can answer different questions depending on unit construction, boundary selection, variable meaning, temporal resolution, and inferential assumptions.

Definition 23.62 (Methodological transfer contract)**.** A *methodological transfer contract* records a method's original research object, assumptions, unit of analysis, boundary conditions, evidence requirements, inferential target, and known limita-

tions, together with the corresponding elements in the receiving domain and the modifications required for adequate use.

The contract distinguishes technique portability from methodological compatibility. Network analysis can be used in economics, political science, education, ecology, history, or social theory, but the meaning of a node, tie, boundary, missing relation, and centrality measure may differ substantially. A dynamical model can represent economic variables and ecological states without implying that the modeled transitions have the same causal interpretation. A qualitative method can preserve situated meaning in one domain while requiring additional institutional or legal interpretation in another.

Proposition 23.63 (Method portability condition)**.** *A method is portable across domains to the extent that its assumptions and inferential operations remain adequate after the receiving domain has re-specified the research object, units, boundaries, manifestations, and claim type.*

Methodological compatibility can therefore fail even when the computation runs correctly. The failure can arise because the receiving object is not adequately represented, because the unit of analysis changes meaning, because dependence violates the original design, or because the method's output cannot answer the domain-specific question. Recording such failures is part of cross-domain methodological learning.

Definition 23.64 (Methodological correspondence test)**.** A *methodological correspondence test* compares the source and receiving research designs across object definition, sampling or case selection, temporal and spatial boundaries, measurement, dependence structure, inferential target, validation, and revision conditions.

The test is deliberately pluralistic. It does not rank formal, quantitative, historical, interpretive, qualitative, or computational methods on one scale. It asks whether the chosen method can answer the receiving domain's question with an identifiable warrant and whether another method is needed to recover structures lost in transfer.

23.3.6 Normative Compatibility

Normative translation requires additional restraint because evaluative concepts often carry domain-specific sources of authority. GRE can investigate distribution, participation, effective options, dependence, generative opportunity, conversion conditions, circulation, return, and economic consequences of institutional arrangements. Those findings can inform inquiry into justice, legitimacy, rights, educational goods, ecological stewardship, or aesthetic value. They do not by themselves settle the normative standards governing those domains.

Definition 23.65 (Normative interface profile)**.** A *normative interface profile* identifies the evaluative concept being translated, affected subjects or positions, the source of the relevant normative reasons, domain-specific standing and authority, empirical premises, comparison rule, unresolved value conflicts, and the claims that remain outside the competence of the originating domain.

Normative compatibility can be partial. Economic evidence that one institutional design forecloses future options may be relevant to a political argument about partic-

ipation, a legal argument about rights, an educational argument about agency, or an ecological argument about intergenerational stewardship. The relevance of the evidence does not imply that the normative concept has become economic. The receiving domain may assign different weight to the same consequence or regard another consideration as prior.

Proposition 23.66 (Normative authority non-transfer)**.** *Cross-domain relevance of an economic consequence does not transfer normative authority to GRE when the justificatory standard for the resulting judgment belongs partly or principally to another domain.*

The proposition also runs in the reverse direction. A legal entitlement, political commitment, educational norm, or ecological value can constrain economic design without automatically determining every economic allocation question. Normative interfaces require explicit coordination among reasons rather than hierarchical absorption of one domain by another.

Definition 23.67 (Normative compatibility threshold)**.** A *normative compatibility threshold* is met for a specified cross-domain task when the participating domains can identify the relevant subjects, stakes, reasons, and comparison rules sufficiently to use one another's findings without attributing justificatory authority beyond what each domain can defend.

This threshold permits collaboration even when normative theories remain contested. A study can compare how alternative legal rules distribute economic dependence while leaving the ultimate legal or political justification open. A policy analysis can identify economic consequences of ecological thresholds while recognizing that the selection of protected ecological goods may require independent normative and scientific inquiry.

23.3.7 Translation Loss

Cross-domain translation is rarely lossless. The relevant question is therefore not whether loss exists, but whether the loss is identifiable and acceptable for the stated task. Some losses are semantic: a term becomes broader or narrower. Others are inferential: the receiving domain can no longer draw conclusions available in the source domain. Temporal, scale, institutional, evidential, normative, and formal losses can also occur.

Definition 23.68 (Translation-loss ledger)**.** A *translation-loss ledger* records the structures omitted, transformed, aggregated, reclassified, or rendered unobservable during cross-domain translation, together with the reason for each loss, its expected effect on inference, whether it is reversible, and the tasks for which the translated object remains adequate.

The ledger makes translation loss inspectable rather than treating it as an unavoidable but unspecified cost. A legal category translated into an economic indicator may lose procedural history and doctrinal distinctions. A historical narrative translated into model states may lose ambiguity and contested meaning. An economic capability profile translated into a governance analysis may fail to capture legitimate authority or public justification. A formal representation transported into another domain may

preserve topology while losing institutional semantics.

Proposition 23.69 (Loss-sensitive adequacy)**.** *A cross-domain translation remains adequate for a task when the recorded losses do not remove structures required for the target inference and when the receiving analysis does not silently rely on information the translation no longer contains.*

Loss-sensitive adequacy differs from completeness. A deliberately coarse translation can be useful when the research question is correspondingly coarse. Problems arise when later stages of analysis forget the original limitation and begin treating the translated object as if it retained the source domain's full meaning.

Definition 23.70 (Cumulative translation-loss threshold)**.** A *cumulative translation-loss threshold* is reached when successive mappings, aggregations, reinterpretations, or formalizations remove enough task-relevant structure that the resulting object can no longer support the claim for which it is being used.

Cumulative loss is especially relevant in interdisciplinary pipelines. A historical category can first be operationalized as a variable, then aggregated across regions, then incorporated into a formal model, then exported into a policy comparison. Each step can be defensible individually while the sequence as a whole may no longer preserve the historical distinctions needed for the final claim. Translation provenance should therefore remain end-to-end rather than being documented only at the most recent interface.

Proposition 23.71 (Translation provenance continuity)**.** *When a cross-domain claim depends on a sequence of translations, the final warrant should remain traceable through the intermediate mappings and losses that connect the originating evidence to the receiving inference.*

This proposition links translation discipline to the research-infrastructure architecture of Chapter 22. Versioned concepts, data provenance, model lineages, and disagreement records are not merely archival conveniences; they make cumulative cross-domain inference auditable.

23.3.8 Domain-Specific Remainders

Some structures remain material to a domain even after a useful translation has been achieved. These domain-specific remainders should not be treated as defects to be eliminated by further abstraction. They can identify precisely what a receiving domain cannot inherit without changing the question, the object, or the standard of warrant.

Definition 23.72 (Domain-specific remainder)**.** A *domain-specific remainder* is a concept, distinction, evidential requirement, normative responsibility, historical condition, institutional form, or inferential dependency that remains material in its originating or receiving domain but is not adequately preserved by the proposed cross-domain translation.

Remainders can be small or constitutive. A historical dating convention may remain locally necessary without affecting an economic comparison. By contrast, legal validity, political legitimacy, educational meaning, ecological regeneration, or aesthetic judgment can be constitutive to the neighboring domain's principal question.

Translating away such a remainder can change the object rather than merely simplify it.

Definition 23.73 (Remainder-protection rule)**.** The *remainder-protection rule* requires a cross-domain analysis to preserve an explicit record of any remainder whose removal would materially change the source or receiving domain's principal question, warrant, or object of evaluation.

This rule has two consequences. First, cross-domain work can remain integrated without becoming reductive. A project can combine economic, legal, historical, ecological, and political components while leaving some judgments distributed across domains. Second, persistent remainders provide evidence about the limits of wider generalization. A candidate GRT concept should not be called invariant merely because domain-specific remainders have been omitted from the comparison.

Proposition 23.74 (Remainder-preserving translation)**.** *A translation can be productive without being complete when it preserves enough shared structure for the stated task and leaves material domain-specific remainders visible, attributable, and capable of constraining the resulting inference.*

Definition 23.75 (Cross-domain translation portfolio)**.** A *cross-domain translation portfolio* is a versioned set of translation specifications, compatibility profiles, methodological transfer contracts, normative interface profiles, loss ledgers, failed mappings, and domain-specific remainders maintained across a family of GRE interfaces.

The portfolio allows cross-domain comparison to accumulate without forcing convergence. Repeatedly successful mappings can become candidates for stronger comparison. Recurrent losses can indicate stable boundary structures. Failed mappings can identify concepts whose apparent similarity was superficial. Reinterpretation in a neighboring domain can also return corrections that change the economic object, its periodization, its measurement, or its normative significance.

Proposition 23.76 (Translation-with-remainder condition)**.** *Cross-domain translation contributes to a wider Generative Relational research programme when it specifies the task, preserves the structures needed for that task, records compatibility and loss across relevant dimensions, protects material domain-specific remainders, and remains open to correction from the receiving domain.*

Translation across GR domains can therefore be systematic without presupposing general-theoretical identity. Shared relational and generative vocabularies create comparison opportunities; ontological, epistemic, methodological, and normative compatibility determine which forms of transfer are defensible; translation-loss records identify what has been transformed; and domain-specific remainders preserve the independent answerability of neighboring programmes. The next section applies this architecture to the first substantive interface, Generative Relational History, where historical generation, path dependence, multiple timescales, contingency, and retrospective re-epistemization directly condition economic analysis while retaining specifically historical responsibilities.

23.4 GRE–GRH Historical Interface

Sections 23.1–23.3 established the boundary, containment, and translation disciplines required before a substantive cross-domain interface can be developed. The present section applies those disciplines to the interface between Generative Relational Economics (GRE) and Generative Relational History (GRH). Its role is to specify how historical reconstruction can condition economic explanation without reducing history to a stock of background variables or allowing economic categories to organize the historical record by default. The objective is to identify the historical structures that GRE may legitimately import, the economic questions that can be sharpened through GRH, the corrections that historical inquiry can return to GRE, and the limits beyond which historical explanation should retain independent disciplinary responsibility. The discussion proceeds through historical generation, inherited constraint, path dependence, multiple timescales, fast–slow dynamics, contingency, retrospective re-epistemization, and limits of historical import. The method is interface-oriented and bidirectional: economic claims are made historically answerable, while historical claims are not required to become economic claims in order to matter.

Definition 23.77 (GRE–GRH interface record)**.** A *GRE–GRH interface record* identifies an economic object or claim, the historical formation relevant to it, the historical evidence and categories required for reconstruction, the economic mechanism or consequence under examination, the translation connecting the two domains, the domain-specific remainders retained on each side, and the corrections that either domain could return to the other.

Definition 23.77 makes the interface narrower than a general statement that economics is historical. GRE can study value conversion, institutions, power, generative capacity, or allocation over time while still failing to reconstruct how the relevant categories, organizations, evidential records, and feasible alternatives came into being. Conversely, GRH can reconstruct the formation of an institution or economic category without reducing that history to a present economic mechanism. The interface becomes analytically useful when both contributions remain identifiable.

Proposition 23.78 (Historical answerability of economic claims)**.** *A GRE claim whose explanatory force depends materially on inherited institutions, sequence, changing categories, temporal coupling, or historically differentiated possibilities should remain answerable to historical reconstruction concerning those dependencies rather than treating them as fixed initial conditions without provenance.*

Table 23.4 summarizes the principal interface operations developed below.

23.4.1 Historical Generation of Economic Structures

Economic structures are often encountered in GRE after they have already become recognizable as markets, firms, public agencies, property regimes, standards, infrastructures, professional roles, monetary arrangements, platforms, or systems of allocation. Historical inquiry asks a prior question: how did the structure acquire the relations, categories, authority, material support, and recognizability that allow it to function as the economic object now being analyzed? The answer cannot always be

Table 23.4: Principal operations at the GRE–GRH historical interface

Interface domain	GRE question	Historical responsibility and restraint
Historical generation	How did an economic structure become available, stabilized, or transformed?	Reconstruct formation without assuming current categories existed unchanged in the earlier period
Historical constraint	Which inherited structures condition present economic possibilities?	Identify provenance and transmission rather than treating inheritance as an unexplained residual
Path dependence	How does realized sequence alter later accessibility or transition structure?	Distinguish mechanism-supported dependence from persistence or retrospective storytelling
Multiple timescales	Which processes operate at materially different temporal resolutions?	Reconstruct scale-specific histories before assuming that one chronology represents all processes
Fast–slow dynamics	When is rate separation historically defensible?	Treat characteristic rates and scale separation as regime-dependent rather than permanent properties
Historical contingency	Which alternatives were practically accessible at a historical point?	Preserve uncertainty, branch structure, and contemporaneous constraints against retrospective inevitability
Re-epistemization	How should later evidence or categories revise an earlier economic reconstruction?	Separate change in warranted knowledge from change attributed to the underlying past process
Limits of historical import	Which historical findings can GRE legitimately incorporate?	Preserve historical meaning, evidential provenance, and non-economic remainders; stop import when translation changes the historical object

supplied by extending the economic model backward in time. The historical object may have changed category, boundary, or meaning during its formation.

Definition 23.79 (Historical-generation profile)**.** A *historical-generation profile* reconstructs the emergence or transformation of an economically relevant structure through its antecedent relations, formative events, actors and positions, institutional supports, material conditions, category changes, contested alternatives, stabilization mechanisms, and the evidential traces through which that history can presently be warranted.

The profile distinguishes formation from mere dating. Saying that a regulation was enacted in a particular year does not yet explain when the practical institution it enabled became operative, which earlier practices it codified, which actors resisted or reinterpreted it, or which complementary infrastructures made it economically consequential. Likewise, a technology can exist technically before standards, skills, finance, procurement, legitimacy, and network adoption generate a stable economic field around it.

Proposition 23.80 (Formation-sensitive economic interpretation)**.** *When the present economic function of a structure depends materially on the process through which its relations, categories, or institutional supports were generated, an adequate GRE interpretation should preserve that formation history rather than representing the structure only through its current state.*

Historical generation can also correct economic periodization. A present-oriented economic analysis may date a transformation from a visible market event, legislative change, crisis, or technological release. GRH may identify a longer formation process whose decisive relational changes began earlier, or may show that a nominally singular transition consisted of several distinct historical phases. Such corrections can change the causal window of GRE analysis, the appropriate baseline, and the actors

to whom economic effects are attributed.

23.4.2 Historical Constraint

Historical formation leaves constraints. Some are material, such as infrastructure, land use, accumulated debt, ecological depletion, or technical standards. Others are relational and institutional: established authority, ownership patterns, organizational routines, professional jurisdictions, classification systems, or inherited expectations. Historical constraint is therefore more specific than the observation that the present has antecedents. The question is how an inherited configuration continues to alter what later positions can do, access, contest, or generate.

Definition 23.81 (Historically inherited constraint)**.** A *historically inherited constraint* is a restriction or conditioning structure whose present economic relevance depends materially on a prior historical formation and on one or more mechanisms through which that formation remains operative, is reproduced, or is transformed in the later configuration.

Definition 23.82 (Constraint-transmission record)**.** A *constraint-transmission record* identifies the originating historical configuration, the mechanism by which its effects are carried forward, the later positions or relations affected, the transformations that occurred during transmission, and evidence capable of distinguishing inherited constraint from independently regenerated contemporary constraint.

This last distinction matters. Present inequality can resemble an earlier inequality without being produced through the same historical pathway. Conversely, an inherited structure can remain influential even after its original legal or organizational form disappears. The economic task is therefore not to attach a historical label to every current asymmetry, but to identify whether a historically formed constraint is part of the present mechanism.

Proposition 23.83 (Historical-constraint attribution)**.** *A present economic limitation should be attributed to historical constraint only to the extent that an evidentially supported pathway connects the earlier formation to the later restriction, dependence, cost, capability difference, or altered option structure.*

Historical analysis can return a further correction: what GRE describes as a constraint may also have been a historically generated enabling condition for another position or activity. Rail routes can constrain later spatial development while having generated earlier connectivity; professional standards can restrict entry while preserving competence; fiscal institutions can limit discretionary action while enabling credible long-horizon coordination. GRH can reconstruct these layered functions without requiring GRE to assign one transhistorical valence to the inherited structure.

23.4.3 Path Dependence

GRE already treats path dependence as a mechanism-sensitive relation between realized history and later transition possibilities. The historical interface adds a disciplinary requirement: the relevant path must be reconstructed rather than inferred from persistence alone. GRH can investigate whether the alleged branch points, re-

inforcement mechanisms, switching costs, institutional sequences, and unrealized alternatives were historically available in the form assumed by the economic analysis.

Definition 23.84 (Path-dependence interface profile)**.** A *path-dependence interface profile* links a GRE claim about sequence-dependent economic accessibility to a GRH reconstruction of the relevant starting boundary, historical alternatives, realized events, reinforcement or hysteresis mechanisms, category changes, and evidence concerning later structural consequences.

The interface guards against two symmetrical errors. Economic modeling can compress a long and contested history into a few state variables whose historical meaning is unclear. Historical narration can, in turn, identify a compelling sequence without establishing that the sequence altered later economic accessibility through the mechanism claimed. Path dependence becomes a strong cross-domain claim only when historical reconstruction and economic mechanism analysis support one another without being collapsed.

Proposition 23.85 (Historically warranted path dependence)**.** *A cross-domain path-dependence claim is strengthened when the historical record supports both the practical accessibility of materially different earlier continuations and a transmission mechanism through which the realized sequence changed later economic possibilities.*

This proposition also protects contingency. Once a path is realized, later institutions can make it appear inevitable. A historically reconstructed branch can show that another continuation was once practically possible, while GRE can examine why the realized branch became progressively easier to reproduce or harder to leave. The two domains therefore divide labor: GRH reconstructs the historically situated alternative set and sequence; GRE can analyze the economic reinforcement, conversion, allocation, and capability consequences associated with the path.

23.4.4 Multiple Timescales

Economic processes do not share one historical clock. Prices, transactions, organizational routines, educational capability, infrastructure, legal regimes, demographic change, ecological regeneration, scientific knowledge, and social trust can operate across markedly different horizons. GRE can represent these heterogeneous timescales and their couplings, but GRH can test whether the proposed temporal boundaries correspond to historically distinguishable processes rather than to convenient analytical aggregation.

Definition 23.86 (Timescale-correspondence profile)**.** A *timescale-correspondence profile* records, for each temporally differentiated process in a GRE analysis, the historical events and intervals through which the process is reconstructed, its characteristic persistence or adjustment horizon, the evidence supporting that horizon, changes in its temporal organization, and the mechanisms coupling it to processes represented at other timescales.

A timescale can be institutionally produced. Annual budgeting, election cycles, reporting periods, debt maturities, school calendars, regulatory procedures, maintenance schedules, and archival practices create temporal structures that are neither

purely natural nor arbitrary. Their historical origins can matter to economic explanation. If a fiscal institution changes its reporting cycle, for example, an apparent acceleration in policy response can partly reflect a changed institutional clock rather than a simple increase in economic responsiveness.

Proposition 23.87 (Historically grounded multitemporality)**.** *A multiple-timescale GRE representation is historically stronger when the represented temporal resolutions correspond to reconstructible processes whose durations, boundaries, and couplings are supported by period-specific evidence rather than inferred solely from present observation frequency.*

This also affects aggregation. A century-long institutional transformation can contain several shorter regimes with different economic mechanisms. A monthly time series can conceal a slower category change that alters what the variable means. GRH can therefore reveal that measurements apparently occupying one continuous series belong to historically differentiated regimes. GRE should then decide whether to bridge, segment, or reinterpret the series rather than forcing temporal continuity.

23.4.5 Fast–Slow Dynamics

Fast–slow analysis is a stronger claim than the recognition of multiple timescales. It proposes that some processes change sufficiently faster than others that a rate separation clarifies their interaction. The historical interface asks whether that separation was stable over the period being studied, how the characteristic rates were institutionally or materially generated, and whether historical transitions altered which process counted as fast or slow.

Definition 23.88 (Historical fast–slow interface)**.** A *historical fast–slow interface* links a GRE decomposition of relatively fast and slow processes to historical evidence concerning the origin, persistence, transformation, and breakdown of their characteristic rates and coupling mechanisms within a bounded regime.

Definition 23.89 (Rate-regime historicity)**.** *Rate-regime historicity* is the condition that the characteristic pace of an economic, institutional, technological, ecological, or epistemic process can itself be historically generated and can change enough to alter a previously adequate fast–slow classification.

Market communication can accelerate after new infrastructure; legal change can become rapid during constitutional crisis; organizational routines can freeze under emergency; technological standards can stabilize after periods of rapid competition; ecological degradation can cross thresholds and accelerate. These are not exceptions to an otherwise timeless rate ordering. They show why the rate ordering itself belongs to the historical object.

Proposition 23.90 (Historically bounded rate separation)**.** *A fast–slow decomposition imported into historical analysis should be treated as regime-bounded unless evidence supports persistence of the relevant rate separation across the wider period to which the claim is extended.*

This restraint matters for later governance interfaces as well. A governance arrangement designed around a historically stable mismatch can become inappropriate when one process accelerates, another slows, or cross-frequency coupling

changes. GRH can identify when the temporal architecture changed; GRE can analyze the economic consequences of acting through institutions whose response horizons were formed under an earlier rate regime.

23.4.6 Historical Contingency

Historical contingency is often invoked loosely to mean that events could have been otherwise. At the GRE–GRH interface, a stronger account asks what alternatives were practically accessible to historically situated actors, which conditions made them accessible, what uncertainty existed at the time, and how later developments transformed the significance of the realized choice or event. Contingency is therefore related to, but distinct from, randomness and ignorance.

Definition 23.91 (Historical-contingency record)**.** A *historical-contingency record* identifies a bounded historical configuration, the materially distinct continuations that were plausibly accessible within it, the actors and constraints relevant to those continuations, contemporaneous uncertainty or disagreement, the realized continuation, and the later mechanisms through which its consequences were amplified, attenuated, or transformed.

The requirement of practical accessibility prevents counterfactual imagination from becoming unlimited. An alternative need not have been equally likely, politically dominant, or economically optimal, but there should be historical grounds for treating it as more than a possibility invented from the later standpoint. Such grounds can include proposals, debates, competing standards, organizational capacities, unrealized investments, legal alternatives, or choices actually made in comparable settings.

Proposition 23.92 (Contingency-amplification condition)**.** *A contingent historical difference becomes economically consequential for GRE when subsequent relations, institutions, investments, expectations, or constraints transmit or amplify that difference into later value, capability, allocation, dependence, or option structures.*

Historical contingency also disciplines responsibility claims. Later observers can know consequences unavailable to earlier actors. GRH can reconstruct what alternatives and information were accessible at the time; GRE can analyze how the realized decision redistributed later economic possibilities. Keeping the two questions separate avoids both retrospective absolution and retrospective omniscience.

23.4.7 Retrospective Re-Epistemization

Later inquiry can change what is responsibly knowable about an earlier economic process. New archives can open, records can be digitized and linked, categories can be revised, previously excluded testimony can become available, and later consequences can make earlier patterns recognizable. GRE has already developed historical re-epistemization as a way to preserve this distinction. The GRH interface strengthens it by requiring later revision to remain historically situated rather than treating the newest reconstruction as if it had always been available.

Definition 23.93 (Cross-domain re-epistemization record)**.** A *cross-domain re-epistemization record* preserves an earlier economic reconstruction, the evidence,

categories, and methods available when it was formed, the later historical materials or conceptual changes that motivate revision, the revised reconstruction, and the specific descriptive, causal, evaluative, or classificatory claims whose warrant has changed.

This record can reveal several kinds of revision. A later archive may change the estimated timing of an institutional shift. A new category can make previously invisible labor recognizable. A changed model can show that observations formerly treated as independent belonged to one relational process. A long-delayed consequence can alter judgment about the generative effect of an earlier intervention. Each revision changes the epistemic relation to the past; none requires the claim that the past process itself changed because later inquiry changed.

Proposition 23.94 (Then–now epistemic separation)**.** *A retrospective GRE–GRH revision should distinguish what later inquiry can warrant about an earlier process from what relevant actors or analysts could reasonably know, classify, or infer within the earlier historical configuration.*

This distinction is especially important for evaluation and attribution. Later evidence can support a stronger causal account while still showing that contemporaneous decision-makers lacked access to the evidence needed to form that account. Conversely, evidence of contemporaneous warnings can weaken claims that later-discovered harms were wholly unforeseeable. Re-epistemization therefore permits more accurate retrospective judgment without erasing historical epistemic position.

23.4.8 Limits of Historical Import

The GRE–GRH interface becomes reductive if every historically reconstructed distinction is converted into an economic variable, mechanism, or explanatory input. Historical meaning, chronology, periodization, archival absence, category formation, lived interpretation, and contested memory can remain material even when their economic consequence is uncertain. Historical import therefore requires an explicit stopping rule.

Definition 23.95 (Historical-import contract)**.** A *historical-import contract* specifies the historical object or finding proposed for use in GRE, the economic task it is intended to serve, the historical meaning and provenance that must remain preserved, the transformation required for economic use, the historical remainder not imported, the validation responsibility of GRE, and the conditions under which the import should be withdrawn or returned for further historical inquiry.

The contract prevents a common asymmetry in interdisciplinary work. Historical scholarship can be used merely to provide examples, dates, or background while economic theory determines in advance which features count as causally relevant. A more balanced interface allows historical reconstruction to alter the economic object itself. It can show that a category was unstable, that the assumed institution did not yet exist in its later form, that a period boundary is misplaced, or that two observations grouped together economically belonged to historically different relations.

Definition 23.96 (Historical-import saturation threshold)**.** A *historical-import saturation threshold* is reached when additional historical material becomes constitutive

enough to the principal question, evidence, categories, or explanatory responsibility that the inquiry can no longer be adequately governed as GRE with historical support alone and instead requires joint GRE–GRH governance or reclassification.

This threshold mirrors the borrowing discipline developed in Section 23.2. A GRE paper can legitimately use historical reconstruction without becoming a history paper. Yet when the principal controversy concerns archival interpretation, periodization, historical meaning, or reconstruction of the event sequence itself, historical expertise is no longer auxiliary. Domain accountability requires the research architecture to change accordingly.

Definition 23.97 (GRH correction return)**.** A *GRH correction return* is a historically warranted finding transmitted back to GRE that requires revision of an economic category, periodization, initial condition, mechanism, timescale, counterfactual set, evidential interpretation, or domain boundary.

Correction returns are central to a genuinely bidirectional interface. A historical study can force GRE to split a supposedly stable category, move the beginning of a trajectory, revise the mechanism connecting two events, or recognize that a formal timescale decomposition was an artifact of later aggregation. Such revisions do not weaken interdisciplinary inquiry; they are evidence that the interface preserves independent answerability.

Proposition 23.98 (Historical-interface containment)**.** *GRE can legitimately import historical findings when their provenance, historical meaning, and task-relevant distinctions remain preserved, the economic use is separately warranted, and material historical remainders remain visible; where historical reconstruction becomes constitutive to the principal question or where translation changes the historical object, the inquiry should shift toward joint governance or remain within GRH rather than expanding GRE by default.*

Definition 23.99 (GRE–GRH interface portfolio)**.** A *GRE–GRH interface portfolio* is a versioned collection of historical-generation profiles, constraint-transmission records, path-dependence interface profiles, timescale-correspondence profiles, fast–slow interface records, contingency records, re-epistemization records, historical-import contracts, non-import decisions, and GRH correction returns maintained across related research programmes.

Proposition 23.100 (Historical-interface answerability)**.** *A mature GRE–GRH interface should make it possible to state which economic claims depend on historical formation, which historical reconstructions support or weaken those claims, which translations were performed, which historical structures were deliberately not imported, which corrections returned to GRE, and which unresolved questions remain properly historical rather than economic.*

The historical interface therefore adds more than context to GRE. Historical generation identifies how economic objects become possible; inherited constraint and path dependence connect realized sequence to later accessibility; multiple timescales and fast–slow analysis become historically bounded rather than timeless classifications; contingency preserves unrealized alternatives against retrospective inevitability; and re-epistemization permits later correction without overwriting earlier epistemic positions. The next section examines multiscale historical time and transition.

23.5 Multiscale Historical Interfaces

Section 23.4 established the general GRE–GRH historical interface. The present section deepens that interface by examining historical processes that become intelligible only when several temporal resolutions are distinguished and related. Its role is to specify how event time, institutional time, structural time, and intergenerational time can be represented without converting them into fixed ontological layers. The objective is to identify economically relevant cross-scale couplings, diagnose circumstances in which apparent scale separation fails, reconstruct transitions whose timing differs across processes, and formulate provisional multiscale hypotheses with explicit ontological restraint. The discussion proceeds through four temporal resolutions, their couplings, breakdown of separation, historical transition, economic interpretation, and formal hypotheses. The method is historical and relational, with formalization used only where it clarifies lag, memory, coupling, or regime change.

Definition 23.101 (Multiscale historical interface record)**.** A *multiscale historical interface record* specifies a historical-economic object, the temporal resolutions relevant to it, the processes assigned provisionally to each resolution, their characteristic response or persistence horizons, the mechanisms connecting resolutions, the evidence supporting those assignments, the historical regimes within which they remain useful, and the revisions required when the temporal decomposition ceases to preserve the object of inquiry.

The record treats scale as a property of an analytical representation relative to a research question. Event, institutional, structural, and intergenerational time are therefore not assumed to divide the world into four natural layers. They identify temporal resolutions at which different changes may become empirically and historically tractable. The same organization, regulation, technology, or relation can participate in more than one resolution when different mechanisms or questions are under examination.

Proposition 23.102 (Scale-indexed historical answerability)**.** *A multiscale GRE claim is historically answerable when the temporal resolutions it uses, the processes assigned to them, and the couplings asserted among them can be reconstructed and revised from historical evidence rather than being fixed solely for analytical convenience.*

Table 23.5 summarizes the principal temporal resolutions and interface responsibilities developed below.

23.5.1 Event Time

Event time is the finest temporal resolution considered here. It concerns bounded occurrences whose ordering, duration, and immediate relational consequences matter to the economic inquiry. Examples can include a policy announcement, a contract termination, a payment failure, a strike, an emergency procurement decision, a platform rule change, a market interruption, or a sudden coordination event. Event time is not defined by short duration alone. A formally brief act can have no material economic consequence, while a process lasting several months can function analytically as an event when the research question concerns its relation to slower institutional or structural change.

Table 23.5: Principal temporal resolutions in the GRE–GRH multiscale interface

Temporal resolution	Typical analytical object	Economic relevance	Historical restraint
Event time	Decisions, shocks, announcements, transactions, protests, failures, interventions	Immediate reallocation, repricing, interruption, coordination, or change in expectations	Event boundaries and significance depend on prior relations and later transmission
Institutional time	Rules, routines, budgets, contracts, administrative cycles, organizational learning	Persistence, lagged adjustment, access conditions, authority, and recurrent allocation	Institutional clocks and revision rates can change historically
Structural time	Infrastructures, ownership patterns, durable position distributions, standards, production systems	Long-lived constraints, dependencies, capability distributions, and transition conditions	Slow change should not be equated automatically with structural importance
Intergenerational time	Assets, debt, knowledge, ecological conditions, institutional memory, durable obligations	Transmission of capacity, burden, opportunity, and constraint across successor cohorts or positions	Generational boundaries and carriers require domain-specific reconstruction
Cross-scale coupling	Relations among processes represented at different resolutions	Feedback, lag, amplification, buffering, and changing feasible sets	Coupling must be demonstrated rather than inferred from temporal coincidence

Definition 23.103 (Event-time profile)**.** An *event-time profile* records an event's analytical boundary, internal sequence, relevant participants and positions, pre-event configuration, immediate relational changes, contemporaneous uncertainty, available alternatives, evidential timestamps, and the pathways through which the event may transmit effects into slower temporal resolutions.

This profile keeps event analysis from becoming a chronology of salient dates. Historical prominence and economic significance are different properties. A highly visible announcement may leave allocation, capability, or institutional practice largely unchanged. A less visible procedural decision may alter access conditions for years. GRE therefore requires a transmission account before escalating a dated event into a broader economic explanation.

Definition 23.104 (Event transmission trace)**.** An *event transmission trace* identifies the relations through which an event changes later states, the delay before those changes become observable, the positions through which transmission occurs, the forms of amplification or attenuation encountered, and the evidence distinguishing transmission from coincident change.

The trace also permits an event to be economically consequential through blocked transmission. A regulatory announcement can be historically important while failing to alter organizational practice because implementation resources, legal authority, technical capacity, or local incentives prevent translation into institutional change. Such cases should remain visible rather than being classified simply as weak events.

Proposition 23.105 (Event-time transmission condition)**.** *An event-time observation warrants a claim about slower economic transformation only when a transmission mechanism connects the event to the later institutional, structural, or intergenerational configuration and the relevant lag is consistent with the reconstructed sequence.*

Event time is therefore especially useful for locating initiation, interruption, trigger, and coordination. It is less adequate by itself for attributing persistence. Persistence becomes the object of the slower resolutions considered next.

23.5.2 Institutional Time

Institutional time concerns the recurrent temporal organization through which rules, routines, budgets, administrative procedures, contracts, standards, and organizational memory are reproduced or revised. Institutions possess several clocks at once. Budget cycles can be annual, leadership succession irregular, contracts multi-year, legal review episodic, and informal routines continuous. The relevant institutional time therefore depends on the mechanism under investigation rather than on a single calendar frequency.

Definition 23.106 (Institutional-time profile)**.** An *institutional-time profile* identifies an institution's recurrent cycles, revision opportunities, implementation lags, memory mechanisms, persistence horizons, decision bottlenecks, and the historical conditions under which those temporal properties were established or altered.

Institutional time can buffer event volatility. A rapid price change or political announcement may be absorbed by procurement rules, reserve requirements, tenure protections, budgeting procedures, or professional routines. The same institutional architecture can also amplify event effects when a scheduled review, election, refinancing cycle, or regulatory deadline concentrates change into a narrow window.

Definition 23.107 (Institutional temporal memory)**.** *Institutional temporal memory* is the set of procedures, records, routines, commitments, material investments, and role expectations through which earlier institutional states continue to condition later decisions after the initiating events have passed.

Memory in this sense is distributed. It can reside in archives, software, infrastructure, standardized forms, professional training, legal commitments, or expectations held by external actors. Institutional persistence therefore does not require unchanged personnel or explicit recollection by current decision makers.

Proposition 23.108 (Institutional-lag interpretation)**.** *A lag between an event and an institutional response should be interpreted through the institution's historically reconstructed revision opportunities, commitments, and memory mechanisms rather than being treated automatically as inertia or inefficiency.*

Institutional time can itself accelerate or slow. Emergency powers may compress ordinary review cycles. Standardization can lengthen the persistence of a technical regime. Digital infrastructure can shorten coordination time while increasing the cost of changing deeply embedded software or data standards. Historical analysis is therefore required to determine whether a characteristic institutional rate remains stable across the period being modeled.

23.5.3 Structural Time

Structural time concerns transformations in durable configurations that organize many economic relations simultaneously. Relevant structures can include ownership distributions, transport or energy infrastructures, monetary architectures, production systems, labor-market segmentation, urban form, knowledge infrastructures, platform ecosystems, and persistent configurations of authority or dependence. Structural time is often slower than event or institutional time, yet slowness is neither necessary nor sufficient for structural status.

Definition 23.109 (Structural-time profile)**.** A *structural-time profile* reconstructs the temporal formation, persistence, modification, and possible dissolution of a configuration whose relations condition multiple economic positions or processes beyond a single event or institutional cycle.

The definition makes scope and relational reach central. A slowly changing administrative routine can remain institution-specific, while a rapid collapse of payments infrastructure can become structurally consequential within days because it reorganizes exchange possibilities across many positions. Structural time should therefore be diagnosed through the temporal behavior of a structural relation, not equated with a predetermined duration.

Definition 23.110 (Structural persistence mechanism)**.** A *structural persistence mechanism* is a relation or process through which a structural configuration reproduces enough of its position distribution, infrastructure, standards, dependencies, or conversion possibilities to condition later economic action despite local events and institutional turnover.

Structural persistence can coexist with continuous local change. Firms enter and exit while an ownership regime remains stable; technologies improve while dependence on a common standard deepens; individual contracts change while the bargaining structure governing them persists. The historical object is therefore the reproduction or transformation of the configuration, not the absence of movement within it.

Proposition 23.111 (Structural-time inference)**.** *A claim of structural persistence or transformation should identify the configuration being preserved or changed, the mechanisms carrying that configuration across local turnover, and the evidence showing that the relevant relational reach exceeds the temporary state of particular actors or institutions.*

Structural time becomes especially important when apparent short-run flexibility depends on long-run constraints. An actor may switch suppliers quickly while remaining dependent on the same logistical infrastructure, legal regime, financing architecture, or technical standard. Multiscale analysis can therefore prevent local mobility from being mistaken for structural openness.

23.5.4 Intergenerational Time

Intergenerational time concerns economic effects carried across successor cohorts, organizational generations, institutional administrations, or other historically meaningful sequences of positions. Biological generations can be relevant, but they are not the only form. Public debt can bind later taxpayers; infrastructure can outlast its designers; knowledge systems can survive their founding communities; ecological degradation can shape economic possibilities for actors not present when the relevant decisions were made.

Definition 23.112 (Intergenerational transmission profile)**.** An *intergenerational transmission profile* identifies the earlier configuration, the carriers through which resources, capacities, obligations, knowledge, constraints, or ecological conditions are transmitted, the successor positions receiving them, the transformations occurring during transmission, and the evidence needed to distinguish inherited effects

from conditions regenerated independently in the later period.

The carriers can be material, institutional, informational, legal, ecological, or relational. Their persistence need not be symmetric. An inherited asset can preserve value for one position while an inherited liability narrows another's options. Institutional memory can support continuity while also carrying exclusions forward. The relevant GRE question concerns how the inherited configuration changes later generative capacity, allocation, dependency, or feasible alternatives.

Definition 23.113 (Intergenerational temporal boundary)**.** An *intergenerational temporal boundary* is the historically justified division used to distinguish predecessor and successor positions for a particular transmission question, together with the reasons that this division is analytically preferable to competing cohort, organizational, legal, or demographic boundaries.

This definition avoids assuming that a biological generation is the correct unit for every inquiry. A pension system, infrastructure project, environmental liability, or research institution can transmit effects over temporal intervals that do not align with demographic cohorts. The boundary should be chosen according to the transmission mechanism and then tested for robustness.

Proposition 23.114 (Transmission-based intergenerational claim)**.** *An intergenerational GRE claim is stronger when the transmitting carriers, successor positions, temporal boundary, and transformation of the inherited object are reconstructed explicitly rather than inferred from chronological succession alone.*

Intergenerational time also creates a normative interface, because later positions can bear consequences without participating in the initiating decision. The present section records the temporal structure of that relation. Evaluation of legitimacy, rights, or justice remains subject to the disciplinary containment principles established earlier in Chapter 23.

23.5.5 Cross-Scale Coupling

The analytical value of multiple temporal resolutions lies primarily in their relations. Event effects can alter institutional revision; institutional routines can reproduce structural dependence; structural conditions can shape which events become consequential; intergenerational inheritances can constrain institutional choices long after the originating configuration disappears. These relations are forms of cross-scale coupling.

Definition 23.115 (Cross-scale historical coupling)**.** A *cross-scale historical coupling* is a historically reconstructable relation through which a process represented at one temporal resolution materially alters the state, response, persistence, or transition conditions of a process represented at another temporal resolution.

Coupling can be directional or reciprocal. A crisis event may accelerate institutional change, while institutional design determines how future crises are absorbed. Structural infrastructure can constrain event-level choices, while accumulated event-level decisions gradually modify the infrastructure. The strength and direction of coupling can also change across historical regimes.

Definition 23.116 (Cross-scale coupling profile)**.** A *cross-scale coupling profile* identi-

fies the source and receiving temporal resolutions, the interface variable or relation through which influence is transmitted, the lag and persistence of that influence, the direction and possible reciprocity of coupling, the conditions under which the coupling strengthens or weakens, and rival explanations for the observed co-movement.

The profile guards against an easy multiscale error: temporal correlation does not establish cross-scale mechanism. An institutional change can follow a market disruption because both respond to a third political, technological, or ecological development. Historical sequencing is necessary but insufficient. The interface relation must also be reconstructed.

Proposition 23.117 (Cross-scale attribution discipline)**.** *A cross-scale causal interpretation should identify a transmissive relation, temporally plausible ordering, and evidence capable of distinguishing coupling from shared exposure or coincident change at the relevant resolutions.*

Cross-scale coupling also permits amplification and buffering to be studied relationally. A local event can remain local because institutional and structural configurations absorb it. Another event of similar immediate magnitude can produce wider transition because it arrives when institutional commitments are weak, structural dependencies are concentrated, or intergenerational burdens have accumulated. Multiscale analysis therefore shifts attention from event magnitude alone to the receiving configuration.

23.5.6 Breakdown of Scale Separation

Analysts often simplify a historical-economic system by treating some processes as fast and others as slow. Such decomposition can be useful when characteristic response times differ enough that slower variables remain approximately stable over the faster process, or faster processes can be summarized when analyzing slower change. The usefulness of that approximation depends on the historical regime and coupling structure.

Definition 23.118 (Historical scale separation)**.** *Historical scale separation* is an analytically justified approximation in which two or more processes have sufficiently different characteristic response or persistence horizons, under sufficiently limited cross-scale coupling over the research window, that they can be modeled at distinct temporal resolutions without materially distorting the claim under investigation.

The definition includes both rate difference and coupling. Large differences in nominal frequency do not guarantee separability. High-frequency financial transactions can exert cumulative influence on slower institutional balance sheets; slowly changing infrastructure can constrain each rapid transaction. Conversely, strong coupling at one historical moment can weaken after institutional reform, technological substitution, or organizational learning.

Definition 23.119 (Scale-separation breakdown record)**.** A *scale-separation breakdown record* documents the prior temporal decomposition, evidence that characteristic rates or coupling strengths have changed, the mechanism producing the change, the inference invalidated by the earlier decomposition, and the revised temporal representation required for the later regime.

Breakdown can occur through acceleration, deceleration, synchronization, or stronger cross-scale feedback. A crisis can compress years of institutional adjustment into weeks. A temporary emergency arrangement can persist and become structural. A technological platform can synchronize formerly separate organizational cycles. Ecological degradation can transform a previously slow background constraint into an immediate economic limit. Each case changes the temporal architecture of the explanation.

Proposition 23.120 (Conditional scale-separation rule)**.** *Scale separation should be retained only while the reconstructed rate differences and coupling relations remain adequate for the claim being made; evidence of rate convergence, synchronization, or materially stronger cross-scale influence warrants revision of the temporal decomposition.*

The practical implication is methodological. A model calibrated in a stable regime may cease to be informative during transition precisely because the decomposition that made it tractable has failed. Model failure in such a case can reveal a historical change in temporal organization rather than only a parameter-estimation problem.

23.5.7 Historical Transition

Historical transitions are often dated by prominent events: a crisis, election, treaty, collapse, reform, technological release, or market opening. Multiscale reconstruction can show that the event date is only one temporal marker within a longer transition. Institutional implementation can precede or follow formal enactment, structural effects can accumulate over decades, and intergenerational consequences can become visible much later.

Definition 23.121 (Multiscale historical transition)**.** A *multiscale historical transition* is a historically reconstructed reconfiguration in which changes across two or more temporal resolutions alter the relations, persistence conditions, or feasible trajectories of an economic configuration enough that the earlier temporal decomposition or mechanism no longer provides an adequate account.

This definition does not require simultaneous change. Lead–lag relations can be constitutive to the transition. Event-level disruption can precede institutional reform; institutional reform can precede structural reorganization; structural change can accumulate before an event makes it politically visible. The temporal sequence is therefore part of the explanatory object.

Definition 23.122 (Transition chronology matrix)**.** A *transition chronology matrix* records, for each relevant temporal resolution, the onset of detectable change, principal transition markers, periods of acceleration or reversal, stabilization or continued contestation, and the evidence linking changes across resolutions.

A chronology matrix can also preserve disagreement. Historians, economists, legal scholars, and political theorists may date the same transition differently because they track different objects. Such disagreement need not be resolved into one authoritative date when the distinct dates correspond to real differences in event, institutional, structural, or normative transformation.

Proposition 23.123 (Plural dating of historical transition)**.** *A multiscale transition*

may legitimately possess several analytically relevant dates when those dates correspond to distinct changes at different temporal resolutions and their relations are made explicit.

Historical transition can therefore be represented as a process with internal temporal structure rather than as a point separating two equilibria. This is especially important for GRE because the value, capability, power, and option structures of a transition can change before a new institutional or structural configuration becomes stable.

23.5.8 Economic Interpretation

Multiscale historical reconstruction becomes part of GRE when temporal distinctions change an economic claim. Historical detail alone does not require an economic interpretation, and an economic interpretation should identify which GRE object is altered by the historical timing. Relevant objects can include allocation, capability, value generation and conversion, circulation, generative return, dependency, power, feasible alternatives, institutional access, and the persistence of economic relations.

Definition 23.124 (Multiscale economic interpretation bridge)**.** A *multiscale economic interpretation bridge* specifies how a historically reconstructed temporal relation changes the identification, measurement, mechanism, comparison, or evaluation of an economic object, together with the historical remainder that should not be reduced to the economic interpretation.

The bridge prevents temporal vocabulary from functioning as explanation by itself. Calling a process "slow," "structural," or "intergenerational" does not explain an economic consequence. The analysis should show, for example, how a lag changes access to credit, how infrastructure persistence alters feasible production choices, how institutional memory redistributes bargaining capacity, or how inherited ecological conditions alter later opportunity sets.

Definition 23.125 (Economic multiscale relevance criterion)**.** A historical temporal distinction satisfies the *economic multiscale relevance criterion* when incorporating that distinction materially changes at least one economic object, mechanism, comparison, or warranted inference relative to an otherwise comparable analysis that omits it.

This criterion also helps limit unnecessary complexity. A research project need not represent every temporal resolution merely because several can be imagined. Additional scales should enter when they change the economic answer or the uncertainty surrounding it.

Proposition 23.126 (Economic interpretation proportionality)**.** *The complexity of a multiscale economic interpretation should be proportionate to the historical distinctions required to preserve the relevant economic mechanism, comparison, or uncertainty; additional temporal layers require an identifiable analytical contribution.*

Economic interpretation remains bidirectional. GRE can ask GRH for more precise periodization or transmission history, while GRH can return evidence that the economic categories themselves changed during the period. In the latter case, the appropriate response may be category revision rather than the addition of another

time scale to an unchanged model.

23.5.9 Formal Hypotheses and Ontological Restraint

Formal representation can make multiscale hypotheses explicit, particularly when research concerns lagged coupling, memory, response horizons, or changing rate regimes. The representation developed here is deliberately minimal. It provides notation for candidate historical-economic mechanisms while leaving open whether the empirical object is better represented by discrete events, continuous processes, networks, institutions, narratives, or another formal architecture.

Definition 23.127 (Analytical temporal index set)**.** Let $\mathcal{K} = \{e, i, s, g\}$ denote an *analytical temporal index set*, where the labels refer respectively to event, institutional, structural, and intergenerational resolutions. For each $k \in \mathcal{K}$, let $x_k(t) \in X_k$ denote a research-defined state representation at time t. The spaces X_k and their elements are analytical constructions whose contents must be specified by the empirical study.

The notation does not imply that four corresponding substances or ontological levels exist. It records a decision to represent selected historical-economic processes at four temporal resolutions. Different studies can omit a resolution, divide one resolution further, or replace the index set when evidence supports a different decomposition.

When cross-scale influence is delayed or historically distributed, a coupling input from resolution ℓ to resolution k can be represented by Equation 23.1.

$$c_{k\leftarrow\ell}(t) = \int_0^{H_{k\ell}} K_{k\ell}(u)\, \phi_{\ell\to k}(x_\ell(t-u))\; du. \tag{23.1}$$

Here $H_{k\ell}$ is the historically relevant memory horizon, $K_{k\ell}(u)$ is a weighting kernel describing how influence varies with lag u, and $\phi_{\ell\to k}$ is an explicitly specified interface map translating features represented at resolution ℓ into quantities meaningful for the receiving representation at resolution k. A discrete-time sum can replace the integral when the evidence is event-based or observed at discrete intervals.

Hypothesis 23.128 (Delayed cross-scale coupling)**.** *For a specified historical-economic process, a model that represents an empirically supported lagged interface between two temporal resolutions may account for the reconstructed transition more adequately than an otherwise comparable model restricted to contemporaneous coupling, provided that the additional memory structure improves discrimination rather than merely absorbing unexplained residual variation.*

Equation 23.1 can enter a scale-specific transition representation. One minimal form is stated in Equation 23.2.

$$x_k(t+\Delta_k) = F_k(x_k(t), \{c_{k\leftarrow\ell}(t)\}_{\ell\in\mathcal{K},\,\ell\neq k}, q_k(t); \theta_k)\,. \tag{23.2}$$

Here Δ_k is the temporal resolution selected for process k; F_k is a research-specified transition map; $q_k(t)$ collects contextual inputs represented outside the cross-scale state set; and θ_k denotes parameters, rules, or historically fixed assumptions of the chosen model. The equation is a template for hypothesis construction, not a claim that every historical-economic process follows a smooth or stationary transition law.

Characteristic response horizons can also be allowed to vary through history. For two represented processes k and ℓ, Equation 23.3 defines a simple dimensionless rate-separation indicator.

$$\rho_{k\ell}(t) = \frac{\min\{\tau_k(t), \tau_\ell(t)\}}{\max\{\tau_k(t), \tau_\ell(t)\}}, \qquad 0 < \rho_{k\ell}(t) \leq 1, \tag{23.3}$$

where $\tau_k(t)$ and $\tau_\ell(t)$ are empirically or interpretively justified characteristic response horizons. A small value of $\rho_{k\ell}(t)$ indicates strong rate separation, while a value approaching one indicates similar characteristic horizons. Equation 23.3 does not by itself establish scale separation because strong cross-scale coupling can remain material even when characteristic rates differ greatly.

Hypothesis 23.129 (Regime-dependent scale separation)**.** *For historical periods in which the response horizons $\tau_k(t)$, $\tau_\ell(t)$, or the coupling represented by $c_{k\leftarrow\ell}(t)$ change materially, a model that permits time-varying scale separation may outperform a model that fixes fast and slow classifications across the entire period.*

The hypothesis is intentionally testable and limited. It can fail because the temporal decomposition is unnecessary, because observed rate changes are measurement artifacts, because another mechanism explains the transition, or because the chosen scale labels do not preserve the historically relevant object.

Definition 23.130 (Formal multiscale hypothesis record)**.** A *formal multiscale hypothesis record* specifies the temporal index set, state representations, empirical meanings of the represented quantities, assumptions required by the transition and coupling structures, evidence used to identify lags or response horizons, competing representations, validation criteria, and the historical regimes beyond which the formalization should not be presumed stable.

Definition 23.131 (Multiscale ontological restraint record)**.** A *multiscale ontological restraint record* distinguishes what the formal representation assumes for analytical tractability from what the inquiry is prepared to claim about the constitution of historical-economic reality, including any scale, state, continuity, separability, or causal assumptions that remain representational rather than ontological commitments.

The restraint record is especially important when formal languages imported from dynamical systems, statistical physics, field theory, network science, or other mathematical traditions are used. Successful representation can support claims about predictive adequacy, reconstruction, comparison, or mechanism under stated assumptions. It does not by itself establish that historical economies literally possess the ontology associated with the originating physical or mathematical model.

Proposition 23.132 (Formal–ontological separation in multiscale history)**.** *Empirical success of a multiscale formalization warrants stronger confidence in the represented relations only to the extent supported by its identification and validation; it does not by itself establish that the analytical temporal resolutions, state spaces, kernels, or transition maps constitute the ultimate ontology of the historical-economic process.*

Definition 23.133 (Multiscale historical interface portfolio)**.** A *multiscale historical interface portfolio* is a versioned collection of event-time profiles, institutional and structural time profiles, intergenerational transmission profiles, coupling profiles,

scale-separation breakdown records, transition chronology matrices, economic interpretation bridges, formal hypotheses, and ontological-restraint records maintained across related GRE–GRH inquiries.

Proposition 23.134 (Multiscale historical-interface answerability)**.** *A multiscale GRE–GRH analysis is answerable when each temporal resolution has an explicit empirical or interpretive role, cross-scale couplings are historically reconstructable, breakdown of scale separation can trigger model revision, economic interpretation is proportionate to the mechanisms affected, and formal representations remain distinguishable from ontological claims.*

Multiscale historical inquiry therefore extends the GRE–GRH interface by making temporal heterogeneity itself inspectable. Events, institutions, structures, and intergenerational transmissions can be studied at different resolutions while their couplings remain part of the explanatory object. Historical transitions can alter both the states being modeled and the temporal decomposition used to model them. These results provide the temporal groundwork for the subsequent governance interface, where institutional response horizons, adaptation, and cross-frequency mismatch become questions of governance as well as economic analysis.

23.6 Generative Relational Governance Interface

Sections 23.4 and 23.5 developed the historical interface through which GRE can receive corrections concerning formation, sequence, temporal resolution, and multiscale change. The present section establishes the corresponding interface with Generative Relational Governance (GRG). Its role is to distinguish economic conditions that generate governance problems from governance questions whose principal warrant concerns authority, legitimacy, participation, institutional coordination, collective decision, or the revision of governing arrangements. The objective is not to construct GRG inside GRE. It is to specify how economic findings concerning relations, generative processes, constraints, capacities, power, value circulation, and temporal change enter governance inquiry; how governance arrangements return economically consequential effects; and where GRE must stop and defer. The discussion proceeds through economic conditions of governance, governance of economic relations and generative processes, adaptive and field governance, institutional learning, governance under uncertainty, and explicit limits on GRE governance claims. The method is relational and interface-oriented. Earlier GRE governance architectures remain available as economic descriptions, while claims whose warrant depends materially on governance-specific concepts are transferred for independent GRG analysis.

Definition 23.135 (GRE–GRG interface record)**.** A *GRE–GRG interface record* specifies an economically consequential configuration that raises a governance question, the GRE findings entering the interface, the governance-specific objects that require independent analysis, the direction of translation, affected and governing positions, authority and participation structures where known, temporal and scale conditions, unresolved normative or institutional questions, expected return corrections, and the GRE claims that would require revision if GRG analysis changes the interpretation of the case.

Table 23.6: Principal operations at the GRE–GRG governance interface

Interface object	GRE contribution	GRG question	Return to GRE
Governance conditions	Resources, dependencies, constraints, capabilities, asymmetries, temporal pressures	What governing arrangement is justified and institutionally competent?	Revised interpretation of feasible and legitimate economic action
Economic relations	Formation, maintenance, exit, membership, higher-order relation effects	Who may authorize, alter, review, or terminate governing rules?	Changes in relational incidence, access, and option structure
Generative processes	Allocation, conversion, circulation, return, regeneration, capture, dissipation	Which process stages warrant governing intervention and by what authority?	Revised process boundaries, responsibilities, and economic consequences
Adaptive governance	Monitoring, evidence, reversibility, path dependence, response horizons	How should revision authority, safeguards, and accountability be organized?	Revised adaptation costs, institutional capacities, and reachable futures
Field governance	Distributed positions, infrastructures, dependencies, cross-scale coupling	How should polycentric or distributed governing relations be coordinated?	Revised field boundaries, control points, and economic propagation pathways
Institutional learning	Evidence flows, implementation results, organizational memory, capability change	Who may interpret evidence and convert learning into rule revision?	Revised models of institutional adaptation and economic persistence
Uncertainty	Model uncertainty, incomplete observation, scenario dispersion, irreversibility	Which procedures remain legitimate and revisable under unresolved uncertainty?	Revised decision boundaries, monitoring needs, and economic safeguards
Scope limit	Economic stakes and consequences	Authority, legitimacy, public justification, collective standing, constitutional ordering	Domain correction, reclassification, or narrowed GRE claim

The interface record treats governance as more than implementation of an economic recommendation. GRE may identify a relation whose maintenance is underprovided, a value-circulation pathway whose capture is concentrated, or a capability asymmetry whose consequences are persistent. Those findings can generate governance questions without determining who should govern, by what authority, through which procedures, or with what standards of legitimacy. Conversely, governance arrangements can constitute the economic field by defining membership, review, access, rule-change procedures, representation, infrastructural obligations, or permissible forms of coordination. The interface is therefore bidirectional.

Proposition 23.136 (Economic–governance handoff condition)**.** *A GRE inquiry should hand a material subquestion to GRG when resolution of that subquestion depends principally on the justification, allocation, exercise, contestation, or revision of governing authority rather than on economic description, economic mechanism, or economic consequence alone.*

Proposition 23.136 does not require GRE to become silent once a governance question appears. Economic analysis can continue to identify resources, dependencies, opportunity costs, incidence, temporal constraints, institutional capacities, power effects, or feedback. The handoff concerns the source of warrant for the governance conclusion. It therefore preserves the containment principle of Section 23.2 while keeping the interface open to return correction.

Table 23.6 summarizes the principal interface operations developed below.

23.6.1 Economic Conditions of Governance

Governance problems often become visible through economic conditions before they can be resolved as governance questions. Scarce maintenance resources can make formally protected rights difficult to exercise. Infrastructure ownership can place practical gatekeeping capacity in private hands. High exit costs can turn nominally voluntary relations into persistent dependencies. Rapid technical change can outpace institutional review. Unequal access to expertise or data can change whose claims become governable. These are economic conditions because they concern resources, capacities, constraints, dependencies, and opportunity structures. Their existence can create governance demand without specifying the legitimate response.

Definition 23.137 (Economic governance profile)**.** An *economic governance profile* records the resources, capacities, constraints, dependencies, asymmetries, infrastructures, temporal pressures, value flows, affected positions, and foreseeable economic consequences that materially condition whether and how a governance problem can be addressed.

The profile is deliberately broader than a fiscal or budget analysis. Governance capacity can depend on staffing, information, technical interoperability, organizational competence, public trust, translation, monitoring, repair capability, or the practical availability of alternatives. These conditions can be distributed across several institutions. A governing body can possess formal authority while lacking the economic or organizational capacity needed to make that authority consequential. Conversely, an actor without formal public authority can possess infrastructural or informational capacities that strongly condition the feasible governing field.

This distinction helps prevent two opposite errors. One is to infer governance legitimacy from economic capacity: possession of resources or control does not by itself establish a right to govern. The other is to discuss governance as if institutional authority could operate independently of material capacity. A rule that cannot be observed, implemented, maintained, contested, or repaired may remain formally valid while weakly governing the economic relation in practice.

Proposition 23.138 (Governance-capacity non-equivalence)**.** *Economic capacity to implement, enforce, monitor, or revise a governing arrangement does not by itself establish legitimate governing authority, while legitimate authority does not by itself establish the economic capacity required for effective governance.*

The proposition creates an explicit interface. GRE can investigate the economic preconditions and consequences of governance capacity. GRG must examine the authority and justification through which such capacity may properly be exercised. A complete interface analysis requires both where the distinction is material.

23.6.2 Governance of Economic Relations

The earlier substantive GRE treatment of governance in Chapter 16 developed governance of relations as an economic problem. The present interface revisits that architecture at the disciplinary boundary. Economic relations can be governed through contracts, standards, organizational rules, platform architecture, professional norms, public regulation, community practices, collective bargaining, or combinations of

these. GRE can reconstruct how such arrangements affect relation formation, maintenance, transformation, exit, membership, and higher-order dependence. GRG becomes necessary when the question turns to who may set or alter those rules, how affected positions acquire standing, what forms of participation or contestation are adequate, or which governing relation is justified.

Definition 23.139 (Economic-relation governance interface)**.** An *economic-relation governance interface* records an economic relation, the rules and infrastructures conditioning its formation and operation, the positions authorized or able to alter those conditions, participation and review pathways, economic incidence, exit and dependency conditions, unresolved governance questions, and the corrections that governance analysis may return to the economic account.

This representation distinguishes governance *of* a relation from governance *through* a relation. An employment relation can itself be governed by law, contract, organizational procedure, and collective bargaining. The same relation can also govern access to income, insurance, information, professional standing, or future opportunity. A platform-client relation can be subject to external regulation while simultaneously governing access, ranking, data visibility, and dispute procedures for participants. GRE should therefore trace both directions when they change economic capability or dependence.

Governance also enters relational exit. The earlier relational-governance analysis treated exit as more than formal termination. Practical exit can depend on portability, alternative infrastructure, debt, information, switching cost, social protection, legal continuity, or the preservation of accumulated capacities. GRG can add questions about procedural fairness, authority, voice, representation, or duties of transition. The economic and governance analyses overlap without becoming identical.

Proposition 23.140 (Relational governance dual-accountability)**.** *Where a governing arrangement materially conditions an economic relation, adequate interface analysis should identify both its economic incidence on affected positions and the governance structure through which the relevant rules are authorized, contested, reviewed, and revised.*

This dual accountability prevents an efficient or stable relation from being treated as sufficiently governed merely because its economic outputs are favorable, and it prevents a formally well-authorized arrangement from being treated as economically adequate when its incidence generates persistent exclusion, dependency, or capacity loss.

23.6.3 Governance of Generative Processes

The earlier substantive GRE treatment developed governance of generative processes across allocation, propagation, conversion, circulation, return, accumulation, extraction, dissipation, transformation, and capture. The cross-domain question is narrower: which parts of that analysis remain economic, and which require governance theory once intervention into a generative process becomes institutionally consequential?

GRE can identify a process stage at which value is systematically captured, return

is interrupted, conversion costs are concentrated, or regenerative capacity deteriorates. Such findings can support a claim that a process is economically consequential and that its governing conditions deserve investigation. They do not alone determine whether the process should be restricted, redistributed, redesigned, publicly governed, collectively governed, left decentralized, or governed through some hybrid arrangement.

Definition 23.141 (Generative-process governance interface)**.** A *generative-process governance interface* specifies the economic process under examination, its stages and carriers, the points at which governing arrangements can alter initiation, direction, rate, pathway, conversion, circulation, return, capture, or termination, the affected positions, the economic consequences of alternative arrangements, and the governance questions whose resolution requires authority or legitimacy analysis beyond GRE.

The interface is particularly important where a process has several desirable and undesirable consequences at once. A knowledge-production system can generate epistemic value while concentrating ownership of infrastructure. A platform can reduce coordination costs while increasing dependence on a private rule architecture. A policy can accelerate investment while narrowing future reversibility. A return obligation can support source-side regeneration while imposing administrative burdens that exclude small participants. Governing the generative process therefore requires a profile of plural consequences rather than a single optimization target.

Proposition 23.142 (Process-governance non-deduction)**.** *An economically diagnosed failure or asymmetry in a generative process can justify opening a governance inquiry without, by itself, determining the legitimate governing form, governing authority, or permissible distribution of decision rights.*

This proposition is a direct containment rule. GRE contributes the process diagnosis and economic consequence profile. GRG must examine the governing architecture where the conclusion depends on public justification, authority, representation, or collective decision.

23.6.4 Adaptive Governance

Adaptive governance is already present inside GRE as an economic object. Earlier chapters developed monitoring, feedback, experimentation, reversibility, distributed learning, rule evolution, historical re-evaluation, and co-evolution for economic governance. The GRG interface becomes necessary because adaptation changes more than policy parameters. It can change who has authority, which evidence counts, which groups carry burdens, how quickly rules can be revised, and which commitments remain protected against rapid change.

The multiscale analysis of Section 23.5 adds an important temporal restraint. Governance can respond too slowly to rapidly changing economic processes, but it can also respond too quickly relative to slower social, institutional, or intergenerational consequences. Adaptive capacity is therefore not equivalent to maximal response speed. The specific frequency-domain problem is reserved for the next section; the present subsection establishes the broader interface.

Definition 23.143 (Adaptive-governance handoff profile)**.** An *adaptive-governance handoff profile* records the changing economic condition, monitoring and evidence pathways, response horizon, reversibility, affected positions, institutional capabilities, rule-change mechanisms, commitments requiring continuity, uncertainty, and the questions of authority, participation, accountability, and legitimate revision that require GRG analysis.

A governance arrangement can be economically adaptive while normatively or institutionally problematic. It may respond rapidly because decision authority is concentrated and contestation is weak. Another arrangement may be procedurally inclusive but unable to process evidence before irreversible harm accumulates. The interface therefore needs both adaptation performance and governance quality. Neither can substitute for the other.

Proposition 23.144 (Adaptive-governance double criterion)**.** *A claim that an adaptive governance arrangement is adequate requires separate support for its capacity to respond to materially changing economic conditions and for the governance procedures through which response authority, participation, accountability, and protected commitments are organized.*

The distinction also makes revision historically inspectable. A successful adaptation can still expose a weakness in the original governing arrangement. GRG feedback can therefore return to GRE by changing how economic adaptation costs, coordination capacities, institutional frictions, or feasible response horizons are modeled.

23.6.5 Field Governance

Many economic-governance problems do not have a single governing center. Firms, public agencies, standards bodies, courts, communities, infrastructures, professional organizations, technical systems, and affected groups can each exercise partial governing capacity over different aspects of the same economic field. GRE can represent these distributed relations through positions, dependencies, infrastructures, power mechanisms, and propagation pathways. GRG is needed to analyze the governing architecture produced by the interaction of those partial authorities and capacities.

Definition 23.145 (Field-governance interface map)**.** A *field-governance interface map* represents the governing positions relevant to an economic field, the domains and objects over which each position exercises formal or practical influence, interdependencies among governing sites, coordination and conflict pathways, affected but weakly represented positions, economic propagation channels, and the unresolved questions of authority, legitimacy, accountability, and institutional design.

The term *field* remains an analytical representation rather than an ontological claim. Its use is warranted when the research question requires analysis of distributed and mutually conditioning governing relations that cannot be adequately described as one principal-agent hierarchy or one organization. The map can therefore include overlapping public and private authority, technical standards, market dependence, legal review, informal coordination, and community practice without assuming that these components form a unified governing system.

Field governance can generate coordination gains while also diffusing responsibil-

ity. A harmful outcome may result from the interaction of several locally reasonable rules, none of which controls the whole configuration. Conversely, distributed governance can create redundancy, experimentation, local knowledge, and checks on concentrated authority. GRE can investigate the economic effects of these structures. GRG must examine how accountability, conflict resolution, subsidiarity, representation, and meta-governance should operate across them.

Proposition 23.146 (Distributed-governance attribution condition)**.** *In a distributed governance field, attribution of an economic outcome to a governing position should identify the mechanism and scope of that position's influence, the relevant dependencies on other governing sites, and the counterfactual role of coordination or non-coordination rather than treating formal jurisdiction as sufficient evidence of causal control.*

This condition is economic and governance-relevant at once. It helps GRE avoid overstating causal control, and it gives GRG a clearer object for examining responsibility and institutional design.

23.6.6 Institutional Learning

Institutions can collect evidence, preserve memory, revise procedures, and alter rules. Yet information acquisition does not automatically become institutional learning. Learning requires a pathway through which evidence changes interpretation, capability, routine, decision rule, governing arrangement, or future observation. GRE can study the resources, infrastructures, organizational capacities, incentives, and economic consequences involved in that pathway. GRG becomes necessary where the question concerns which institutions may interpret evidence authoritatively, whose experience receives standing, how disagreement is preserved, and how learning may legitimately change governing rules.

Definition 23.147 (Learning-to-authority trace)**.** A *learning-to-authority trace* reconstructs how evidence or experience is generated, recorded, interpreted, translated across institutional boundaries, assigned standing, connected to an authorized review process, incorporated or rejected, and converted into a change in governing practice, while preserving unresolved disagreement and the economic consequences of the resulting revision.

The trace distinguishes epistemic availability from governing uptake. A frontline institution may know that an access rule is failing while lacking authority to alter it. A regulator may possess formal authority while receiving delayed or aggregated evidence that removes the local mechanism. A community may hold situated knowledge that is visible only through procedures that the governing institution does not recognize as valid evidence. Learning failure can therefore occur at generation, preservation, translation, standing, authority, or implementation.

The section also retains the re-epistemization discipline developed earlier in the book. An institution can revise a prior rule because later evidence changes its warrant without implying that the earlier decision was irrational given what was then knowable. Governance learning benefits from preserving this version history because it supports responsibility, repair, and future institutional memory.

Proposition 23.148 (Institutional-learning conversion condition)**.** *Evidence becomes governance-relevant institutional learning only when a traceable pathway connects its generation and interpretation to a change in institutional understanding, capability, rule, procedure, or future observation, with the authority and accountability for that conversion made explicit.*

GRG correction can return here by changing GRE's assumptions about institutional response capacity. If governance analysis shows that evidence lacks standing, authority is fragmented, or review procedures structurally filter certain positions, an economic model that assumes frictionless institutional updating should be revised.

23.6.7 Governance under Uncertainty

GRE repeatedly operates under uncertainty concerning measurement, causal mechanisms, future trajectories, heterogeneous values, model adequacy, and the behavior of interacting institutions. Governance does not remove those uncertainties. It organizes collective action while some of them remain unresolved. Economic analysis can compare scenarios, costs, dependencies, reversibility, option preservation, monitoring value, or distribution of exposure. GRG must address the procedures and authority through which action is justified when evidence is incomplete and disagreement persists.

Definition 23.149 (Governance-uncertainty profile)**.** A *governance-uncertainty profile* records the material uncertainties relevant to an economic-governance question, their sources and possible reducibility, affected positions, distribution of exposure, reversibility, information latency, monitoring options, alternative actions, disagreement, institutional response capacity, and the governance procedures through which commitment, review, escalation, or restraint may be justified.

Several kinds of uncertainty should remain distinguishable. Epistemic uncertainty concerns incomplete knowledge about the present configuration or mechanism. Stochastic uncertainty concerns variation represented probabilistically. Model uncertainty concerns disagreement among representations. Historical uncertainty can concern missing records or contested reconstruction. Normative uncertainty concerns unresolved evaluation. Strategic uncertainty arises when governed actors respond to the governance process itself. These forms can interact but should not be collapsed into one scalar confidence level.

Uncertainty can also be asymmetrically distributed. Some positions may face irreversible consequences while others face mainly financial variance. Some possess information needed to adapt while others learn only after harm occurs. Governance under uncertainty therefore includes distribution of epistemic access, exposure, waiting costs, and capacity to revise. GRE can make these asymmetries visible; GRG must address their governance significance.

Proposition 23.150 (Uncertainty-governance non-substitution)**.** *Economic techniques for robustness, option preservation, monitoring, or expected consequence cannot substitute for governance analysis where commitment under uncertainty depends materially on authority, standing, legitimacy, burden allocation, or procedures for later revision.*

The proposition preserves a useful division of labor. Economic analysis can help compare consequences and identify where uncertainty matters. Governance analysis must examine who may act, whose risks count, how disagreement is processed, and how commitments remain contestable and revisable.

23.6.8 Limits of GRE Governance Claims

The preceding subsections show that GRE can make substantial contributions to governance inquiry. It can identify economic conditions of governing capacity, reconstruct the incidence of governing rules on economic relations, analyze process-level intervention points, estimate adaptation costs and response horizons, map distributed economic influence, examine institutional learning capacities, and characterize uncertainty and exposure. These contributions remain economically bounded. They do not independently establish legitimate authority, public justification, constitutional standing, political representation, the moral priority of competing claims, or the proper constitution of a governing community.

Definition 23.151 (GRE governance-claim boundary)**.** The *GRE governance-claim boundary* is the point at which an inference from economic structure, mechanism, capacity, consequence, or constraint to a governance conclusion would require a material premise concerning authority, legitimacy, collective standing, public justification, constitutional ordering, or governance-specific normativity that GRE has not independently established.

This boundary is claim-relative rather than topic-relative. GRE can legitimately study a public institution's budget, capability, infrastructure, relational incidence, or economic effects. It crosses the boundary when those findings are treated as sufficient to settle the institution's legitimate authority. GRE can show that a governance arrangement concentrates economic dependence. It does not follow that one particular constitutional remedy is established. GRE can show that a slower review process preserves some long-horizon options while increasing short-horizon exposure. The legitimate balance among those consequences remains a governance question unless the relevant normative and authority premises have been supplied from an appropriate domain.

The interface must also permit return correction. GRG may show that an economic category misidentifies the governing unit, that the relevant authority is distributed rather than centralized, that participation changes the object being governed, that institutional legitimacy constrains feasible policy, or that the economic model has treated a governance commitment as an exogenous parameter when it is historically constitutive. Such findings should be allowed to revise GRE.

Definition 23.152 (GRG correction return)**.** A *GRG correction return* records a governance finding that materially changes a GRE boundary, category, mechanism, feasible-set assumption, temporal horizon, institutional representation, or interpretation of an economic consequence, together with the evidence and reasoning supporting that correction and the GRE claims requiring revision.

Definition 23.153 (GRE–GRG interface portfolio)**.** A *GRE–GRG interface portfolio* is a versioned collection of governance-condition profiles, economic-relation interfaces, generative-process interfaces, adaptive-governance handoffs, field-governance

maps, learning-to-authority traces, uncertainty profiles, unresolved governance remainders, and GRG correction returns maintained across cases and research projects.

The portfolio supports cumulative comparison without presuming a completed unified theory. Recurrent economic conditions can reveal stable governance questions. Recurrent correction returns can expose systematic blind spots in GRE. Repeated non-transfer can identify genuine disciplinary boundaries. Over time, these records can support stronger cross-domain hypotheses, but only after the relevant domains have independently tested them.

Proposition 23.154 (GRE–GRG interface answerability)**.** *A GRE governance claim is cross-domain answerable when the economic basis of the claim, the governance-specific premises it requires, the handoff boundary, the unresolved remainder, and the possible GRG correction return are explicit enough that contrary governance analysis can narrow, revise, or reclassify the GRE inference.*

The proposition completes the general GRE–GRG interface. The next section narrows the problem to temporal mismatch among economic dynamics and governing response, asking when differences in characteristic frequency or response horizon become economically consequential and which parts of that diagnosis properly belong to governance theory.

23.7 Frequency-Domain Governance Interface

The multiscale historical analysis of Section 23.5 and the GRE–GRG interface of Section 23.6 jointly raise a more specific question: what happens when economically consequential processes and governing processes operate with materially different characteristic response horizons? The role of the present section is to formulate that question as an interface problem rather than as a self-contained theory of governance. Its objective is to distinguish economic diagnostics of temporal mismatch from governance conclusions concerning authority, legitimacy, procedural cadence, or institutional redesign. The discussion proceeds through multiple dynamical frequencies, governance horizons, temporal mismatch, cross-frequency coupling, synchronization and desynchronization, institutional response times, economic questions, and questions deferred to GRG. The method combines multiscale economic interpretation with restrained formalization. The term *frequency-domain* is used here in an analytical sense: a process can be characterized by a rate, recurrence interval, adjustment horizon, or response time without being assumed to be literally periodic or adequately represented by a Fourier decomposition. Table 23.7 summarizes the principal interface operations developed below.

Definition 23.155 (Frequency-domain governance interface record)**.** A *frequency-domain governance interface record* specifies an economic process and a governing process whose characteristic temporal responses are being compared, the empirical or interpretive basis for their response horizons, observation resolution, relevant lags and memory, coupling pathways, affected positions, economic consequences of relative timing, uncertainty, candidate adaptation mechanisms, governance-specific questions, and the GRE claims that would require revision if GRG analysis changes

Table 23.7: Principal operations in the frequency-domain governance interface

Interface object	Economic diagnostic	Governance question	Interface limit
Dynamical frequency	Characteristic adjustment or response horizon	Which temporal processes should governance recognize?	Frequency is analytical unless periodicity is independently established
Governance horizon	Detection, review, authorization, implementation, feedback, revision	Which cadence is institutionally and normatively appropriate?	Faster response does not by itself imply better governance
Temporal mismatch	Direction and magnitude of relative response delay	Is mismatch acceptable, remediable, or constitutive of due process?	Economic cost cannot settle legitimacy
Cross-frequency coupling	Lagged influence across processes with different rates	Which couplings warrant governing attention?	Coupling does not establish authority
Synchronization	Alignment sufficient for a specified governing function	Which forms of alignment should be pursued or resisted?	Synchronization is task-relative, not a universal objective
Desynchronization	Persistent lag, overshoot, missed windows, or unstable feedback	Which institutional changes are justified?	Diagnosis does not determine constitutional remedy
Institutional response time	Response-chain latency and bottlenecks	Who may change the response chain and under what safeguards?	Capacity analysis remains distinct from authority
Economic scope	Costs, incidence, volatility, dependence, options, investment, distribution	What economic consequences follow from timing?	GRE retains economic answerability
GRG handoff	Economic stakes made explicit	Legitimacy, standing, procedural cadence, emergency authority, review	Governance warrant remains external to GRE

the interpretation of the governing response.

The record prevents a temporal metaphor from becoming a conclusion. A market price can update in seconds while prudential review takes months; a platform ranking system can change daily while employment law changes over years; ecological degradation can accumulate over decades while procurement or investment decisions are revised quarterly. These differences can matter economically, but the fact that one process is faster does not establish that governance should accelerate. Slow response can reflect incapacity, institutional memory, due process, legal constraint, deliberative protection, or a deliberate commitment to stability. Fast response can improve adaptation in one setting while amplifying volatility or short-horizon incentives in another.

Definition 23.156 (Analytical process frequency)**.** For a process p with a research-justified characteristic response horizon $\tau_p(t) > 0$, its *analytical process frequency* is the reciprocal quantity defined in Equation 23.4.

$$f_p(t) = \frac{1}{\tau_p(t)}. \tag{23.4}$$

Equation 23.4 provides a convenient common unit for comparing processes whose characteristic adjustment horizons differ. A higher value of $f_p(t)$ indicates a shorter characteristic response horizon. The definition does not imply periodic recurrence, stationarity, or a unique natural frequency. The horizon $\tau_p(t)$ may itself vary historically, as emphasized by Equation 23.3 and the regime-dependent scale-separation hypothesis of Section 23.5.

23.7.1 Multiple Dynamical Frequencies

Economic configurations contain processes with heterogeneous characteristic rates. Payment systems can settle within seconds; inventory decisions may adjust over days; wage contracts can persist for months or years; capital infrastructure can remain in place for decades; demographic and ecological effects may unfold over generations. Even within one institution, information, authorization, implementation, and learning can proceed at different rates. A frequency-domain perspective becomes useful when those differences alter interaction, transmission, adaptation, or the interpretation of observed outcomes.

Definition 23.157 (Dynamical-frequency profile)**.** A *dynamical-frequency profile* records, for each process material to a specified research question, its characteristic response horizon, empirical or interpretive basis, variability through time, observation resolution, relevant lags, recurrence or persistence where applicable, and the uncertainty associated with assigning the process to a temporal rate band.

The profile should preserve heterogeneity rather than forcing every process into a single temporal metric. Some processes admit high-frequency measurement but have slow substantive adjustment. Others change rapidly but are observed only through infrequent surveys or administrative records. Observational frequency and process frequency therefore require separation. Daily data do not prove daily structural adjustment, and annual data do not prove that the underlying process changes only annually.

Frequency labels should also be scale-relative. A quarterly adjustment may be slow relative to algorithmic repricing and fast relative to infrastructure renewal. The labels *high*, *medium*, and *low* frequency therefore have meaning only against a stated comparison set and research problem.

Proposition 23.158 (Frequency relativity)**.** *A classification of an economic process as high- or low-frequency is analytically warranted only relative to a specified comparison set, response-horizon criterion, and research question; the classification should be revised when those conditions change materially.*

The proposition extends the scale-relative discipline of Section 23.5. It also protects the governance interface from a common simplification: a process described as “fast” in one research design need not justify accelerated governance in another.

23.7.2 Governance Horizons

Governance itself has temporal structure. A governing arrangement must observe or receive signals, interpret them, establish standing or agenda priority, authorize action, implement a response, receive feedback, and sometimes revise the rule. Different stages may have different durations and different institutional owners. The relevant governance horizon is therefore rarely identical to a statutory deadline or meeting interval.

Definition 23.159 (Governance-horizon profile)**.** A *governance-horizon profile* records the characteristic temporal intervals associated with detection, interpretation, agenda formation, authorization, implementation, feedback, review, appeal, and revision for a specified governing arrangement, together with their institutional

owners, dependencies, uncertainty, and conditions under which the intervals may shorten, lengthen, or become discontinuous.

A profile can reveal several distinct sources of apparent slowness. Evidence may arrive late even when authorization is rapid. Authorization can be slow because standing is contested. Implementation can lag because capacity is scarce. Appeals may deliberately delay finality. A rule can also be intentionally sticky so that short-horizon fluctuations do not generate constant institutional change. These differences matter because a proposed remedy aimed at "speeding governance" may target the wrong stage.

Governance horizons can also be endogenous to economic conditions. Resource scarcity can lengthen inspection or adjudication. Concentrated expertise can shorten decision time for some actors while increasing dependence on those actors. Automation can accelerate monitoring while leaving interpretation and accountability unresolved. Economic analysis can identify these conditions without settling whether a shorter horizon is legitimate.

Proposition 23.160 (Governance-horizon decomposition)**.** *A claim about governance speed should identify the response stage to which the claim refers, because detection, interpretation, authorization, implementation, feedback, and revision can possess different characteristic horizons and can respond differently to institutional change.*

23.7.3 Temporal Mismatch

A temporal mismatch arises when the relative response horizons of economically coupled processes become material to an outcome of interest. The direction of the mismatch matters. Governance may react more slowly than the economic process it seeks to influence; it may also react more quickly than the slower social or institutional relations that bear the consequences. Both cases can produce problems, and neither is captured adequately by a general presumption that faster governance is preferable.

Definition 23.161 (Directed response-horizon mismatch)**.** Let $\tau_p(t) > 0$ denote the characteristic response horizon of an economic process p, and let $\gamma_g(t) > 0$ denote the characteristic response horizon of a governing process g. The *directed response-horizon mismatch* is defined by Equation 23.5.

$$m_{pg}(t) = \log\left(\frac{\gamma_g(t)}{\tau_p(t)}\right). \tag{23.5}$$

A positive value of $m_{pg}(t)$ indicates that the selected governing response horizon is longer than the selected economic-process horizon; a negative value indicates that governance responds on the shorter horizon; and a value near zero indicates similar characteristic horizons. Equation 23.5 is meaningful only when both horizons are independently justified and comparable for the task. It is not a welfare index, a legitimacy score, or a recommendation to equalize response times.

Definition 23.162 (Temporal-mismatch consequence profile)**.** A *temporal-mismatch consequence profile* records the process pair, direction and magnitude of mismatch, lag structure, affected positions, economic consequences, adaptation strategies, op-

tion losses or gains, distribution of exposure, evidence of persistence, alternative explanations, and the governance questions that remain unresolved after the economic diagnosis.

Consequences can include regulatory arbitrage, delayed repair, accumulated exposure, unstable investment expectations, premature intervention, compliance churn, loss of institutional memory, or option foreclosure. The same numerical mismatch can have different implications across domains. A slow approval process can be costly in emergency response and protective in irreversible infrastructure decisions. An economic diagnosis therefore requires a mechanism linking timing to consequence.

Proposition 23.163 (Temporal-mismatch relevance condition)**.** *A difference in characteristic response horizons becomes economically relevant when a reconstructable mechanism connects that difference to material changes in allocation, capability, dependence, value conversion or circulation, exposure, option structure, investment, maintenance, or another economically specified outcome.*

23.7.4 Cross-Frequency Coupling

Processes at different characteristic frequencies can remain strongly coupled. High-frequency market adjustment may accumulate into slower balance-sheet or employment effects. Slow institutional rules can shape the feasible set within which rapid transactions occur. Periodic reporting can trigger clustered behavior in processes that otherwise change continuously. The relevant research object is therefore the pathway through which one temporal band enters another, including lags, aggregation, thresholds, and feedback.

Definition 23.164 (Cross-frequency governance coupling)**.** A *cross-frequency governance coupling* is a research-specified pathway through which variation in an economic or governing process represented at one characteristic rate materially affects a process represented at another rate, with the translation, aggregation, lag, threshold, or memory mechanism made explicit.

The delayed cross-scale coupling representation in Equation 23.1 supplies one possible formal template. At the governance interface, however, the map from one rate band to another must also identify institutional mediation. A rapid market signal may matter to a regulator only after it crosses a reporting threshold. A slow legal or organizational commitment may influence high-frequency behavior through constraints embedded in software, contracts, or access rules. Cross-frequency coupling is therefore partly a question of information architecture and partly a question of institutional structure.

Definition 23.165 (Cross-frequency coupling dossier)**.** A *cross-frequency coupling dossier* records the source and receiving processes, characteristic rates, mediation mechanism, lag or memory structure, aggregation rule, thresholds, institutional interfaces, direction of influence, feedback, affected positions, evidence, competing mechanisms, and the historical regimes in which the coupling is expected to remain stable.

Proposition 23.166 (Cross-frequency attribution discipline)**.** *Observed correlation*

across processes with different characteristic rates supports a cross-frequency governance claim only when the research design identifies a plausible translation or transmission pathway and addresses relevant common causes, measurement aggregation, and institutional timing.

23.7.5 Synchronization

Synchronization refers here to task-relative temporal alignment among processes, not to a universal objective of making institutions move at the same speed as markets. A governing process is synchronized with an economic process when their timing relation is adequate for a specified governing function under stated conditions. Adequacy can involve prompt response, deliberate delay, periodic review, buffering, or staged commitment.

Definition 23.167 (Governance synchronization profile)**.** A *governance synchronization profile* specifies the governing function, economic process, relevant response horizons, tolerated lag or lead, triggering conditions, buffering mechanisms, review cadence, affected positions, performance criteria, and evidence supporting the claim that the timing relation is adequate for that function.

This definition makes synchronization functional rather than merely temporal. A circuit breaker may need to respond within minutes to a market discontinuity, while a pension-governance rule may intentionally resist high-frequency repricing. A scientific funding institution may need slow review for epistemic quality but faster emergency mechanisms for sudden infrastructure failure. The desirable temporal relation therefore depends on the object being governed and on values or authority questions that may exceed GRE.

Synchronization can also generate costs. Matching governance too closely to high-frequency signals can increase institutional volatility, short-horizon incentives, or sensitivity to noise. Conversely, periodic synchronization can create bunching, deadline effects, and synchronized risk-taking. GRE can investigate these economic consequences; GRG must evaluate when alignment is institutionally or normatively justified.

Proposition 23.168 (Task-relative synchronization)**.** *Governance synchronization should be evaluated relative to a specified governing function and consequence structure; temporal alignment that improves one function can impair another and therefore does not constitute a general criterion of good governance.*

23.7.6 Desynchronization

Desynchronization occurs when the temporal relation among coupled processes no longer supports the function for which the relation was relied upon. The phenomenon can take several forms: persistent lag, premature intervention, missed decision windows, oscillatory correction, accumulated backlog, stale information, or asynchronous adaptation across institutions. Desynchronization can be episodic or structural.

Definition 23.169 (Governance desynchronization record)**.** A *governance desynchronization record* documents the governing function that has become temporally mis-

aligned, the economic and governing response horizons, the observed form of lag or lead, onset and persistence, affected positions, consequences, attempted adaptations, evidence of feedback or oscillation, and alternative explanations for the observed failure.

Desynchronization should not be diagnosed solely from dissatisfaction with an outcome. A regulator can act after a market movement without being desynchronized if delayed intervention is part of the governing design. Conversely, nominally rapid action can remain desynchronized when evidence collection, implementation, appeal, or repair operates on a much slower horizon than the public decision announcement suggests.

An important economic consequence is strategic adaptation. When actors learn that governance reacts with a predictable lag, they may shift behavior into the interval between economic change and institutional response. When governance reacts predictably to short-horizon indicators, actors can also optimize toward the trigger. These feedbacks can transform the temporal structure itself.

Proposition 23.170 (Endogenous desynchronization)**.** *A governance timing mismatch can become endogenous when actors adapt strategically to the governing response horizon, thereby changing the economic process that the governance arrangement was calibrated to address.*

This proposition gives the interface a dynamic character. Temporal mismatch is not necessarily an externally given gap between two fixed clocks. Governance response can alter economic frequency, and economic adaptation can alter the effective governance horizon.

23.7.7 Institutional Response Times

Institutional response time is produced by a chain of processes rather than by one clock. Detection, interpretation, standing, authorization, implementation, enforcement, feedback, appeal, and revision can be sequential, overlapping, or distributed among institutions. Bottlenecks can migrate as one stage is accelerated. Faster data collection, for example, may simply move delay into interpretation or authorization.

Definition 23.171 (Institutional response-time vector)**.** For a specified governing process g, an *institutional response-time vector* is an ordered collection of research-defined characteristic durations for the material stages of response, such as detection, interpretation, authorization, implementation, feedback, appeal, and revision, together with the dependency structure indicating which stages are sequential, parallel, conditional, or recurrent.

The vector is preferable to a single average response time when the institutional mechanism matters. Two institutions can have the same total elapsed time while differing radically in where delay occurs and whose participation is possible during that delay. A long authorization stage can reflect legal safeguards; a long implementation stage can reflect capacity shortage; a long feedback stage can reflect poor observability. These cases create different economic consequences and different governance questions.

Definition 23.172 (Response-time bottleneck profile)**.** A *response-time bottleneck*

profile identifies the stages that materially determine the effective response horizon, the resources and authority controlling those stages, queueing or information constraints, distribution of waiting costs, opportunities for parallelization or delegation, and the safeguards that would be altered by acceleration.

Proposition 23.173 (Response-time bottleneck specificity)**.** *A proposal to accelerate institutional response has adequate economic specificity only when it identifies which response stage is binding, how acceleration changes economic consequences, and which costs, safeguards, or participation opportunities may be displaced to another stage or position.*

The proposition does not determine whether acceleration is legitimate. It establishes what an economic argument must make visible before the question is handed to GRG.

23.7.8 Economic Questions

The frequency-domain interface generates questions that remain properly economic: how relative timing changes prices, investment, labor adjustment, maintenance, compliance costs, dependence, access, distribution, value pathways, capabilities, and option sets; who bears waiting costs; and who possesses the resources to bridge institutional lag.

Definition 23.174 (Economic timing question)**.** An *economic timing question* asks how relative timing changes economically specified structures, mechanisms, distributions, capabilities, dependencies, value pathways, option sets, costs, exposures, or trajectories while leaving governance legitimacy to the appropriate domain.

Distributional, capability, relational, generative, value-circulation, and historical questions can therefore be distinguished according to the economic object altered by timing. Their comparison can be preserved in a common portfolio.

Definition 23.175 (Frequency-governance economic consequence portfolio)**.** A *frequency-governance economic consequence portfolio* is a versioned collection of mismatch, coupling, synchronization, desynchronization, response-bottleneck, incidence, capability, option, and historical rate-regime records maintained across cases.

The portfolio supports comparison without presuming an optimal governance frequency. Recurrent patterns can generate stronger interface hypotheses while remaining short of governance prescriptions.

Proposition 23.176 (Economic frequency-domain answerability)**.** *A frequency-domain claim remains within GRE when its warrant can be stated in terms of economically specified timing, mechanism, incidence, capability, dependence, value pathway, option structure, or consequence, with the response-horizon assumptions and historical regime made explicit.*

23.7.9 Questions Deferred to GRG

The disciplinary boundary is reached when the unresolved issue concerns the legitimate temporal constitution of governance itself: emergency authority, deliberative

delay, fast-track triggers, standing in time-sensitive review, procedural safeguards, appeals under irreversibility, or the distribution of authority among institutions with different response horizons.

Definition 23.177 (Frequency-domain GRG handoff)**.** A *frequency-domain GRG handoff* records an economically identified temporal problem and the unresolved governance premises concerning authority, legitimacy, standing, procedural cadence, review, emergency action, accountability, or constitutional ordering that must be supplied before a prescriptive governance conclusion is warranted.

Acceleration and delay can each redistribute power. Compressed consultation can privilege actors able to respond quickly; rapid compliance can favor organizations with greater administrative capacity; delayed action can impose irreversible exposure on positions with little ability to wait. GRE can reconstruct these economic asymmetries, while the legitimate procedural response requires governance-specific justification. The same applies to institutional slowing: cooling-off periods or longer commitment horizons can have economic merits while changing representation, accountability, and relations among governing bodies.

Definition 23.178 (GRG temporal-correction return)**.** A *GRG temporal-correction return* records a governance finding that changes the economic interpretation of a response horizon, mismatch, synchronization claim, or institutional timing mechanism, including cases in which delay is constitutive of legitimate procedure, acceleration undermines standing or accountability, or the relevant governing unit differs from that assumed by GRE.

Definition 23.179 (Frequency-domain governance interface portfolio)**.** A *frequency-domain governance interface portfolio* is a versioned collection of dynamical-frequency and governance-horizon profiles, mismatch and coupling dossiers, synchronization and desynchronization records, institutional response-time analyses, economic consequence portfolios, GRG handoffs, and temporal-correction returns maintained across cases and historical regimes.

Proposition 23.180 (Frequency-domain governance interface answerability)**.** *A frequency-domain governance claim is cross-domain answerable when the characteristic horizons, comparison scale, coupling mechanism, economic consequence, governance-specific remainder, and possible GRG correction return are explicit enough that contrary evidence or governance analysis can revise the timing diagnosis, narrow the economic inference, or reclassify the question.*

The interface converts temporal-rate differences into bounded research questions rather than direct policy rules. GRE diagnoses economic consequences; GRG supplies the warrant where conclusions depend on legitimate authority, procedural cadence, standing, accountability, or constitutional design. The next section applies the same containment discipline to law.

23.8 Generative Relational Law Interface

Sections 23.6 and 23.7 established the governance interface and its temporal specialization. The present section turns to Generative Relational Law (GR-Law). Its role is to distinguish legally constituted positions from economically manifested re-

lations while preserving the ways in which law can create, stabilize, authorize, constrain, revise, and sometimes transform economic possibility. The objective is not to reconstruct jurisprudence inside GRE. It is to specify how property, contract, legal personhood, rights, duties, recognition, legal infrastructure, and relational justice enter economic analysis; which parts of those objects remain specifically juridical; and how legal findings can return corrections to GRE. The section therefore develops nine interfaces: property, contract, legal personhood, rights, duties, institutional recognition, legal infrastructure, relational justice, and the limits of economic reduction. The method follows the containment and translation disciplines developed in Sections 23.2–23.3. Earlier GRE analyses of ownership and control, legal generative-field protection, and practical legal standing remain available as economic and governance architectures, while claims about legal validity, legal status, doctrinal interpretation, competent authority, or juridical consequence are handed to GR-Law for independent warrant.

Definition 23.181 (GRE–GR-Law interface record)**.** A *GRE–GR-Law interface record* specifies an economically consequential legal configuration, the legal positions or institutions involved, the GRE objects affected, the direction of translation, the legal questions requiring independent analysis, the economic manifestations being investigated, temporal and jurisdictional boundaries, practical realization pathways, unresolved normative or doctrinal questions, expected legal correction returns, and the GRE claims that would require revision if the legal characterization changes.

The record prevents two opposite reductions. The first treats law as a surface description of underlying economic control, bargaining power, or material dependence. The second infers economic capability or practical consequence directly from formal legal status. GRE needs neither reduction. Legal forms can be causally constitutive of economic relations, while their practical incidence depends on resources, institutions, interpretation, enforcement, documentation, standing, and historical context. Earlier GRE work on law as generative-field protection showed that legal ordering can constitute and protect generative fields; the present task is to specify how such legal objects travel across the disciplinary boundary.

Proposition 23.182 (Legal handoff condition)**.** *A GRE inquiry should hand a material subquestion to GR-Law when resolution of that subquestion depends principally on legal validity, legal classification, legal personhood, juridical standing, interpretation of authoritative legal materials, the existence or content of a right or duty, competent legal authority, or the legal consequences of an institutional act rather than on economic structure, mechanism, or consequence alone.*

Proposition 23.182 does not remove legal institutions from economic inquiry. GRE can continue to examine how a legally recognized position changes access, bargaining, dependency, investment, risk, value circulation, capability, or future options. The handoff concerns the source of warrant for the legal proposition. A legal conclusion should not be reconstructed indirectly from prices, incentives, social practice, or economic usefulness where the legal domain supplies its own criteria of recognition and validity.

Table 23.8 summarizes the principal operations developed below.

Table 23.8: Principal operations at the GRE–GR-Law interface

Interface object	GRE contribution	GR-Law question	Return to GRE
Property	Control, access, use, exclusion, transfer, dependence, generative effect	Which legal positions constitute the property relation and under what authority?	Revised distinction between legal entitlement and economic control
Contract	Bargaining structure, dependence, allocation, incentives, performance consequences	Is an agreement legally valid, enforceable, interpretable, voidable, or otherwise legally qualified?	Revised account of feasible relations, remedies, and economic exposure
Legal personhood	Economic agency, organizational capacity, relational participation	Which entity or configuration possesses legal personality, powers, liabilities, or standing?	Revised subject boundaries and responsibility architecture
Rights	Effective access, capability, dependency, realization cost	What legal right exists, with which correlative positions and remedies?	Revised distinction between formal entitlement and practical capability
Duties	Compliance cost, burden incidence, maintenance, organizational capacity	What legal obligation exists, who bears it, and how is performance legally assessed?	Revised responsibility and incidence mapping
Recognition	Economic consequence of status, classification, registration, or authorization	Which act or institution creates, confirms, or contests legal status?	Revised boundary, membership, and access conditions
Legal infrastructure	Documentation, procedure, enforcement, remedy, institutional access	Which legal pathways and authorities make the position legally operable?	Revised realization, delay, exclusion, and correction pathways
Relational justice	Power, capability, dependence, participation, generative consequences	Which legal and normative standards bear on the relation, and which remain outside law?	Revised justice profile without collapsing validity into justice
Scope limit	Economic effects of legal ordering	Validity, doctrine, standing, interpretation, authority, legal remedy	Domain correction, reclassification, or narrowed GRE claim

23.8.1 Property

Property is a particularly important interface because economic analysis frequently uses the language of ownership as if it were interchangeable with practical control. The earlier GRE analysis of ownership and control separated those positions within economic architecture. The legal interface requires a further distinction: legal property relations can allocate claims, powers, privileges, immunities, liabilities, use positions, exclusion positions, transfer powers, security interests, and remedial standing that do not map one-to-one onto observed control over a resource or asset.

Definition 23.183 (Property interface profile)**.** A *property interface profile* records the economically relevant object, the legal property positions asserted or recognized, practical control and access, use and exclusion relations, transfer and succession possibilities, security or liability relations, jurisdiction and temporal scope, realization pathways, affected positions, and the economic consequences that depend on the distinction between legal entitlement and practical control.

This profile is useful where several actors possess different layers of authority over the same economically consequential object. A platform may control technical access while users retain contractual or statutory positions; a household may possess practical use of land while formal title remains elsewhere; a public body may own infrastructure whose operation is delegated; a community may possess socially recognized stewardship that only partly overlaps with formal legal property. GRE can reconstruct the economic incidence of these relations, but the legal content of title, possession, license, easement, security, or other legally differentiated positions re-

quires legal analysis.

Property can also create economic reality rather than merely record it. Legal title can enable collateralization, succession, exclusion, licensing, taxation, organizational separation, or legal remedy. These possibilities can alter investment, bargaining, mobility, risk, and generative capacity. Yet the economic consequence remains historically and institutionally mediated. A formally strong entitlement can be difficult to use, while a practically entrenched control relation can be economically powerful without corresponding legal title.

Proposition 23.184 (Property–control non-equivalence)**.** *Neither legal property status nor observed economic control should be inferred from the other without an explicit interface analysis identifying the legal positions, realization pathways, practical control mechanisms, and domain-specific evidence that connect them.*

The proposition preserves both directions of correction. GR-Law can show that an apparent owner lacks a relevant legal power or that several distinct legal positions have been compressed into one economic variable. GRE can show that legally specified property relations produce uneven practical control because of finance, infrastructure, information, institutional access, or asymmetrical enforcement.

23.8.2 Contract

Contract connects legal relation formation with economic allocation, exchange, coordination, dependence, risk, and expectation. GRE can examine bargaining positions, outside options, information asymmetry, repeated interaction, switching cost, performance capacity, and downstream generativity. These economic features can strongly condition how a contractual arrangement operates. They do not, by themselves, establish whether a contract exists, how its terms are legally interpreted, whether particular provisions are enforceable, or which remedies follow from breach or invalidity.

Definition 23.185 (Contract interface record)**.** A *contract interface record* specifies the relevant parties or legal positions, the economically consequential agreement or purported agreement, bargaining and dependency conditions, exchanged performances or commitments, legal characterization requiring independent analysis, performance and enforcement pathways, remedies or termination possibilities where known, temporal scope, and the economic consequences that depend on the legal status or interpretation of the arrangement.

The record separates three questions that are often collapsed. One concerns economic agreement: what positions expected to exchange or coordinate. A second concerns legal contract: whether the legal system recognizes a binding relation and with what content. A third concerns practical realization: what happens when performance, enforcement, renegotiation, or exit occurs in institutions with unequal resources and different response times. These questions interact without becoming identical.

Contract can also reorganize future possibility. Long commitments can stabilize investment and cooperation, but can constrain exit or redirect later bargaining. Standard-form contracts can reduce negotiation cost while centralizing rule forma-

tion. Automated or digitally mediated contracting can increase execution speed while shifting interpretation, correction, or contestation burdens. GRE can study these economic effects; GR-Law must determine the legal positions generated by the contractual architecture.

Proposition 23.186 (Contractual validity non-deduction)**.** *Economic evidence concerning assent, exchange, efficiency, reliance, dependence, or performance cannot by itself establish contractual validity, legal interpretation, enforceability, or remedy; those propositions require legal warrant appropriate to the competent legal order.*

Conversely, legal validity does not settle the economic quality of the relation. A legally enforceable contract can coexist with severe dependency, capability asymmetry, extractive conversion, or weak practical exit. The interface therefore permits legal and economic assessments to remain simultaneously valid but analytically distinct.

23.8.3 Legal Personhood

Legal personhood is another point at which economic and legal vocabularies can diverge sharply. GRE can identify an organization, institution, community, platform, artificial system, or other stabilized configuration as an economically consequential relational entity. That economic entity need not possess legal personality. Conversely, a legal person can persist despite substantial changes in membership, assets, management, or economic capacity because the legal order supplies continuity rules that differ from the criteria used for economic identity.

Definition 23.187 (Legal-personhood interface profile)**.** A *legal-personhood interface profile* records the economically identified entity or configuration, the asserted or recognized legal person, the legal capacities or liabilities relevant to the case, continuity and representation rules, organizational or relational structures through which the person acts, practical control positions, affected counterparties, and the economic claims that depend on whether legal and economic entity boundaries coincide.

This profile matters for responsibility, contracting, asset holding, litigation, taxation, succession, and institutional memory. Economic analysis can mistakenly attribute conduct to a diffuse network when law locates responsibility in a legally constituted organization; it can also overidentify the legal person with the practical site of decision when actual control lies elsewhere. The distinction becomes more important in complex corporate groups, platforms, public-private arrangements, autonomous technical systems, and other configurations in which legal personality, operational agency, control, and relational subjecthood are distributed differently.

Proposition 23.188 (Personhood non-equivalence)**.** *Legal personhood, economic agency, organizational continuity, relational subjecthood, moral standing, and phenomenological subjectivity are distinct analytical statuses; a claim established at one level should not be transferred to another without an explicit translation and an independently adequate warrant.*

The proposition is particularly important for future GR work involving AI or non-human subjects. GRE may identify economically consequential agency or dependence without determining legal personhood. GR-Law may recognize legal

personality for instrumental or institutional reasons without settling moral or ontological questions. The interface should preserve these remainders rather than force a unified concept of the subject.

23.8.4 Rights

Rights enter GRE through the economic possibilities and protections they condition. Access to property, employment, welfare, information, mobility, participation, privacy, remedy, or organizational decision can affect capability, bargaining, dependency, risk, and future options. Yet the word *right* should not be used as an economic shorthand for any desirable capability or protected interest. The earlier GRE treatment of legal generative-field protection already distinguished legal positions from broader practical effects; the present interface preserves that distinction across disciplines.

Definition 23.189 (Right-realization interface profile)**.** A *right-realization interface profile* records the legally specified right or legal position, its relevant correlatives, the competent legal source where identified, standing and procedural conditions, documentation requirements, enforcement and remedy pathways, time and resource costs, practical accessibility, affected economic capabilities, and the divergences between formal entitlement and realized economic possibility.

A right can be economically consequential before litigation occurs because counterparties organize expectations around it. It can also remain weakly realized when evidence, procedure, representation, language, cost, delay, or institutional capacity obstruct use. This makes rights a relational infrastructure for economic possibility rather than a scalar resource that can simply be counted.

Proposition 23.190 (Formal-right capability divergence)**.** *A legally recognized right and an economically realizable capability should be measured separately whenever exercise of the right depends on material, procedural, informational, organizational, or temporal conditions that vary across positions.*

The proposition does not demote formal recognition. Legal recognition can itself alter bargaining, expectation, remedy, or institutional obligation even before practical exercise. It instead prevents the economic researcher from treating recognition as sufficient evidence of effective capability or, conversely, from treating weak realization as evidence that no legal right exists.

23.8.5 Duties

Duties are the correlative side of many legally structured relations and can condition economic order through requirements to perform, refrain, disclose, maintain, compensate, care, protect, document, or cooperate. Their economic incidence depends on who bears the cost of compliance, what capability is required for performance, how duties are monitored, and what happens when responsibility is distributed across organizations or infrastructures.

Definition 23.191 (Duty-incidence profile)**.** A *duty-incidence profile* records the legally specified duty or asserted obligation, the position bearing it, beneficiaries or protected positions where identifiable, required conduct, compliance resources,

monitoring and evidential conditions, performance pathway, sanctions or remedies where known, distribution of direct and indirect burdens, and the economic consequences of fulfillment, non-fulfillment, delegation, or transfer.

Economic compliance cost is only one dimension. A duty can create organizational capability by requiring maintenance, reporting, preservation, or institutional learning. It can also shift burden toward smaller actors with less administrative capacity, creating asymmetric exit or participation effects. Outsourcing performance can preserve formal responsibility while changing practical control and incidence. These are questions GRE can examine without deciding the legal content of the duty.

Proposition 23.192 (Duty-performance non-equivalence)**.** *The legal existence of a duty, practical performance of the required conduct, economic incidence of compliance, and normative adequacy of the obligation are distinct propositions and should not be inferred from one another without the corresponding legal, empirical, and evaluative warrants.*

This distinction supports reciprocal correction. GR-Law can revise GRE when the economic model assigns responsibility to the wrong legal position or ignores legally non-delegable obligations. GRE can return evidence that nominal duty allocation produces persistent capacity bottlenecks, burden displacement, or weak realization.

23.8.6 Institutional Recognition

Many economic possibilities depend on institutional recognition: registration of a company, recognition of family status, licensing, citizenship or residency status, certification, title registration, insolvency status, legal capacity, protected classification, or recognition of an organization as competent to act. Recognition can therefore be constitutive rather than merely descriptive.

Definition 23.193 (Legal-recognition interface record)**.** A *legal-recognition interface record* identifies the status or position to be recognized, the competent institution or process, evidential and procedural requirements, effective date and duration, contestation or correction pathways, economic capacities activated or constrained by recognition, excluded or ambiguous positions, and the GRE claims that depend on the recognition decision.

Recognition can alter boundaries and membership in ways that have immediate economic effects. An organization can acquire capacity to contract, hold assets, employ staff, or receive funding. A person can become eligible for welfare, work, mobility, inheritance, or representation. A resource can enter a protected category that changes use, transfer, or liability. These changes are not adequately modeled as shifts in preference or price because the legal act can constitute the relevant economic position itself.

Proposition 23.194 (Recognition constitutivity condition)**.** *Where a legal recognition act creates or materially changes the status required for economically consequential action, GRE should model the recognition event as a constitutive change in the relevant relational architecture rather than as a mere informational update about a pre-existing economic state.*

The converse also matters. Not every social or economic recognition is legal recog-

nition. Communities, platforms, markets, or professional fields can recognize statuses through non-legal processes. The interface record should therefore identify which recognition regime is doing the constitutive work.

23.8.7 Legal Infrastructure

Legal positions become economically usable through infrastructures of documentation, registration, advice, evidence, adjudication, administration, enforcement, appeal, and remedy. The earlier GRE treatment of relational infrastructure located legal infrastructure among the systems that make formal standing practically consequential. The present interface asks which parts of that realization pathway remain economic objects and which require legal interpretation.

Definition 23.195 (Legal-infrastructure dependency profile)**.** A *legal-infrastructure dependency profile* records the documents, registries, competent institutions, procedural stages, evidential systems, representation resources, enforcement mechanisms, remedies, digital or physical access points, interoperability dependencies, response times, and correction pathways required for a legal position to become practically consequential in an economic setting.

The profile can reveal single points of exclusion. A formal entitlement may depend on identity documentation, a registry entry, legal advice, a filing deadline, a digital credential, translation, or access to a competent tribunal. Delay at one stage can shift bargaining power elsewhere. A remedy that arrives after an irreversible economic loss can remain legally meaningful while providing limited restoration of the earlier option set. Infrastructure therefore connects legal time to economic time.

Legal infrastructure can itself become a field of power and dependence. Concentrated expertise, procedural complexity, proprietary digital systems, high representation costs, or asymmetrical access to evidence can shape whose legal positions become economically effective. GRE can analyze this incidence. The legal evaluation of procedure, due process, jurisdiction, admissibility, remedy, or institutional competence remains a GR-Law question.

Proposition 23.196 (Legal-infrastructure realization condition)**.** *Where an economic capability, protection, or liability depends materially on legal status, the analysis should trace the institutional realization pathway and its costs, delays, failure modes, and remedies rather than infer practical economic standing from formal legal recognition alone.*

This proposition also makes infrastructure a correction channel. If GR-Law shows that GRE has assumed an unavailable remedy, misidentified the competent authority, or overlooked a procedural precondition, the economic model of access, risk, or bargaining should be revised.

23.8.8 Relational Justice

The interface with justice requires especially careful containment because legal validity, legal protection, economic relational justice, and broader normative justice are related but non-equivalent. The earlier GRE treatment of relational justice examined justice through the quality and conditions of relations. Legal institutions can protect standing, allocate remedies, constrain domination, structure participation, recognize

responsibility, and make claims contestable. Yet neither legal compliance nor economic generativity is sufficient by itself to establish justice.

Definition 23.197 (Legal-relational justice interface)**.** A *legal-relational justice interface* records the economically consequential relation under evaluation, affected positions and standing, relevant legal rights, duties, powers, liabilities, procedures, recognition structures, remedies, practical realization conditions, GRE justice considerations, unresolved normative premises, and the points at which legal validity and broader justice evaluation diverge.

The interface is needed because law can correct some relational injustices while reproducing or legitimating others. A procedure may satisfy formal requirements yet remain economically inaccessible. A property arrangement may be legally stable while concentrating generative opportunity. A contract may be valid while practical exit is severely asymmetric. Conversely, a relation that appears economically unequal can be structured by legal protections that are invisible in a coarse economic representation. The legal domain can therefore change the relevant justice facts without exhausting the justice inquiry.

Proposition 23.198 (Validity–justice non-equivalence)**.** *Legal validity, legality of conduct, effective legal protection, economic relational justice, and broader normative justice are distinct evaluative objects; a conclusion at one level should not be treated as sufficient warrant for a conclusion at another.*

A relational justice analysis should consequently record where its normative premises come from. GRE can identify dependence, asymmetry, exclusion, capability loss, generative foreclosure, or unequal participation as normatively relevant structures. GR-Law can identify legal rights, duties, standing, procedural guarantees, and remedies. Political theory, ethics, or other domains may still be required to justify broader claims about legitimacy, priority, or obligation. The interface keeps these contributions composable without forcing one domain to dominate the others.

23.8.9 Limits of Economic Reduction

The legal interface reaches its boundary when economic explanation begins to substitute for legal warrant. Law can have economic functions, but legal categories are not exhausted by their efficiency, incentive, distributional, or generative effects. Property is not merely control; contract is not merely exchange; personhood is not merely agency; rights are not merely capabilities; duties are not merely costs; recognition is not merely information; legal procedure is not merely transaction friction; and legal remedy is not merely compensation. Each category possesses domain-specific structure that can become economically consequential precisely because it is legally constituted.

Definition 23.199 (Economic-reduction signal in legal analysis)**.** An *economic-reduction signal in legal analysis* is an analytical move that treats a materially legal question as resolved by economic variables or functions while omitting the legal criteria of validity, classification, authority, interpretation, standing, procedure, or remedy on which the legal proposition depends.

Common signals include equating de facto control with ownership, treating re-

peated performance as sufficient evidence of contractual validity, inferring legal personhood from operational autonomy, counting nominal rights as effective capabilities, treating legal duties only as compliance costs, describing registration as a passive information event, and evaluating procedure solely through speed or administrative expense. These moves can be useful simplifications for a bounded economic task, but they become invalid when the omitted legal structure is material to the conclusion.

Definition 23.200 (GR-Law correction return)**.** A *GR-Law correction return* records a legal finding that requires revision of a GRE object, boundary, mechanism, subject classification, option set, responsibility allocation, temporal assumption, or economic consequence because the prior economic analysis mischaracterized or omitted a materially relevant legal relation.

Correction can move in several directions. GR-Law may show that a legally recognized power exists where GRE modeled only informal influence; that a purported property relation is legally divided among several positions; that an entity lacks legal capacity assumed by an economic model; that a right or duty is narrower or broader than the economic proxy; or that a remedy changes the effective option set. GRE can return evidence that legal rules operate through unexpected economic dependencies, generate unequal realization costs, or alter long-horizon generative conditions. Neither correction has automatic priority outside the proposition it supports.

Definition 23.201 (GRE–GR-Law interface portfolio)**.** A *GRE–GR-Law interface portfolio* is a versioned collection of property, contract, personhood, rights, duties, recognition, infrastructure, justice, handoff, and correction records maintained across jurisdictions, institutions, historical periods, and economic domains.

The portfolio makes legal variation analytically visible. A legal form that produces one economic effect in one institutional environment may generate another elsewhere because enforcement, administrative capacity, social practice, or infrastructural access differs. Comparative work should therefore preserve jurisdiction, period, institutional setting, and doctrinal version rather than treating a legal label as a universally equivalent variable.

Proposition 23.202 (GRE–GR-Law interface answerability)**.** *A GRE claim that materially depends on law is cross-domain answerable when the relevant legal object, source of legal warrant, economic manifestation, realization pathway, jurisdictional and temporal scope, domain-specific remainder, and possible GR-Law correction return are explicit enough that contrary legal analysis can revise the economic interpretation or reclassify the question.*

This condition keeps law economically consequential without making it economically reducible. GRE studies how legally constituted positions alter resources, relations, capabilities, dependence, value pathways, participation, and future options. GR-Law supplies the domain warrant where the conclusion depends on legal validity, classification, standing, interpretation, authority, or remedy. The next section carries the same containment discipline into political theory, where power, authority, legitimacy, participation, and collective action create another closely coupled but non-equivalent interface.

23.9 Political Theory Interface

Section 23.8 established the interface between GRE and Generative Relational Law by separating juridical constitution from economic manifestation. The present section turns to political theory. Its role is to identify where economic relations become inseparable from questions of political power, authority, collective action, public institutions, legitimacy, participation, recognition, and political-economic ordering without allowing GRE to absorb those questions into economics. The objective is to specify which political phenomena GRE can investigate as economically consequential structures, which propositions require specifically political-theoretical warrant, and how political-theoretical findings can return corrections to GRE. The section develops nine interfaces: power, authority, collective action, public institutions, legitimacy, participation, recognition, political economy, and the limits of economic explanation. The method follows the containment and translation disciplines established in Sections 23.2–23.3. Earlier GRE analyses of economic power, justice, governance, institutions, and public economic order remain available, but they do not independently establish political authority, public legitimacy, political standing, or the normative terms of collective rule.

Definition 23.203 (GRE–political-theory interface record)**.** A *GRE–political-theory interface record* specifies an economically consequential political configuration, the relevant economic positions and relations, the political objects or claims involved, the direction of translation, the economic manifestations under investigation, the political-theoretical questions requiring independent warrant, the institutional and historical boundaries of the inquiry, the principal forms of evidence, unresolved normative questions, expected political-theory correction returns, and the GRE claims that would require revision if the political characterization changes.

The record is designed to prevent four recurrent collapses. Economic power should not be equated with political power. Effective control should not be equated with authority. Collective economic coordination should not be equated with political collective action. Economic performance or social acceptance should not be treated as sufficient evidence of political legitimacy. These distinctions remain compatible with strong causal interaction across the boundary. Resources, ownership, information, dependence, organization, infrastructure, and capability can condition political possibility, while political authority, institutional design, recognition, and collective decisions can restructure economic relations.

Proposition 23.204 (Political-theory handoff condition)**.** *A GRE inquiry should hand a material subquestion to political theory when resolution of that subquestion depends principally on political authority, legitimacy, collective standing, public justification, representation, membership in a political community, the normative structure of collective decision, or specifically political forms of recognition rather than on economic mechanism or consequence alone.*

Proposition 23.204 concerns the source of warrant rather than the importance of the political object for economics. GRE can continue to analyze how authority, participation, recognition, or public institutions alter allocation, capability, bargaining, risk, value conversion, investment, dependence, or generative opportunity. The handoff is triggered when the conclusion itself is political-theoretical.

Table 23.9: Principal operations at the GRE–political-theory interface

Interface object	GRE contribution	Political-theory question	Return to GRE
Power	Resources, dependence, capability, conversion, circulation, control	When does an asymmetry become specifically political power, through which public or collective relation?	Revised power typing and mechanism boundaries
Authority	Compliance conditions, institutional capacity, economic incidence	What authorizes rule, decision, command, or representation?	Revised distinction between control, office, and authority
Collective action	Coordination costs, incentives, resources, network structure	What constitutes a political collectivity, public purpose, or representative action?	Revised collective unit and coordination mechanism
Public institutions	Fiscal capacity, allocation, administration, infrastructure	What makes an institution public and what political standing attaches to its acts?	Revised public/private and institutional boundary assumptions
Legitimacy	Economic conditions and consequences of acceptance, contestation, compliance	What makes an exercise of power or authority politically legitimate?	Revised treatment of compliance, durability, and institutional stability
Participation	Access costs, capabilities, material constraints, incidence	What counts as political participation, standing, representation, or voice?	Revised participation and exclusion profiles
Recognition	Economic consequences of status, membership, visibility, classification	What political status or standing is created, denied, or contested?	Revised subject, membership, and capability boundaries
Political economy	Mutual conditioning of economic and political structures	Which political mechanisms constitute, stabilize, or transform economic ordering?	Revised causal architecture and scope of economic explanation
Scope limit	Economic manifestations and consequences of political ordering	Authority, legitimacy, public justification, representation, political membership	Handoff, reclassification, or joint governance

Table 23.9 summarizes the principal operations developed below.

23.9.1 Power

Power is the first interface because Chapter 16 already established an extensive GRE architecture for economic power. That architecture distinguishes asymmetry from relationally realized power and identifies mechanisms involving resources, capabilities, dependence, institutional position, conversion, circulation, capture, and reproduction. Political theory introduces an additional question: under what conditions does a power relation become specifically political rather than merely economically consequential?

Definition 23.205 (Political-power interface profile)**.** A *political-power interface profile* records the relevant economic asymmetries, the affected positions, the collective or public relation in which power is exercised, the decision or possibility being conditioned, the mechanism of influence or control, the institutional setting, the relevant political standing or membership relation, the temporal horizon, contestability, and the economic consequences of the political power relation.

This profile prevents political power from being inferred directly from wealth, ownership, market concentration, or organizational resources. These can be important carriers or enabling conditions, but the political claim requires an additional relational specification. Economic resources may finance agenda setting, organization, information production, lobbying, electoral mobilization, institutional access, or coercive capacity. Yet the political mechanism depends on how those resources

enter institutions, public decisions, collective membership, authority structures, or recognized political channels.

Conversely, political power can reshape economic possibility without being reducible to prior economic advantage. Public authority may redefine property, taxation, eligibility, organizational form, labor regulation, monetary conditions, public investment, or legal status. GRE therefore needs a typed interface rather than a one-directional account in which economic resources mechanically become political outcomes.

Proposition 23.206 (Economic–political power non-equivalence)**.** *Economic power and political power should be treated as non-equivalent typed relations unless an interface analysis identifies the collective or public mechanism through which an economic asymmetry becomes politically operative or a political power relation becomes economically consequential.*

The proposition allows strong coupling without identity. It also creates room for empirical divergence: concentrated economic resources may fail to translate into political influence under some institutional conditions, while politically authoritative positions may exercise substantial economic effects despite limited private wealth.

23.9.2 Authority

Authority requires a sharper boundary because observed compliance, organizational hierarchy, or practical control can be economically reconstructed without establishing why an actor or institution is entitled, authorized, or recognized to issue binding decisions. GRE can analyze the costs, capacities, incentives, dependencies, and consequences surrounding authoritative arrangements, but the specifically political meaning of authority requires a separate warrant.

Definition 23.207 (Authority–economy interface record)**.** An *authority–economy interface record* specifies the actor or institution claiming or exercising authority, the domain of decision, the affected economic positions, the resources and administrative capacities supporting implementation, the observed patterns of compliance or contestation, the political basis of authority requiring independent analysis, and the economic consequences produced through the authoritative relation.

The distinction is useful where several mechanisms can generate similar behavior. An employer may obtain compliance through contractual dependence; a platform may structure action through technical control; a public agency may issue decisions backed by legal competence; a political institution may claim authority over a population; a community body may possess socially recognized leadership. Their economic effects may overlap, but their political status need not.

Proposition 23.208 (Authority non-deduction)**.** *Political authority should not be inferred solely from effective control, repeated compliance, organizational hierarchy, economic indispensability, coercive capacity, or administrative success.*

The proposition also protects GRE from an inverse mistake. A politically authoritative institution may lack the economic resources or administrative capacity required to realize its decisions. GRE can investigate that implementation gap, but it should not redefine authority as whatever produces compliance most efficiently. Political

theory remains responsible for the constitutive and normative question of authority, while GRE investigates the economic conditions and consequences of its exercise.

23.9.3 Collective Action

Collective action is closely connected to economic coordination, but the two are not interchangeable. GRE can study resource mobilization, coordination costs, incentive compatibility, network structure, shared infrastructures, dependence, and distributional consequences. Political collective action may additionally involve the constitution of a public, representation, contestation, common purposes, political identity, and claims made in the name of others.

Definition 23.209 (Collective-action interface profile)**.** A *collective-action interface profile* records the participants and represented positions, the collective objective or contested issue, resource and coordination requirements, decision and representation procedures, participation and exit conditions, internal asymmetries, relevant public or political standing, external effects, temporal durability, and the economic consequences of collective action or collective-action failure.

This profile makes it possible to use economic theories of incentives or coordination without treating them as complete theories of political collectivity. Free-riding, transaction costs, organizational resources, or selective incentives may explain part of mobilization, but they do not alone establish who constitutes the collective, whose interests can be represented, how dissent is handled, or why an action should count as politically representative.

Proposition 23.210 (Collective-action domain differentiation)**.** *Economic coordination analysis can inform political collective-action research when resource, incentive, and dependency mechanisms are material, but political claims about collective standing, representation, membership, and public purpose require additional political-theoretical analysis.*

The interface is especially important for unions, associations, social movements, cooperatives, public campaigns, neighborhood organizations, and platform-mediated collectivities. GRE may analyze how material capacity enables participation or how collective action changes allocation and bargaining. Political theory may revise the unit of analysis when the relevant political collective differs from the economically convenient aggregation.

23.9.4 Public Institutions

Public institutions connect governance, law, economics, and political theory. GRE can analyze public finance, administrative capacity, service provision, procurement, infrastructure, redistribution, public investment, institutional learning, and the economic consequences of organizational design. The additional political question is what makes an institution public in the relevant sense and what authority, standing, accountability, or representative relation attaches to its acts.

Definition 23.211 (Public-institution interface record)**.** A *public-institution interface record* specifies the institution, its legally and politically constituted mandate, the public or constituency to which it is related, its resource base, decision architecture,

administrative capabilities, accountability and contestation channels, affected economic positions, and the economic consequences of its decisions and institutional capacities.

The record guards against defining publicness by funding source or ownership alone. A publicly funded organization may exercise little political authority; a privately organized body may perform delegated public functions; hybrid institutions may combine public mandate with market financing; central banks, universities, utilities, public corporations, regulatory bodies, and multilevel institutions can occupy different positions across jurisdictions.

Proposition 23.212 (Publicness non-deduction)**.** *The political publicness of an institution should not be inferred solely from public funding, state ownership, administrative scale, monopoly position, economic importance, or service provision.*

GRE can nonetheless study the consequences of public institutional form. Fiscal capacity, staffing, informational infrastructure, procurement rules, bureaucratic delay, risk-bearing capacity, and institutional memory can shape economic generativity. Political theory remains necessary where the analysis turns to representative standing, public authority, political accountability, or the justification of collective institutional power.

23.9.5 Legitimacy

Legitimacy marks one of the clearest limits on economic reduction. Institutions with high output, low administrative cost, rapid response, stable compliance, or broad material benefits may still face political-theoretical questions about legitimacy. Conversely, a politically legitimate institution may produce costly, contested, or economically inefficient outcomes under some conditions. GRE therefore needs an interface that allows economic evidence to matter without allowing economic performance to settle the political question.

Definition 23.213 (Legitimacy–economy interface profile)**.** A *legitimacy–economy interface profile* records the institution or exercise of power under evaluation, the affected political community or positions, the economic conditions supporting or constraining the arrangement, observed compliance and contestation, distributional and generative consequences, material participation conditions, the political standards of legitimacy requiring independent argument, and the economic consequences of legitimacy or legitimacy deficits.

Economic inquiry can contribute in at least three ways. First, it can show whether participation, voice, legal remedy, or public reasoning is materially inaccessible to some groups. Second, it can identify who bears the costs of maintaining an institution and who receives its benefits. Third, it can examine whether economic dependence makes apparent consent or compliance difficult to interpret. These findings can be politically relevant without themselves constituting a theory of legitimacy.

Proposition 23.214 (Performance–legitimacy non-equivalence)**.** *Economic performance, aggregate welfare gains, administrative efficiency, institutional durability, observed compliance, or low contestation should not be treated as sufficient evidence of political legitimacy.*

The reverse also matters. Political legitimacy does not imply that economic consequences are benign, equally distributed, or generatively sustainable. The two domains therefore require reciprocal correction rather than hierarchical reduction.

23.9.6 Participation

Participation already appears throughout GRE in economic relations, organizational life, governance, knowledge production, and AI-mediated systems. Political participation introduces additional issues of standing, representation, voice, agenda influence, membership, and collective decision. A person can participate economically while being excluded politically, or possess formal political participation rights while lacking the resources, time, information, accessibility, or security needed for effective exercise.

Definition 23.215 (Political-participation interface profile)**.** A *political-participation interface profile* records formal opportunities for political participation, effective access conditions, resource and capability requirements, standing and membership rules, agenda and decision channels, representation structures, participation burdens, participation-induced risks, internal asymmetries, and the economic consequences of participation or exclusion.

The profile allows GRE to investigate material participation conditions while leaving the specifically political meaning of participation to political theory. Time scarcity, transport, care obligations, income loss, information costs, digital access, language capacity, disability accommodation, and exposure to retaliation can all affect practical participation. They are economically tractable without defining what participation should count as politically sufficient.

Proposition 23.216 (Formal–effective political participation distinction)**.** *Formal availability of a participatory channel should be distinguished from effective political participation when access costs, capability requirements, standing rules, representation structures, or material risks generate systematic differences in who can use the channel and with what influence.*

GRE can therefore contribute a participation-incidence analysis, but political theory must still address questions concerning representation, equality of political standing, deliberative adequacy, or the normative meaning of voice.

23.9.7 Recognition

Recognition is another concept shared across domains but not automatically equivalent. Economic institutions recognize categories for purposes such as eligibility, credit, employment, pricing, ownership, membership, or access. Political recognition may concern membership in a polity, public status, minority standing, representation, visibility, or acknowledgement of historically constituted groups. These forms can interact without collapsing into one another.

Definition 23.217 (Political-recognition interface record)**.** A *political-recognition interface record* specifies the subject or group seeking or receiving recognition, the political status or standing at issue, the recognizing institution or public, the economic classifications that interact with the political status, material conditions of recogni-

tion, exclusion or misrecognition pathways, and the economic consequences of recognition, non-recognition, or contested recognition.

Recognition can be constitutive. A status may alter access to representation, public resources, legal remedies, institutional consultation, or eligibility for specific protections. Yet GRE should not infer political recognition from economic inclusion alone. Market access, employment, taxation, or service eligibility may coexist with political exclusion or unequal standing.

Proposition 23.218 (Recognition non-equivalence)**.** *Economic recognition, institutional classification, legal recognition, social visibility, and political recognition should be treated as distinct but potentially interacting relations unless the inquiry supplies an explicit translation establishing the relevant correspondence.*

The proposition is particularly important for analyses of marginalized groups, migrants, indigenous communities, informal workers, stateless persons, algorithmically classified populations, and other positions whose economic and political recognition can diverge substantially.

23.9.8 Political Economy Interface

Political economy is not merely the juxtaposition of political and economic variables. It concerns configurations in which political and economic structures are mutually conditioning and sometimes jointly constitutive. Chapter 21 already placed GRE in dialogue with political-economic traditions. The present task is narrower: to define the interface through which political-theoretical claims and GRE claims can interact without either domain claiming exhaustive explanatory priority.

Definition 23.219 (Political-economy interface dossier)**.** A *political-economy interface dossier* records the economic structures under investigation, the political institutions and relations conditioning them, the direction and timing of causal or constitutive influence, the relevant power and authority mechanisms, historical dependencies, public decisions, distributive and generative consequences, competing economic and political explanations, and the points at which domain-specific warrant is required.

The dossier should distinguish at least four patterns. Economic structures can condition political organization by shaping resources, dependencies, concentration, or participation costs. Political institutions can condition economic structures through taxation, monetary arrangements, property regimes, public investment, regulation, recognition, and institutional design. Some arrangements may be jointly constituted, so separating a political cause from an economic effect becomes analytically misleading. Finally, the domains can change at different rates, producing lags and feedbacks rather than a stable one-way relation.

Proposition 23.220 (Bidirectional political-economic constitution)**.** *Where evidence supports reciprocal or jointly constitutive mechanisms, GRE should represent political and economic structures as bidirectionally conditioning rather than assigning explanatory priority to one domain by default.*

This proposition does not imply symmetrical influence in every case. The direction, strength, timing, and scale of influence remain empirical and historical ques-

tions. It instead rejects a default hierarchy in which economic structure is always foundational or political institutions are always decisive.

Definition 23.221 (Political-theory correction return)**.** A *political-theory correction return* is a documented finding from political-theoretical inquiry that requires GRE to revise an economic object, relation, mechanism, subject boundary, institutional classification, participation profile, power type, public/private distinction, or scope claim because the prior GRE formulation depended on an inadequate political characterization.

Examples include discovering that GRE treated an exercise of authority as mere organizational control, modeled a constituency as a homogeneous economic group despite contested political membership, inferred legitimacy from compliance, or treated a public institution as equivalent to a large service provider. Such corrections belong inside the GRE research record rather than being relegated to external commentary.

23.9.9 Limits of Economic Explanation

The political-theory interface becomes most important where economic mechanisms remain relevant but cease to be sufficient for the principal claim. Political questions often include economic conditions and consequences; that does not make them reducible to economic explanation. The relevant boundary is therefore substantive rather than lexical.

Definition 23.222 (Economic-reduction signal in political analysis)**.** An *economic-reduction signal in political analysis* is present when a political claim concerning authority, legitimacy, political standing, representation, public justification, collective membership, or recognition is inferred principally from economic performance, resource possession, incentives, market behavior, observed compliance, or aggregate welfare without an independently warranted political bridge.

The signal does not make economic evidence irrelevant. It identifies a missing interface step. An institution's distributive consequences can be central to legitimacy arguments, but those consequences do not constitute the entire legitimacy claim. Economic dependence can distort participation, but measuring dependence does not establish what equal political standing requires. Concentrated wealth can condition political power, but wealth concentration is not itself a complete political-power relation.

Proposition 23.223 (Political explanation handoff)**.** *When the principal explanatory or evaluative burden of an inquiry depends on specifically political concepts whose content cannot be supplied by economic relations alone, the inquiry should move to political theory, adopt joint GRE–political-theory governance, or narrow its GRE claim to the economic conditions and consequences that GRE can warrant.*

A disciplined interface also requires return paths. Political theory can reveal that an economic unit has been politically misclassified, that a participation variable conceals unequal standing, that an authority relation has been mistaken for control, or that economic welfare has been used as a proxy for legitimacy. GRE can return complementary evidence concerning material barriers, capability effects, dependence,

distribution, long-horizon economic consequences, and generative opportunity.

Definition 23.224 (GRE–political-theory interface portfolio)**.** A *GRE–political-theory interface portfolio* is a versioned collection of political-interface records, power translations, authority handoffs, collective-action profiles, public-institution records, legitimacy interfaces, participation profiles, recognition interfaces, political-economy dossiers, correction returns, non-equivalent concepts, and unresolved boundary questions maintained across projects.

The portfolio makes repeated interface problems visible. It can show, for example, whether GRE repeatedly overextends economic power into political authority, whether participation studies systematically omit political standing, or whether public-institution analyses compress heterogeneous political mandates into administrative capacity variables.

Proposition 23.225 (GRE–political-theory interface answerability)**.** *A GRE–political-theory interface is answerable when the economic claim, political claim, translation path, evidential source, domain-specific remainder, and possible political-theory correction return are explicit enough that contrary political analysis can revise the GRE interpretation or reclassify the inquiry.*

This condition preserves a productive but bounded political interface. GRE can investigate how economic structure conditions political possibility and how political ordering reshapes economic relations. Political theory retains independent responsibility for authority, legitimacy, representation, political standing, collective membership, and public justification. Their interaction becomes a site of reciprocal correction rather than a route toward disciplinary absorption.

23.10 Generative Relational Education Interface

Chapter 19 treated education as a substantive economic domain in which resources, institutions, infrastructures, technologies, and relations participate in the generation of learning, capability, judgment, participation, and future options. The present section has a different role. It specifies the interface between GRE and a prospective Generative Relational Education programme without turning GRE into a general theory of education. Its objective is to identify which educational structures GRE can investigate through economic conditions and consequences, which claims require specifically educational or pedagogical warrant, and how educational findings can return corrections to GRE. The section develops nine interfaces: learning relations, capability generation, curiosity, aesthetic judgment, epistemic participation, educational infrastructure, knowledge communities, economic conditions of education, and limits of economic reduction. The method follows the containment and translation disciplines established in Sections 23.2–23.3. The educational domain analysis developed in Chapter 19 remains available, but its economic description does not by itself establish educational quality, pedagogical adequacy, developmental appropriateness, or the purposes that education ought to serve.

Definition 23.226 (GRE–education interface record)**.** A *GRE–education interface record* specifies the learner or learning collective, the educational relation or process under investigation, the relevant economic positions and constraints, the educa-

tional objects or claims involved, the economic manifestations being studied, the educational-theoretical questions requiring independent warrant, the temporal and developmental horizon, the infrastructures and communities supporting learning, the principal forms of evidence, and the GRE claims that would require revision if the educational characterization changes.

The record separates three questions that often travel together but should remain analytically distinct. First, under what economic conditions can learning relations occur? Second, what educational processes actually generate learning, capability, curiosity, judgment, or participation? Third, what later economic consequences follow from those educational changes? GRE has a direct role in the first and third questions and a bounded role in the second. Educational theory, pedagogy, developmental inquiry, and domain-specific teaching knowledge can be constitutive to the second question even when the process is economically consequential.

Proposition 23.227 (Educational-theory handoff condition)**.** *A GRE inquiry should hand a material subquestion to educational theory when resolution of that subquestion depends principally on the constitution of learning, pedagogical adequacy, developmental appropriateness, curricular purpose, educational relationship, or the formation of educational judgment rather than on economic condition or consequence alone.*

Proposition 23.227 does not make educational processes external to economic inquiry. Time, household security, teacher labor, institutional funding, language access, digital infrastructure, credential systems, geographic location, disability access, and opportunity costs can materially determine which educational relations are reachable and sustainable. The handoff concerns the source of warrant for the educational claim.

Table 23.10 summarizes the principal operations developed below.

23.10.1 Learning Relations

Learning relations are the first interface because Chapter 19 already represented education as historically situated interaction among learners, teachers, peers, texts, tools, families, institutions, communities, and artificial systems. The interface question is narrower: which properties of these relations are economically conditioned, and which require educational interpretation before GRE can treat them as generative?

Definition 23.228 (Learning-relation interface profile)**.** A *learning-relation interface profile* records the learner or learning collective, the persons, practices, artifacts, institutions, or systems participating in the relation, the economic conditions enabling or constraining contact, the forms of instruction, participation, feedback, recognition, and practice involved, the expected educational change, the temporal horizon, evidence of later capability or participation, and the educational questions that cannot be settled by economic observables alone.

The profile prevents resource provision from standing in for an educational relation. A funded classroom, tutoring subscription, network connection, AI tutor, or teacher allocation can make interaction possible without establishing that the interaction produces understanding, revisable capability, or a sustainable learning trajectory. Conversely, a relation can be educationally powerful even when the material re-

Table 23.10: Principal operations at the GRE–education interface

Interface object	GRE contribution	Educational-theory question	Return to GRE
Learning relations	Time, resources, access, dependency, institutional and technological conditions	Which relations support learning, feedback, practice, recognition, and development?	Revised conversion and relation architecture
Capability generation	Resource conversion, option expansion, durability, economic realization	Which capabilities are educationally constituted and how are they regenerated?	Revised distinction between output and capability
Curiosity	Security, time, exposure, access, attention, opportunity cost	How is curiosity cultivated, sustained, redirected, or weakened?	Revised treatment of preference, salience, and question formation
Aesthetic judgment	Abundance, selection constraints, informational environments	How is educational judgment formed and calibrated within a field of practice?	Revised orientation and judgment variables
Epistemic participation	Access, standing costs, language, infrastructure, network position	What counts as consequential participation in learning and knowledge practice?	Revised participation and capability profiles
Educational infrastructure	Funding, labor, facilities, platforms, accessibility, maintenance	Which infrastructures are pedagogically usable and developmentally appropriate?	Revised access, maintenance, and resilience analysis
Knowledge communities	Resource flows, mentoring capacity, reproduction, entry conditions	How are norms, practices, identities, and standards learned through participation?	Revised unit of analysis and community-reproduction mechanisms
Economic conditions	Distribution, household constraints, public finance, labor markets, opportunity costs	How do educational aims respond to or resist economic pressures?	Revised incidence and generative-return claims
Scope limit	Economic conditions and consequences of education	Educational quality, pedagogy, development, curricular purpose, formation of judgment	Handoff, reclassification, or joint inquiry

source intensity is modest, provided that it supplies appropriate challenge, feedback, participation, trust, recognition, or entry into a practice. Situated accounts of learning are relevant here because they treat changing participation in practice as part of learning rather than as a context external to it (Lave and Wenger 1991; Wenger 1998).

Economic conditions nonetheless matter to relational form. Time scarcity can shorten feedback cycles or make sustained mentoring difficult. Employment or household insecurity can reduce the learner's capacity to remain in an apprenticeship. Funding rules can reward large-group delivery over individual diagnosis. Platform design can determine whether interaction is reciprocal or one-directional. Credential competition can alter peer cooperation. GRE can reconstruct these mechanisms while leaving the educational adequacy of the relation open to domain-specific inquiry.

Proposition 23.229 (Learning-relation non-reduction)**.** *The economic accessibility, cost, or intensity of a learning relation should not be treated as sufficient evidence of its educational generativity unless educational inquiry also supports the mechanism through which participation in that relation changes later understanding, capability, judgment, or participation.*

This proposition also allows education to correct GRE. If educational inquiry shows that a relation GRE treated as a transferable service depends on developmental sequencing, tacit recognition, embodied practice, trust, or a community norm, the economic model may need to revise its unit of analysis. The relevant economic object can shift from an isolated instructional input toward a relation or institutional configuration whose continuity has economic consequences.

23.10.2 Capability Generation

Capability generation sharpens the boundary between education and resource transfer. GRE has repeatedly distinguished possession of a resource from the capability to mobilize it. Education makes this distinction especially visible because immediate performance can be produced through assistance, memorization, imitation, or highly specific support while later independent or adaptive capability remains weak.

Definition 23.230 (Educational capability-generation interface)**.** An *educational capability-generation interface* specifies the educational capability under investigation, the resources and relations through which it is expected to form, the learner's prior position, the forms of supported and unsupported performance observed, evidence of transfer or regeneration across changed conditions, the economic resources required for continuation, and the educational warrant for treating the observed change as capability rather than temporary performance.

The interface can incorporate capability-oriented economic analysis without reducing educational formation to later earnings or productivity. Sen's capability approach is relevant because it distinguishes resources from substantive opportunities to act, while GRE adds a temporal question about how those capabilities are generated and regenerated through relations (Sen 1999). Educational theory can then ask which practices, sequences, explanations, feedback forms, or curricular structures actually produce the relevant capability.

This distinction matters acutely under artificial assistance. A learner can complete a task with an AI system while remaining unable to verify the result, reconstruct the reasoning, transfer the method, or notice when the system fails. Chapter 19 described this as assistance-to-capability conversion. At the interface level, the economic question concerns access to assistance, its distribution, cost, dependency, and downstream capability consequences; the educational question concerns the constitution of learning under assisted conditions.

Proposition 23.231 (Capability-generation warrant)**.** *A GRE claim that an educational arrangement generates capability should distinguish resource receipt and supported performance from evidence of durable, transferable, or regenerable capacity, and should defer the educational constitution of that capacity to appropriate pedagogical or domain-specific warrant where necessary.*

The proposition prevents capability language from becoming a broad positive label for educational spending or attainment. It also creates a correction path. If later educational evidence shows that a supposedly durable capability depends on continuous hidden support, narrow task familiarity, or institutional recognition that does not travel across settings, GRE should revise the claimed option-space expansion or generative return.

23.10.3 Curiosity

Curiosity is economically conditioned but not well represented as a stable preference whose intensity can simply be observed and priced. Earlier chapters treated curiosity as part of the sequence through which encounters become questions and sustained inquiry. Education provides one of the principal environments in which that capacity

can be enlarged, narrowed, rewarded, redirected, or made costly.

Definition 23.232 (Curiosity-support interface profile)**.** A *curiosity-support interface profile* records the learner's opportunities for encounter and exploration, available discretionary time, material security, access to mentors, texts, tools, environments, and communities, institutional incentives and penalties for question formation, the range of questions treated as admissible, observed persistence of inquiry, and educational evidence concerning how curiosity is cultivated or inhibited.

GRE can analyze the distribution of conditions in this profile. Quiet space, language access, libraries, laboratories, field experience, mobility, mentorship, broadband, computational resources, and freedom from immediate insecurity are not evenly distributed. Examination systems and labor-market pressures can also alter the opportunity cost of open-ended inquiry. Veblen's discussion of "idle curiosity" remains useful as an early account of inquiry whose value is not exhausted by immediate utility (Veblen 1914). The present interface adds a distributional question: who can afford to sustain such inquiry, and through which educational arrangements does curiosity become a capability rather than a fleeting disposition?

Educational theory supplies a different warrant. It can investigate developmental timing, appropriate challenge, problem situations, intrinsic and extrinsic motivation, classroom climate, teacher response, disciplinary norms, and the relation between curiosity and understanding. Dewey's treatment of inquiry and problematic situations is relevant here because it connects learning with active reconstruction rather than passive reception (Dewey 1910). GRE can study the conditions under which such environments become materially available without presuming to derive the pedagogy from those conditions.

Proposition 23.233 (Curiosity non-instrumentality condition)**.** *GRE should not treat curiosity as educationally valuable only when a direct productivity, earnings, or innovation pathway is already identifiable; it may analyze the economic conditions that widen or restrict open-horizon inquiry while leaving the educational and intrinsic significance of curiosity partly outside economic valuation.*

The condition matters especially in rapidly changing knowledge environments. A question that appears economically peripheral at one moment can later become consequential, but uncertainty about future usefulness is not the only reason to preserve curiosity. The interface therefore protects a domain-specific remainder even while GRE studies the resource architecture that makes curiosity unequally possible.

23.10.4 Aesthetic Judgment

Aesthetic judgment enters the education interface through orientation. Learners and educators encounter more possible texts, models, examples, explanations, projects, styles, and generated artifacts than can be pursued equally. Judgment helps orient attention among alternatives, but the relevant judgments are neither reducible to truth conditions nor safely inferred from market demand or popularity.

Definition 23.234 (Educational aesthetic-judgment interface)**.** An *educational aesthetic-judgment interface* records the field of alternatives from which a learner or educator selects, the qualities perceived as elegant, fitting, coherent, striking, fertile,

or well formed, the educational task for which those qualities matter, the social and institutional conditions shaping exposure and recognition, later epistemic or practical consequences, and the boundary between aesthetic orientation and evidential warrant.

The interface builds on the distinction developed in Chapter 6: aesthetic judgment can orient inquiry without directly establishing truth. Kant's treatment of aesthetic judgment and Dewey's processual account of aesthetic experience provide contrasting resources for thinking about the structure of such judgment (Kant 1987; Dewey 1934). GRE's concern is narrower. Abundance, platform ranking, curricular time, institutional prestige, cost, and access can influence which forms and examples a learner encounters and which judgments are reinforced. These conditions can become economically unequal even when the educational meaning of the judgment cannot be reduced to an economic variable.

Aesthetic judgment is also field-specific. Elegance in a proof, explanatory economy in a theory, balance in a design, expressive adequacy in a performance, and coherence in an argument are not interchangeable properties. Educational inquiry is needed to determine how learners acquire the perceptual and evaluative capacities appropriate to a practice, how those capacities relate to standards and criticism, and when they should remain open to revision.

Proposition 23.235 (Aesthetic-orientation non-proxy)**.** *Neither market valuation, institutional prestige, popularity, nor immediate performance should be used as a general proxy for educationally relevant aesthetic judgment; GRE may study the economic conditions shaping exposure and selection while educational and aesthetic inquiry retain responsibility for the judgment's domain-specific formation and significance.*

This proposition anticipates the more explicit aesthetics interface developed later in Chapter 23. The educational interface is narrower: it asks how learners acquire orientation capacities within practices and how economic conditions shape the space in which those capacities can develop.

23.10.5 Epistemic Participation

Learning becomes more than private acquisition when learners enter practices in which they can ask questions, interpret evidence, contribute artifacts, receive criticism, revise claims, teach others, and participate in the reproduction of knowledge. Chapter 17 described epistemic participation as a relational economic object. The education interface asks when access to an epistemic setting becomes consequential participation and how educational formation changes the learner's position within it.

Definition 23.236 (Educational epistemic-participation profile)**.** An *educational epistemic-participation profile* records the practice or knowledge community entered, the learner's initial position, access and language conditions, opportunities to observe, question, contribute, verify, receive feedback, and exercise judgment, the distribution of recognition and responsibility, changes in capability and standing over time, and the economic and educational barriers affecting continued participation.

Participation can therefore differ from mere presence. Enrollment in a university, access to an online course, attendance at a laboratory, or membership in a professional platform does not establish that the learner has entered the epistemic relations through which capability and standing develop. Time, confidence, language, equipment, social recognition, disability access, mentoring, institutional status, and economic security can condition whether formal access becomes effective participation.

The distinction is particularly important where AI makes symbolic production cheap. A learner may generate polished text, code, images, or analyses without acquiring a stronger position in the epistemic process of problem formation, verification, critique, and responsibility. Conversely, AI can widen participation when it reduces language, explanation, or access barriers and supports learners in entering practices previously beyond reach. The interface should therefore track the learner's changing epistemic role rather than output volume alone.

Proposition 23.237 (Participation-conversion condition)**.** *Formal access to an educational or epistemic setting should be treated as stronger educational participation only when the learner acquires consequential opportunities to understand, question, contribute, receive correction, exercise judgment, and assume progressively meaningful roles within the relevant practice.*

Educational inquiry can return corrections here as well. If a participation measure based on attendance, platform activity, publication count, or credential acquisition fails to capture actual entry into a practice, GRE should revise the economic relation it associates with participation and avoid treating nominal activity as capability generation.

23.10.6 Educational Infrastructure

Educational infrastructure connects the economic and educational domains because it is materially costly, institutionally maintained, and often publicly financed, yet its educational value depends on use relations that cannot be inferred from provision alone. Buildings, teachers, libraries, laboratories, networks, archives, curricula, accessibility systems, platforms, translation resources, assessment systems, and AI tools can all function infrastructurally when they sustain recurrent learning across learners and cohorts.

Definition 23.238 (Educational-infrastructure interface record)**.** An *educational-infrastructure interface record* specifies an infrastructural component, its financing and maintenance, labor and governance requirements, intended learners and uses, accessibility and interoperability conditions, pedagogical functions, dependency and failure modes, replacement and repair pathways, temporal durability, and evidence that the infrastructure is educationally usable rather than merely nominally available.

The distinction between availability and usability is central. A broadband connection does not guarantee accessible content. A laboratory does not guarantee supervised entry into experimental practice. A library does not guarantee language access or the ability to navigate its classifications. A teacher position does not guarantee enough time for feedback. An AI platform does not guarantee verification capacity

or continuity if access terms change. Economic analysis can identify the resource and maintenance structure; educational inquiry can determine whether the configuration supports the intended learning processes.

Infrastructure also has temporal depth. Teacher formation, mentoring systems, archives, curriculum knowledge, technical maintenance, and institutional memory can be depleted while current performance remains superficially stable. Cost reduction that removes the very relations through which tacit knowledge or feedback is reproduced can therefore generate infrastructure debt. Conversely, automation or shared infrastructure can free resources for richer educational relations when the savings are actually converted into access, feedback, teacher support, or new learning pathways.

Proposition 23.239 (Educational-infrastructure usability condition)**.** *Educational infrastructure should be treated as effectively available only when relevant learners can enter, use, interpret, and continue relying on it under the conditions required by the educational process, with maintenance and repair sufficient to preserve the relation across the relevant horizon.*

The proposition brings educational correction into infrastructure economics. If a cost model treats teachers, mentors, or community practices as substitutable inputs but educational evidence shows that some carry non-substitutable developmental functions, the economic representation should change rather than treating the pedagogical remainder as noise.

23.10.7 Knowledge Communities

Knowledge communities provide the relational setting in which educational capability can become socially consequential. They preserve standards, practices, questions, language, memory, and opportunities for contribution. Learners can enter them gradually, and established participants can reproduce or close the pathways through which future members acquire standing.

Definition 23.240 (Knowledge-community education interface)**.** A *knowledge-community education interface* records the community or practice, entry pathways, mentorship and peer relations, infrastructures and shared resources, recognition rules, contribution opportunities, tacit and codified knowledge, reproduction responsibilities, exclusion mechanisms, economic conditions of participation, and the learner's changing position within the community over time.

This interface extends the communities-of-practice insight that learning involves changing participation in socially organized practice (Lave and Wenger 1991; Wenger 1998). GRE can study the economic architecture that supports or inhibits such communities: funding for mentorship, time for apprenticeship, career structures, geographical concentration, digital access, language barriers, precarious employment, ownership of shared infrastructure, and incentives affecting whether established members teach, document, or reproduce practice.

Community reproduction can fail despite strong individual output. A research group can publish extensively while weakening mentoring. A professional field can produce high earnings while narrowing entry pathways. A school can raise

test scores while exhausting teachers. A knowledge platform can increase content volume while concentrating moderation, verification, or archival control. The generative object is therefore not aggregate output alone but the capacity of the community to form future participants and revise its practices.

Proposition 23.241 (Knowledge-community reproduction condition)**.** *A knowledge community has stronger educational generativity when participation pathways, mentoring, standards, shared resources, criticism, and opportunities for contribution enable successive participants to acquire and revise the capabilities needed to sustain the practice without relying on hidden depletion of its relational or infrastructural base.*

Educational inquiry can correct GRE by revealing that the relevant unit is a community trajectory rather than an individual learner or organization. It can also expose tacit dependencies that are invisible in monetary flows. These findings should be allowed to revise economic assessments of educational productivity and return.

23.10.8 Economic Conditions of Education

The previous subsections identify educational objects that should not be reduced to economics. The interface nevertheless requires a positive account of what GRE contributes. Education depends on scarce time, labor, material resources, household conditions, public finance, organizational capacity, transport, housing, digital systems, language infrastructure, care, and the distribution of security. Economic relations also shape who can postpone earnings, relocate, undertake unpaid practice, access elite networks, purchase assistance, or absorb educational failure.

Definition 23.242 (Educational economic-condition profile)**.** An *economic-conditions-of-education profile* records the resources, income and security conditions, time budgets, household and care relations, teacher and staff labor conditions, institutional finance, geographic and digital access, opportunity costs, credential incentives, market and public provisioning, technological dependencies, and distributional asymmetries that shape entry into and persistence within an educational process.

The profile should be linked to conversion rather than treated as a list of inputs. Two learners receiving the same nominal scholarship can face different housing, care, disability, language, transport, legal, or household constraints. Two schools with similar budgets can differ in teacher turnover, institutional memory, community trust, or infrastructure quality. Two countries can expand enrollment while producing different capability trajectories because educational relations and institutional conditions differ. GRE's contribution is to reconstruct how resources and economic positions become, or fail to become, usable educational possibility.

Human-capital analysis remains relevant where education affects productivity, employment, and earnings (Becker 1964). The interface widens rather than rejects that analysis. Earnings are one economic consequence among several; educational arrangements can also alter future learning, mobility, participation, knowledge reproduction, institutional capacity, and the ability to reorient under technological or social change. These effects can have economic importance even when they are weakly represented by near-term wages.

Proposition 23.243 (Educational access–conversion distinction)**.** *Equal or expanded*

provision of educational resources should not be interpreted as equal educational opportunity unless the analysis also addresses the economic and relational conditions through which nominal access is converted into usable participation, capability, and future options.

This distinction makes educational inequality more than a resource-gap problem while preserving the economic relevance of resources. It also allows educational theory to return evidence that some conversion conditions have been misidentified. A GRE model can then revise its incidence analysis, capability profile, or estimate of generative educational return.

23.10.9 Limits of Economic Reduction

The education interface becomes most important where economic observables are informative but insufficient for the principal claim. Education can affect productivity, earnings, fiscal capacity, labor-market mobility, innovation, and institutional performance. Yet the educational significance of learning relations, curiosity, judgment, development, cultural transmission, play, identity, care, or entry into a practice cannot be established by those consequences alone.

Definition 23.244 (Economic-reduction signal in education)**.** An *economic-reduction signal in education* is present when a claim concerning educational quality, learning, development, curiosity, judgment, pedagogical adequacy, or educational purpose is inferred principally from resource expenditure, productivity, earnings, credential value, test-linked incentives, market demand, institutional revenue, or aggregate economic return without an independently warranted educational bridge.

Several recurrent reductions follow this pattern. Teaching can be represented as a labor input without identifying the relation through which learning occurs. Curiosity can be treated as a preference for information. Judgment can be proxied by performance on familiar tasks. A knowledge community can be represented as a production network without examining mentorship or practice reproduction. A school can be evaluated as an output-generating organization while its developmental, cultural, or relational functions remain invisible. These representations may answer bounded economic questions, but they become inadequate when used to settle educational ones.

Proposition 23.245 (Educational explanation handoff)**.** *When the principal explanatory or evaluative burden of an inquiry depends on specifically educational concepts whose content cannot be supplied by economic relations alone, the inquiry should move to educational theory, adopt joint GRE–education governance, or narrow its GRE claim to the economic conditions and consequences that GRE can warrant.*

A disciplined interface also requires correction in the reverse direction. Educational theory can show that GRE has misidentified the relevant learner, treated a developmental sequence as freely reorderable, mistaken assisted performance for capability, compressed participation into attendance, ignored tacit mentorship, or evaluated infrastructure without regard to pedagogical usability. Such findings can change the economic object itself.

Definition 23.246 (Education correction return)**.** An *education correction return* is

a documented finding from educational inquiry that requires GRE to revise an economic object, relation, capability claim, participation measure, infrastructure assessment, temporal horizon, community boundary, generative-return estimate, or scope claim because the prior economic formulation depended on an inadequate educational characterization.

The correction can work in the opposite direction as well. GRE can return evidence that an apparently pedagogical problem is being materially conditioned by time poverty, teacher precarity, unequal household resources, infrastructure ownership, credential incentives, platform dependence, or unequal access to knowledge communities. The interface is strongest when neither side treats these returns as secondary commentary.

Definition 23.247 (GRE–education interface portfolio)**.** A *GRE–education interface portfolio* is a versioned collection of learning-relation profiles, capability-generation interfaces, curiosity-support profiles, aesthetic-judgment interfaces, epistemic-participation profiles, infrastructure records, knowledge-community interfaces, economic-condition profiles, correction returns, non-equivalent concepts, and unresolved educational boundary questions maintained across projects.

The portfolio makes recurrent translation problems visible. It can show whether economic studies repeatedly treat provision as participation, whether capability claims are being inferred from supported performance, whether teacher labor is modeled without relational function, or whether educational return is being compressed into earnings despite evidence of longer-horizon capability and community effects.

Proposition 23.248 (GRE–education interface answerability)**.** *A GRE–education interface is answerable when the economic condition or consequence, the educational claim, the translation path, the evidential source, the domain-specific remainder, and the possible education correction return are explicit enough that contrary educational analysis can revise the GRE interpretation or reclassify the inquiry.*

This condition preserves a productive but bounded education interface. GRE can investigate how economic arrangements condition access to learning, capability generation, curiosity, epistemic participation, infrastructure, and knowledge communities, and how educational trajectories later reshape economic possibility. Generative Relational Education retains independent responsibility for the constitution of learning, pedagogical adequacy, developmental formation, educational judgment, and educational purpose. The next interface turns to ecology, where the boundary problem changes again because economic relations interact with ecological constraints, nonhuman subjects, resource flows, and values that can resist economic commensuration.

23.11 Generative Relational Ecology Interface

Chapter 19 treated ecology as a substantive economic domain in which material and energy flows, ecological constraints, stewardship institutions, commons, regenerative capacities, and intergenerational consequences enter the constitution of economic possibility. The present section has a different role. It specifies the

interface between GRE and a prospective Generative Relational Ecology programme without converting ecological inquiry into an enlarged branch of economics. Its objective is to identify which ecological relations GRE can investigate through economic dependence, incidence, allocation, conversion, circulation, maintenance, and future option structure; which claims require specifically ecological, biological, ethical, legal, or political warrant; and how ecological findings can return corrections to GRE. The section develops nine interfaces: human–environment relations, non-human subjects, ecological constraints, resource flows, social metabolism, stewardship, intergenerational relations, ecological value, and limits of economic commensuration. The method follows the containment and translation disciplines established in Sections 23.2–23.3. It also carries forward the multiscale discipline of Sections 23.4–23.5: ecological relations have histories, characteristic rates, spatial extents, and threshold-sensitive dynamics that need not coincide with economic accounting periods or institutional jurisdictions.

Definition 23.249 (GRE–ecology interface record)**.** A *GRE–ecology interface record* specifies the ecological configuration and economic positions under investigation, the human and non-human affected entities or processes, the material and energy flows involved, the biophysical constraints and uncertainties, the economic dependencies and incidence pathways, the stewardship or governance arrangements, the relevant temporal and spatial scales, the ecological claims requiring domain-specific warrant, the forms of value being represented or left non-commensurated, and the GRE claims that would require revision if the ecological characterization changes.

The record separates several questions that are often compressed into one environmental variable. What ecological process or relation is changing? Through which economic activities, infrastructures, institutions, or consumption patterns does that change become consequential? Which persons, organizations, communities, species, populations, or ecological processes are affected? Which of those affected positions count as subjects, rights-holders, represented interests, or objects of stewardship under the relevant ecological, ethical, legal, or political framework? Which effects are economically measurable, and which remain material even when no defensible common metric exists? These questions can interact strongly without sharing one source of warrant.

Proposition 23.250 (Ecological-domain handoff condition)**.** *A GRE inquiry should hand a material subquestion to ecological or neighboring domain inquiry when resolution of that subquestion depends principally on ecological function, species or ecosystem relations, non-human subjecthood, ecological integrity, conservation or restoration standards, moral or legal standing, or other domain-specific judgments that cannot be established from economic dependence, incidence, or valuation alone.*

The handoff does not make ecology external to economics. Economic activity can alter habitats, hydrology, soils, atmospheric conditions, species interactions, nutrient cycles, and regenerative capacities, while ecological change can reorganize livelihoods, infrastructure, health, productivity, migration, insurance, public finance, and future option sets. Ecological economics has long emphasized such coupled relations, thermodynamic irreversibility, and regeneration constraints (Costanza 1989; Georgescu-Roegen 1971; Daly 1990). The interface question is therefore not whether ecology matters economically, but how to preserve the difference between an eco-

Table 23.11: Principal operations at the GRE–ecology interface

Interface object	GRE contribution	Ecological-domain question	Return to GRE
Human–environment relations	Dependence, incidence, access, infrastructure, livelihood, spatial displacement	Which ecological relations and processes constitute the relevant configuration?	Revised economic boundary and dependency map
Non-human subjects	Affectedness, representation costs, economic incidence, stewardship relations	Which non-human entities are subjects, agents, represented interests, or ecologically significant relations?	Revised subject and affected-position architecture
Ecological constraints	Scarcity, exposure, adaptation capacity, economic conversion of limits	Which biophysical rates, thresholds, irreversibilities, and uncertainties constrain the system?	Revised feasible set, horizon, and risk structure
Resource flows	Extraction, throughput, transport, use, recirculation, waste, burden shifting	Which material–energy transformations and ecological sinks or sources are materially relevant?	Revised incidence and supply-chain boundaries
Social metabolism	Institutions, technologies, labor, infrastructures, throughput, distribution	How do coupled socio-ecological transformations persist or reorganize?	Revised process and reproduction model
Stewardship	Cost, labor, capability, authority resources, maintenance finance	What ecological knowledge, practices, and responsibilities constitute adequate stewardship?	Revised maintenance and generative-return claims
Intergenerational relations	Inheritance, option loss, delayed incidence, investment, discounting	Which ecological conditions and regenerative capacities are transmitted across generations?	Revised temporal horizon and future-option analysis
Ecological value	Economic manifestation, heterogeneous valuation, conversion and recognition regimes	Which ecological values or significances remain irreducible to economic valuation?	Revised value plurality and conversion boundaries
Commensuration limit	Economic comparison where warranted	Where does common scaling erase ecological relation, threshold, standing, or value?	Partial ordering, noncomparison, or domain handoff

nomic account of ecological consequence and an ecological account of the processes and values through which those consequences arise.

Table 23.11 summarizes the principal operations developed below.

23.11.1 Human–Environment Relations

Human–environment relations provide the first interface because the word *environment* can conceal the relations that make ecological conditions economically consequential. Water is not merely an external stock when its availability depends on a watershed, seasonal flow, upstream land use, treatment infrastructure, legal access, and maintenance institutions. Soil is not simply a productive input when fertility depends on biological activity, erosion, nutrient cycling, cropping practice, and historical land use. A coastal zone can simultaneously participate in livelihood, habitat, protection, transport, tourism, cultural meaning, and risk. GRE can trace the economic relations generated through these configurations, but it should not infer the ecological architecture from the economic manifestations alone.

Definition 23.251 (Human–ecological interface profile)**.** A *human–ecological interface profile* records the human positions and ecological entities or processes linked in a specified configuration, the forms of dependence and intervention, the spatial and temporal extent of the relation, the economic benefits and burdens, the infrastructures and institutions mediating the relation, the ecological processes whose characterization requires domain-specific evidence, and the boundary conditions under

which the relation changes.

The profile resists two opposite simplifications. The first treats ecological processes as an external background against which economic activity takes place. The second treats every ecological relation as already economically legible once a price, service value, or cost estimate has been assigned. Ecosystem-service valuation can make otherwise invisible dependencies salient (Costanza et al. 1997), but a valuation is a representation of specified benefits or losses, not an exhaustive description of the ecological relation. It can leave unrepresented ecological interactions, non-use significance, uncertainty, thresholds, or values whose relevance does not depend on willingness to pay.

Spatial displacement is equally important. The location of consumption, ownership, or accounting can differ substantially from the location of extraction, habitat change, pollution, water use, or ecological risk. A GRE analysis therefore needs to distinguish the economic site from the ecological footprint of the relation. This is especially important where distant communities, ecosystems, or future users bear burdens generated by present activity.

Proposition 23.252 (Ecological-boundary revision condition)**.** *When ecological inquiry shows that a process materially relevant to an economic claim extends beyond the spatial, temporal, organizational, or jurisdictional boundary used by GRE, the economic configuration should be revised rather than treating the omitted ecological relation as an external residual.*

This proposition makes ecology capable of correcting the economic object itself. A firm boundary, national boundary, project period, or household unit can remain useful for some questions while being inadequate for others. The interface is answerable when the boundary is chosen because it preserves the material relation needed for the claim, not merely because it matches the available accounts.

23.11.2 Non-Human Subjects

Non-human subjects create one of the sharpest limits on economic reduction. Economic activity can affect animals, species populations, forests, rivers, soils, microbial communities, habitats, and ecological processes even when those entities do not enter institutions as human decision-makers. Yet affectedness does not by itself settle whether an entity should be understood as a subject, agent, rights-holder, represented interest, ecological unit, moral patient, or object of stewardship. These classifications belong partly to ecological, ethical, legal, political, and cultural inquiry.

Definition 23.253 (Non-human affected-position record)**.** A *non-human affected-position record* specifies the non-human organism, population, ecological entity, or process under consideration, the economic activity or institution producing the relevant effect, the form and evidence of affectedness, the ecological relation in which the effect is situated, the representational mechanism through which the effect enters human decision-making, and the unresolved questions of subjecthood, agency, standing, or value that require external warrant.

The record allows GRE to remain analytically useful before a complete theory of non-human subjecthood is available. A fishery collapse, habitat fragmentation, river

contamination, pollinator decline, or soil degradation can have clear economic effects and can also matter ecologically in ways not exhausted by those effects. GRE can trace the distribution of costs, benefits, dependence, and stewardship obligations without declaring that market value determines the status of the affected entity.

Representation is a separate interface. Non-human ecological effects may enter institutions through scientific monitoring, ecological indicators, stewardship practice, legal representation, community knowledge, advocacy, or public administration. Such representation can be partial or contested. Institutional silence is therefore not evidence of ecological absence.

Proposition 23.254 (Affectedness–subjecthood non-equivalence)**.** *Evidence that a non-human entity or ecological process is materially affected by economic activity is sufficient to justify inclusion in an economic incidence analysis where the effect is economically consequential, but it is not sufficient by itself to establish ecological subjecthood, agency, moral standing, legal personality, or the normative weight of the affected relation.*

The proposition keeps several debates open while preventing GRE from excluding non-human effects merely because institutional standing is unresolved. Ecological inquiry can later return a correction showing that GRE selected the wrong unit, ignored a constitutive species relation, or treated an ecosystem-level process as a set of independent resource stocks. The economic model should then change accordingly.

23.11.3 Ecological Constraints

Ecological constraints differ from institutional constraints because some relevant limits operate independently of whether economic actors recognize them. Regeneration rates, hydrological availability, assimilative capacity, habitat requirements, thermodynamic irreversibility, climatic conditions, or threshold-sensitive ecological processes can restrict feasible trajectories even when no price or rule represents them adequately. At the same time, their economic incidence is mediated through institutions, infrastructure, technology, wealth, mobility, insurance, and public capacity.

Definition 23.255 (Ecological-constraint interface profile)**.** An *ecological-constraint interface profile* records the biophysical process or limit, its spatial and temporal scale, the ecological evidence supporting it, uncertainty and threshold conditions, the economic activities depending on or altering it, the conversion mechanisms through which the constraint becomes economically consequential, the affected economic positions, and the conditions under which the constraint profile requires revision.

The interface distinguishes a physical constraint from the economic scarcity that may follow from it. A water limitation can generate different economic consequences under different allocation rules, storage systems, crop choices, pricing arrangements, public infrastructures, or migration capabilities. Conversely, a low price can coexist with an ecologically critical dependency when institutions fail to represent depletion or threshold risk.

Threshold-sensitive dynamics require particular restraint. Resilience research has emphasized that persistence under disturbance is not the same as local stability around an equilibrium (Holling 1973). Earth-system research likewise illustrates

how interacting processes can generate rising risks beyond simple linear scarcity (Steffen et al. 2015). GRE can represent the economic consequences of such conditions, but the ecological threshold itself requires ecological evidence and should not be inferred from market response.

Proposition 23.256 (Constraint representation discipline)**.** *An ecological constraint should not be replaced by its economic manifestation when the ecological process has independent dynamics, uncertainty, thresholds, irreversibility, or cross-scale effects material to the claim; the economic representation should remain linked to the ecological evidence that defines the feasible or risky region.*

This condition is especially important for long-horizon policy. If a model updates only when scarcity becomes economically visible, it can respond after ecological deterioration has already narrowed the feasible set. Ecological information can therefore legitimately enter GRE before a fully realized price or income effect exists.

23.11.4 Resource Flows

Resource flows connect economic organization with material and energy transformation. Extraction, transport, processing, use, recirculation, waste, emissions, dissipation, and assimilation occur through physical pathways that can cross firms, households, jurisdictions, ecosystems, and generations. Monetary accounts can track some of these movements while obscuring others, particularly where ecological burdens are displaced spatially or temporally.

Definition 23.257 (Ecological resource-flow interface record)**.** An *ecological resource-flow interface record* specifies the material or energy entity, extraction or source relation, transformation stages, transport and storage, use, recirculation or substitution, residual and waste pathways, ecological sinks or accumulation points, institutional ownership or control positions, economic value flows, and ecological burdens that may occur outside the principal accounting boundary.

This record makes resource circulation different from value circulation. Material can leave one jurisdiction while monetary value remains elsewhere; waste can accumulate after the economic transaction is complete; recycling can recover material while requiring additional energy or creating new residuals; a substitution can reduce one ecological pressure while increasing another. The thermodynamic emphasis in ecological economics is relevant because economic transformation cannot be represented as costless reversible circulation (Georgescu-Roegen 1971).

Proposition 23.258 (Flow-incidence completeness condition)**.** *An economic evaluation of a resource-flow intervention is incomplete where materially relevant extraction, transformation, displacement, dissipation, accumulation, or ecological assimilation occurs outside the accounting boundary and could alter the incidence or long-horizon feasibility of the arrangement.*

The condition does not require every study to model the entire planetary lifecycle of every input. It requires proportional boundary expansion when omitted stages are material to the claim. Ecological inquiry can therefore return evidence that an apparently efficient economic transformation is burden shifting rather than net reduction, and GRE should revise its incidence and generative-return assessment.

23.11.5 Social Metabolism

Social metabolism provides a wider interface for studying recurring patterns of extraction, transformation, circulation, consumption, maintenance, and residual production. The term is useful when economic reproduction depends on continuing material and energy throughput organized by institutions, infrastructures, technologies, labor, settlement patterns, and cultural practices. It should not be interpreted as a claim that society is literally an organism. Its analytical value lies in connecting economic organization to recurrent physical transformations and the institutions that stabilize them.

Definition 23.259 (Social-metabolic interface profile)**.** A *social-metabolic interface profile* records a historically situated pattern of material and energy acquisition, transformation, distribution, use, maintenance, recirculation, and residual production together with the technologies, infrastructures, labor relations, institutions, spatial arrangements, and ecological dependencies that reproduce the pattern.

The profile allows GRE to ask why a throughput pattern persists even when alternative technologies exist. Sunk infrastructure, housing form, transport networks, property relations, industrial standards, consumer routines, supply-chain organization, employment dependence, and public revenue can make one material regime self-reinforcing. Ecological inquiry can simultaneously identify pressures or regenerative limits that the economic institutions do not represent.

Proposition 23.260 (Metabolic reproduction condition)**.** *A socially organized material–energy regime should be analyzed as a reproduced configuration when its continuation depends on mutually reinforcing economic institutions, infrastructures, practices, and ecological dependencies rather than on isolated resource choices alone.*

This proposition connects ecology with GRE's broader interest in generative and reproductive structures. A transition in social metabolism can therefore require more than substitution of one input. It may involve changes in infrastructure, employment, skills, finance, regulation, settlement, maintenance, and collective expectations. The ecological interface helps identify which physical relations must change; GRE can then analyze the economic conversion costs and distributional consequences of that change.

23.11.6 Stewardship

Stewardship concerns the relations through which ecological conditions are observed, maintained, restored, governed, and transmitted. Chapter 19 distinguished stewardship from ownership because legal title or economic control does not guarantee ecological knowledge, maintenance capacity, or long-horizon responsibility. The interface developed here asks which parts of stewardship GRE can analyze economically and which require ecological or governance warrant.

Definition 23.261 (Stewardship interface record)**.** A *stewardship interface record* specifies the ecological configuration to be maintained or restored, the persons and institutions performing stewardship, the ecological knowledge and practices involved, the labor, time, resources, authority, monitoring, and succession conditions,

the economic burdens and benefits, the distribution of control and responsibility, and the ecological and governance questions that remain outside GRE's independent warrant.

Economic analysis can identify whether stewardship labor is compensated, whether maintenance funding is durable, whether incentives favor short-horizon extraction, whether local knowledge holders bear uncompensated costs, whether property or contracting structures fragment responsibility, and whether restoration benefits are captured elsewhere. Yet ecological adequacy depends on the actual system being stewarded. A financially sustainable programme can still be ecologically ineffective; an ecologically effective practice can remain institutionally or distributively unjust.

Proposition 23.262 (Stewardship non-equivalence)**.** *Ownership, control, payment, or formal responsibility should not be treated as sufficient evidence of ecological stewardship; stewardship requires domain-specific evidence that the relevant ecological relations are being observed, maintained, restored, or adaptively managed through adequate knowledge and practice.*

The proposition also prevents the opposite reduction. Ecological effectiveness does not by itself settle questions of authority, participation, legal duty, or distributive justice. Those questions may require GRG, GR-Law, political theory, or ethics. The ecology interface therefore often becomes a multi-domain junction rather than a bilateral exchange between GRE and ecology alone.

23.11.7 Intergenerational Relations

Ecological relations often persist beyond the horizon of present contracts, projects, budgets, or lifetimes. Depletion, contamination, habitat fragmentation, infrastructure lock-in, restoration, soil formation, climate processes, and institutional learning can transfer conditions to people who did not participate in the original decision. Intergenerational analysis therefore requires more than extending a conventional cost stream farther into the future.

Definition 23.263 (Ecological intergenerational interface profile)**.** An *ecological intergenerational interface profile* records the ecological conditions, infrastructures, institutions, knowledge, burdens, regenerative capacities, and option structures transmitted from one temporal cohort to later cohorts; the mechanisms of transmission; uncertainty and irreversibility; the economic valuation or discounting conventions used; and the domain-specific ecological or normative questions that cannot be settled by present economic preferences alone.

The profile distinguishes future economic incidence from the normative standing of future persons or non-human life. GRE can estimate delayed costs, adaptation burdens, investment needs, productivity effects, insurance exposure, or lost options. It can also examine how present institutions privilege short-horizon claims. But it cannot derive the correct intergenerational obligation simply from a discount rate or projected willingness to pay.

Proposition 23.264 (Future-option preservation distinction)**.** *Preservation of future ecological and economic option structures should be analyzed separately from max-*

imization of a present-valued aggregate whenever irreversible or threshold-sensitive ecological change can remove options whose later significance cannot be adequately represented by present preferences or prices.

This proposition does not prescribe one rule of conservation. It requires that irreversible narrowing of future possibility remain visible as its own analytical consequence. Ecological inquiry can return information about regenerative capacity or threshold risk; political, legal, or ethical inquiry can address obligations and standing; GRE can analyze how alternative arrangements distribute the costs of preserving or losing future options.

23.11.8 Ecological Value

Ecological value is an interface because the same ecological configuration can matter through several non-equivalent relations. It can support livelihood, habitat, cultural identity, subsistence, recreation, scientific knowledge, resilience, sacred meaning, existence value, species continuity, or future ecological possibility. Some of these relations can be economically manifested; others can enter policy through ecological, cultural, legal, ethical, or political judgment.

Definition 23.265 (Ecological value interface profile)**.** An *ecological value interface profile* records the ecological entity or relation being evaluated, the persons or non-human positions to whom or through which it matters, the distinct value forms and manifestations identified, the recognition and measurement practices used, any conversion or aggregation rule, the uncertainty and exclusions introduced by that rule, and the value remainders that retain ecological or other domain-specific significance outside the economic metric.

GRE's heterogeneous-value architecture is useful here because it does not require every value to become one substance before comparison. Monetary valuation can be informative for particular decisions, especially when it reveals dependencies or opportunity costs that institutions otherwise ignore. Yet a price may express one manifestation without exhausting the ecological relation. Likewise, biological indicators can represent ecological function without determining economic or moral priority.

Proposition 23.266 (Ecological value non-exhaustion)**.** *An economic valuation of an ecological relation should be treated as exhaustive only where the research task, affected positions, value forms, and conversion assumptions justify that interpretation; otherwise the valuation remains one manifestation within a heterogeneous value architecture and material ecological remainders should remain explicit.*

The proposition preserves both comparability and restraint. It allows economic valuation where it is useful without turning non-monetized significance into zero value. It also permits ecological inquiry to return a correction when the economic representation omits a function, relation, threshold, or subject position material to the decision.

23.11.9 Limits of Economic Commensuration

The final interface concerns the limits of making heterogeneous ecological consequences commensurable. Commensuration can support budgeting, compensation,

prioritization, cost comparison, or policy design. It can also erase differences among reversible and irreversible effects, local and systemic processes, human and non-human affectedness, thresholds and marginal changes, or values whose significance depends on relations rather than quantity alone.

Definition 23.267 (Ecological commensuration contract)**.** An *ecological commensuration contract* states the ecological and economic objects being compared, the common scale or conversion rule, the decision task for which the comparison is intended, the assumptions needed for comparability, the affected positions included, the temporal and spatial horizon, the ecological thresholds or non-substitutable conditions preserved outside the scale, and the circumstances under which the common metric should be suspended.

The contract makes commensuration task-relative. A monetary comparison can be appropriate for estimating compensation costs without being adequate for determining whether habitat loss is ecologically substitutable. A carbon-equivalent metric can assist emissions accounting while leaving biodiversity, toxicity, water, or place-specific relations outside its scope. A composite sustainability index can summarize selected dimensions while concealing threshold effects or unequal incidence. The analytical problem is therefore not whether commensuration is permitted in the abstract, but what claim a particular commensuration can support.

Definition 23.268 (Ecological non-commensuration remainder)**.** An *ecological non-commensuration remainder* is a materially relevant ecological relation, threshold, subject position, uncertainty, value form, spatial specificity, temporal irreversibility, or regenerative condition that is not preserved by the adopted common metric and therefore remains separately visible in the analysis.

Proposition 23.269 (Ecological commensuration stopping condition)**.** *Economic commensuration should stop short of a totalizing common metric when further aggregation would erase a material ecological threshold, non-substitutable relation, unresolved subject or standing question, irreversible loss, or domain-specific value necessary for the decision or claim under investigation.*

This stopping condition does not require universal incommensurability. It supports partial orderings, vector evaluations, threshold constraints, scenario comparisons, and domain-specific judgments where a single scalar would overstate comparability. It also keeps disagreement traceable: two parties may agree on the economic cost while disagreeing on ecological substitutability, standing, or value.

Definition 23.270 (Ecology correction return)**.** An *ecology correction return* is a documented finding from ecological inquiry that requires GRE to revise an economic boundary, subject or affected-position classification, constraint profile, resource-flow map, metabolic process model, stewardship assessment, temporal horizon, value representation, or commensuration rule because the prior economic formulation depended on an inadequate ecological characterization.

The correction can also move in the opposite direction. GRE can return evidence that an ecological intervention is being undermined by livelihood dependence, financing structure, insecure tenure, supply-chain incentives, unequal adaptation capacity, maintenance underinvestment, or concentration of decision-making power. The interface is strongest when such returns change the receiving domain's model

rather than appearing as ancillary commentary.

Definition 23.271 (GRE–ecology interface portfolio)**.** A *GRE–ecology interface portfolio* is a versioned collection of human–ecological profiles and non-human affected-position records. It also preserves ecological-constraint profiles, resource-flow records, social-metabolic profiles, stewardship records, intergenerational profiles, ecological value profiles, commensuration contracts, non-commensuration remainders, correction returns, and unresolved boundary questions across projects.

Proposition 23.272 (GRE–ecology interface answerability)**.** *A GRE–ecology interface is answerable when the ecological process, economic relation, affected positions, spatial and temporal scales, ecological evidence, economic consequence, value representation, non-commensurated remainder, and possible ecology correction return are explicit enough that contrary ecological analysis can revise the GRE interpretation or reclassify the inquiry.*

This condition preserves a productive but bounded ecological interface. GRE can investigate how ecological dependence, resource flows, constraints, stewardship arrangements, and inherited ecological conditions shape economic possibility, and how economic organization feeds back into ecological trajectories. Generative Relational Ecology retains independent responsibility for ecological constitution, ecosystem- and species-specific relations, non-human subjecthood where relevant, ecological integrity, regenerative standards, and forms of ecological significance that do not derive their warrant from economic commensuration. The next interface turns to artificial intelligence, where the boundary problem shifts from human–ecological relations toward artificial agency, heterogeneous subjecthood, capability and epistemic asymmetries, institutional mediation, and the limits of GRE's economic scope.

23.12 Artificial Intelligence Studies Interface

Chapter 18 developed artificial intelligence as a substantive object of GRE through productive capacity, radical capability asymmetry, power conversion, labor, ownership, surplus, dependence, epistemic mediation, participation, heterogeneous subjects, and long-horizon institutional transformation. Chapter 22 then translated that architecture into a research programme. The present section has a different role. It specifies the interface between GRE and the wider field of artificial-intelligence studies without treating technical capability, artificial agency, subjecthood, institutional mediation, or normative status as questions that economics can settle by itself. Its objective is to identify which AI-related questions GRE can answer through economic relations, capabilities, dependence, allocation, value, power, participation, and institutional consequences; which questions require computer science, cognitive science, philosophy, law, political theory, education, sociology, ethics, or other domain-specific warrants; and how findings from those domains can return corrections to GRE. The section develops nine interfaces: artificial agency, heterogeneous subjecthood, capability asymmetry, epistemic asymmetry, dependence, human participation, AI-mediated institutions, economic and non-economic AI questions, and the limits of GRE scope. The method follows the containment and translation disci-

plines established in Sections 23.2–23.3. It also preserves the distinction, established throughout Part VII, between an economically consequential position and a complete ontology of the entity occupying that position.

Definition 23.273 (GRE–AI studies interface record)**.** A *GRE–AI studies interface record* specifies the artificial system, model, toolchain, infrastructure, organization, and human or collective positions under investigation; the technically and institutionally available capabilities; the economic tasks and relations in which those capabilities are realized; the ownership, access, authorization, verification, and dependency conditions; the affected participation pathways; the AI-related claims that require non-economic warrant; the relevant uncertainties and version changes; and the GRE claims that would require revision if the technical, epistemic, institutional, or subjecthood characterization changes.

The record prevents the term *AI* from functioning as an undifferentiated causal variable. A foundation model, a specialized classifier, a recommender system, an autonomous toolchain, an embedded decision aid, and an institutionally delegated software agent can occupy very different economic positions even where they share components. Their significance can also change as interfaces, data access, compute, legal permissions, organizational workflows, or human verification practices change. GRE therefore needs a declared configuration before it can analyze incidence, productivity, bargaining, dependence, participation, or future option structure.

Proposition 23.274 (AI-domain handoff condition)**.** *A GRE inquiry should hand a material AI subquestion to the relevant neighboring domain when resolution of that subquestion depends principally on technical capability, model architecture, robustness or safety, cognition, consciousness, subjecthood, moral standing, legal status, political legitimacy, pedagogical adequacy, or another domain-specific judgment that cannot be established from economic realization and consequence alone.*

The handoff is not a withdrawal from AI research. Economic organization shapes which systems are built, deployed, maintained, trusted, financed, governed, and made available; AI systems in turn can alter production, knowledge, labor, access, coordination, representation, and institutional decision. The interface question is therefore how to preserve these coupled relations without allowing economic consequence to substitute for the independent warrants required by other AI questions.

Table 23.12 summarizes the principal operations developed below.

23.12.1 Artificial Agency

Artificial agency is the first interface because an AI system can initiate or transform economically consequential operations without thereby settling what kind of agent it is in a broader philosophical, cognitive, legal, or moral sense. A software system can select bids, rank applicants, execute trades, schedule workers, generate contractual language, call external tools, adjust prices, or trigger workflow transitions. These operations can change access, cost, timing, risk, and bargaining position. GRE needs to represent such functional participation because leaving it invisible would misdescribe the economic process. Yet functional participation does not by itself establish consciousness, intention, autonomous authorship, legal personality, moral responsibility, or independent standing.

Table 23.12: Principal operations at the GRE–AI studies interface

Interface object	GRE contribution	AI-studies question	Return to GRE
Artificial agency	Delegation, economic action, authority chain, incidence, accountability costs	What operation is genuinely attributable to the system, its operators, or the wider sociotechnical configuration?	Revised agency and responsibility map
Heterogeneous subjecthood	Economic affectedness, participation, value incidence, relational position	What kind of subjecthood, if any, is warranted, and by which ontology or evidence?	Revised subject and standing architecture
Capability asymmetry	Practical realization, complements, access, substitutability, distribution	What technical capacities exist under specified conditions, and how robustly?	Revised capability comparison and feasible-set analysis
Epistemic asymmetry	Information access, verification cost, decision dependence, knowledge conversion	What epistemic functions are performed reliably, and with which uncertainty or failure modes?	Revised epistemic-dependence and authority claims
Dependence	Switching, fallback, lock-in, continuity, bargaining, capability erosion	Which technical and organizational dependencies are intrinsic, contingent, or reversible?	Revised dependency and power-conversion analysis
Human participation	Economic standing, task allocation, influence, future capability, option preservation	Which human contributions remain epistemically, institutionally, socially, or normatively constitutive?	Revised participation and generative-option architecture
AI-mediated institutions	Classification, ranking, allocation, monitoring, workflow, decision mediation	How does technical mediation alter institutional procedure, representation, and accountability?	Revised institutional boundary and mechanism model
Question allocation	Economic incidence and economic mechanism	Which questions belong principally to technical, legal, political, ethical, educational, or other domains?	Revised project governance and handoff structure
Scope limit	Explicit economic claim boundary	Which stronger AI claims exceed GRE warrant?	Contraction, reclassification, or joint inquiry

Definition 23.275 (Artificial economic-agency interface profile)**.** An *artificial economic-agency interface profile* records the operation performed, the artificial component involved, the degree and scope of delegated discretion, the human or organizational objective-setting and authorization structure, the data and tools available to the system, the verification and override conditions, the legal and institutional bearer of consequences, the affected economic positions, and the broader agency claims that remain outside the economic description.

This profile treats agency as typed. The relevant economic question can be whether the artificial component selects among economically consequential alternatives within a delegated action space. A different question asks whether the system understands the action, forms intentions, possesses consciousness, or can bear duties. Those questions can be related, but they are not answered by the same evidence. The profile therefore records the operational contribution without using one vocabulary of agency to settle every domain at once.

Proposition 23.276 (Functional-agency non-equivalence)**.** *Evidence that an artificial system performs delegated or semi-autonomous economic operations is sufficient to justify analysis of functional economic agency only within the stated operation and authority structure; it is insufficient by itself to establish general agency, subjecthood, consciousness, moral responsibility, or legal personality.*

The proposition also improves accountability analysis. When an AI-mediated action fails, a single label such as “the AI decided” can obscure the relations that pro-

duced the outcome. Model developers, deployers, data providers, interface designers, managers, users, and institutional rules can occupy different positions in the causal and authority chain. GRE can trace the costs, dependencies, incentives, and incidence produced by that chain. Legal, ethical, and technical inquiry can separately determine attribution and responsibility under their own standards.

Definition 23.277 (Delegated-operation responsibility map)**.** A *delegated-operation responsibility map* identifies the technical component executing an operation, the positions setting objectives and constraints, the positions supplying data and infrastructure, the positions authorized to approve, override, or contest the result, the positions bearing economic gains and losses, and the unresolved legal, moral, or political responsibility questions requiring domain-specific determination.

23.12.2 Heterogeneous Subjecthood

Heterogeneous subjecthood becomes an interface when economic analysis includes humans, organizations, collectives, artificial systems, and other affected positions without presuming that all occupy the same ontological or normative category. GRE already uses relationally situated subjects and affected positions because economic incidence can fall on entities whose capacities, rights, or values differ. AI intensifies this issue. A system can influence decisions, generate representations, maintain interaction histories, or participate in production while its subject status remains contested or undefined.

Definition 23.278 (AI subjecthood interface record)**.** An *AI subjecthood interface record* distinguishes the artificial system's functional economic position, relational persistence, capacity to initiate or respond within specified operations, representation by human or organizational actors, legal status, claimed or hypothesized cognitive properties, proposed moral or political standing, and the evidence or argument supporting each status separately.

The record allows GRE to remain operationally complete while ontologically restrained. Economic analysis may need to record that a model participates in a bargaining process or that users form durable relations with an artificial interface. Neither observation requires GRE to declare that the system is a subject in every relevant sense. Conversely, if independent inquiry were later to establish forms of artificial subjecthood or standing, GRE would need to revise its incidence, participation, ownership, or exploitation architecture accordingly.

Proposition 23.279 (Subject-status separation)**.** *Functional economic participation, relational persistence, legal personality, moral standing, phenomenological subjecthood, and political membership should remain separately warranted statuses unless an explicit cross-domain argument establishes a valid relation among them.*

This separation is also important for human participants. Treating a human worker and an artificial system as two "agents" inside one optimization model can be useful for a narrow simulation, yet the representation may omit legal rights, vulnerability, embodiment, dependence, care relations, historical membership, or subjective continuity that are material to the economic question. Formal symmetry therefore should not be confused with ontological or normative symmetry.

Definition 23.280 (Heterogeneous-subject translation remainder)**.** A *heterogeneous-subject translation remainder* is a material difference in embodiment, cognition, continuity, vulnerability, legal status, social membership, moral standing, institutional role, or value relation that is not preserved when human, artificial, organizational, or collective positions are represented through a common economic agent vocabulary.

23.12.3 Capability Asymmetry

Capability asymmetry provides a direct connection to Chapter 18, but the interface question differs from the substantive economic analysis undertaken there. GRE asks how technical differences become practically realizable economic capacities through access, complements, verification, institutions, cost, and control. AI studies can return corrections concerning what the system actually can do, under what conditions, with what reliability, and how rapidly those conditions are changing. The economic comparison is therefore downstream of a technical characterization without being reducible to it.

Definition 23.281 (AI capability interface profile)**.** An *AI capability interface profile* records the technical operation or benchmark, the system and version tested, evaluation conditions, uncertainty and failure modes, access and infrastructure requirements, human or organizational complements, economic workflow in which the capability is realized, substitutability and fallback conditions, persistence over time, and the economic consequences attributed to the capability difference.

This profile prevents benchmark performance from functioning as an economy-wide proxy. A model can exceed a human comparison group on one technical measure while remaining economically weak where verification is expensive, integration is poor, data are inaccessible, physical execution is required, or institutional authorization remains human-controlled. The reverse can also occur: a modest technical capability can become economically powerful when embedded in a high-frequency workflow with privileged access to data, distribution, or decision channels.

Proposition 23.282 (Technical-to-economic capability condition)**.** *A technical AI capability should enter a GRE capability claim only when the research design identifies the conditions through which that capability becomes practically available in the economic configuration and distinguishes the technical performance from the complementary resources, permissions, institutions, and verification practices required for realization.*

Capability asymmetry also changes historically. Model updates, declining compute cost, new interfaces, regulation, open-source diffusion, organizational learning, or newly discovered failure modes can expand or contract the relevant asymmetry. Static comparison therefore has limited value for long-horizon claims.

Definition 23.283 (Capability-correction return)**.** A *capability-correction return* is a documented technical or AI-studies finding that requires GRE to revise a capability comparison, feasible action set, substitutability assumption, workflow model, temporal horizon, or concentration claim because the prior economic analysis depended on an inaccurate or obsolete characterization of artificial capability.

23.12.4 Epistemic Asymmetry

Epistemic asymmetry concerns differences in the ability to retrieve, generate, organize, interpret, verify, and mobilize information or knowledge that matters for consequential action. Chapter 17 treated AI within the epistemic economy, and Chapter 18 examined epistemic dependence. The present interface adds a containment question: which part of an observed epistemic advantage is an economic position, and which part requires technical or epistemological analysis of reliability, provenance, uncertainty, representation, or reasoning?

Definition 23.284 (AI epistemic-asymmetry interface profile)**.** An *AI epistemic-asymmetry interface profile* records the epistemic operation, the human and artificial positions compared, the information and tools available to each, the provenance and verification conditions, error and uncertainty characteristics, access and cost structure, institutional authority attached to the output, the downstream economic decision or capability affected, and the epistemic claims requiring non-economic warrant.

A large volume of generated text does not establish superior knowledge. High retrieval speed does not establish reliable interpretation. Accurate prediction in one environment does not establish epistemic authority outside its domain. GRE can study who bears verification costs, who controls access, how outputs alter bargaining or decision capacity, and where institutions delegate authority. Epistemology and AI evaluation remain responsible for stronger claims about truth-tracking, justification, robustness, or reasoning quality.

Proposition 23.285 (Epistemic-conversion condition)**.** *An AI-mediated epistemic difference should be treated as an economically consequential asymmetry only when a traceable pathway connects the epistemic operation to altered decision quality, timing, access, bargaining, productive capability, institutional authority, or future economic possibility under stated verification and uncertainty conditions.*

This condition protects against two symmetric errors. One is to treat every improvement in information processing as economic transformation. The other is to ignore economic consequences until complete epistemological certainty is available. The interface allows graded claims: a system can alter verification cost or decision timing even when the truth status of some outputs remains uncertain, provided the economic mechanism is documented.

Definition 23.286 (Epistemic-authority remainder)**.** An *epistemic-authority remainder* is the part of an AI-mediated authority claim that depends on justification, expertise, reliability, provenance, interpretability, or institutional trust and therefore cannot be inferred solely from economic adoption, usage, market success, or decision impact.

23.12.5 Dependence

Dependence becomes economically important when access to AI-mediated capacity conditions the ability of a person, organization, or institution to perform consequential operations or maintain future alternatives. Yet dependence is heterogeneous. Technical dependence on a model can differ from dependence on compute, data, a

platform, an interface, proprietary formats, organizational permissions, or a small set of verification practices. Cognitive or skill dependence can also emerge when repeated assistance changes what human participants can do without the system.

Definition 23.287 (AI dependence interface profile)**.** An *AI dependence interface profile* records the function for which reliance exists, the technical and institutional layer on which it rests, the availability and cost of substitution, portability of data and workflows, fallback capacity, verification and maintenance requirements, contractual or access conditions, skill or knowledge changes associated with repeated use, and the economic consequences of interruption, degradation, or altered terms.

The profile distinguishes reliance from stronger dependency. Using an AI system because it is convenient is different from reorganizing production so deeply around it that removal becomes costly or impossible. Dependence can also be beneficial in one sense while increasing vulnerability in another. A public institution may gain speed and consistency through a system while becoming dependent on an external provider for updates, audit access, or specialized knowledge.

Proposition 23.288 (Dependency-conversion condition)**.** *AI reliance warrants a stronger GRE dependency claim when loss, degradation, or unilateral alteration of the relevant AI-mediated capability would materially contract the position's feasible operations or future alternatives and when switching, fallback, or endogenous replacement is sufficiently costly, delayed, or uncertain over the stated horizon.*

Dependence can convert capability asymmetry into power, but the conversion is not automatic. A powerful provider may have little leverage where interoperability is high and switching is easy. A technically modest platform can become power-relevant where institutional workflows, data histories, or legal permissions make exit difficult. GRE should therefore analyze the relation rather than infer power directly from technical superiority.

Definition 23.289 (AI dependency correction return)**.** An *AI dependency correction return* is a finding from technical, organizational, or other neighboring inquiry that requires GRE to revise a dependency or power claim because fallback, interoperability, portability, hidden complementarity, skill retention, or infrastructure substitutability differs materially from the economic model previously assumed.

23.12.6 Human Participation

Human participation is an interface because preserving a human presence in a workflow does not establish consequential participation. A person can remain nominally "in the loop" while possessing little capacity to frame the problem, inspect evidence, challenge outputs, change objectives, revise procedures, or refuse deployment. Conversely, AI assistance can expand human participation when it lowers technical barriers, improves access to information, or creates new forms of expression and coordination.

Definition 23.290 (Human participation interface profile)**.** A *human participation interface profile* records the human positions present in an AI-mediated process, the decisions and stages at which they can intervene, access to relevant information and alternatives, capacity to verify and contest outputs, authority to revise goals or pro-

cedures, ability to refuse or exit, opportunities to learn and retain independent capability, and the social, educational, legal, or political meanings of participation that remain outside the economic measure.

The profile allows GRE to distinguish employment retention from participation, and task presence from influence. Human participation can matter economically through error correction, trust, adaptation, local knowledge, innovation, care, legitimacy-sensitive demand, and future skill formation. It can also matter beyond economics through dignity, citizenship, authorship, education, social membership, or meaning. The interface should preserve both kinds of significance without using one to stand in for the other.

Proposition 23.291 (Consequential-participation condition)**.** *A claim that human participation is preserved in an AI-mediated economic process should identify at least one consequential channel through which human participants can affect problem framing, evidence, goals, verification, revision, institutional rules, or future alternatives; residual presence or ceremonial approval alone is insufficient.*

Participation also has a generative dimension. A workflow can produce high output while gradually weakening the participants' ability to understand, revise, or recreate the process. GRE should therefore distinguish immediate productivity from preservation of later independent or collective capacity.

Definition 23.292 (Participation-capability retention record)**.** A *participation-capability retention record* tracks how repeated AI mediation changes human capacities for independent performance, verification, problem formation, judgment, collaboration, institutional revision, and alternative generation over time, together with the economic and non-economic consequences of those changes.

23.12.7 AI-Mediated Institutions

Institutions become AI-mediated when artificial systems participate materially in classification, ranking, allocation, monitoring, prediction, communication, workflow coordination, eligibility determination, or decision support. The institution is not replaced by the model. Rules, authority, budgets, legal mandates, professional practices, data infrastructures, organizational routines, and appeal procedures remain part of the configuration. AI mediation can nevertheless change how those institutional elements operate and which positions become visible or influential.

Definition 23.293 (AI-mediated institution record)**.** An *AI-mediated institution record* specifies the institutional function being mediated, the artificial system and version, the rules and objectives supplied to it, the data and classifications it uses, the human and organizational positions that authorize or rely on its outputs, the affected allocation or participation pathways, the audit and contestation channels, the economic incidence, and the legal, political, technical, or ethical questions requiring separate warrant.

The record treats institutional mediation as relational. A ranking system can alter resource allocation even where final decisions remain formally human. A recommendation system can reorganize attention and opportunity without possessing authority in a legal sense. A predictive system can change how staff allocate scrutiny, thereby

changing the data later used to retrain the system. Institutions and AI systems can therefore co-produce trajectories through feedback.

Proposition 23.294 (Institutional-mediation non-equivalence)**.** *The presence of AI mediation in an institutional process does not by itself establish transfer of institutional authority, legal responsibility, political legitimacy, or normative accountability to the artificial system; each transfer claim requires independent evidence about the relevant rule, practice, and domain-specific status.*

This proposition is especially important where organizations describe decisions as "automated." Automation can redistribute practical control while formal authority remains elsewhere. GRE can analyze incidence, incentives, labor reorganization, access, dependency, and economic power. Legal and political inquiry can determine whether authority or responsibility has shifted under the relevant standards.

Definition 23.295 (Institutional AI feedback profile)**.** An *institutional AI feedback profile* records how AI-mediated classifications or decisions alter later behavior, data generation, organizational routines, resource allocation, participation, and retraining or model-update conditions, including the mechanisms through which the institution and system become mutually conditioning over time.

23.12.8 Economic and Non-Economic AI Questions

The eighth interface makes question allocation explicit. AI-related research often combines technical, economic, epistemic, legal, political, educational, ethical, and ontological questions in one discussion. Their interaction is real, but interaction does not erase disciplinary responsibility. A technically accurate model can be economically undesirable. An economically productive deployment can be legally invalid or politically illegitimate. A safe and profitable system can still raise unresolved questions about education, labor meaning, subjecthood, or moral standing. Conversely, a philosophically interesting question about artificial consciousness may have limited relevance to a specified economic mechanism.

Definition 23.296 (AI question-allocation record)**.** An *AI question-allocation record* decomposes a research problem into technical, economic, epistemic, legal, political, educational, social, ethical, ontological, or other domain-specific subquestions; identifies the evidence and warrant required by each; records their dependencies; and specifies where joint inquiry, sequential handoff, or non-translation is required.

The record does not require every project to involve every domain. Its function is to prevent one domain from answering another domain's question by proxy. Market adoption cannot establish technical safety. Benchmark superiority cannot establish legal authority. Economic efficiency cannot establish justice. Human preference surveys cannot settle artificial consciousness. Likewise, the absence of a settled theory of consciousness need not prevent economic analysis of an AI-mediated workflow where the relevant incidence does not depend on that question.

Proposition 23.297 (Question-separation with dependency)**.** *AI-related questions should remain separately warranted even when their answers are mutually conditioning; a downstream GRE claim may depend on a technical, legal, political, educational, ethical, or ontological premise, but that dependence should be recorded rather than*

converted into economic evidence for the premise itself.

This principle supports efficient interdisciplinary inquiry. If an economic claim changes materially depending on whether a system is robust to adversarial inputs, the technical premise can be handed to AI evaluation. If a labor-incidence result changes depending on whether a worker has a legally protected right to explanation or appeal, the legal premise can be handed to GR-Law. If a participation claim depends on whether meaningful consent is possible under an institutional power structure, political or ethical inquiry may be required. The interface thereby converts interdisciplinarity from thematic breadth into a traceable dependency architecture.

Definition 23.298 (AI interface dependency graph)**.** An *AI interface dependency graph* is a versioned representation of the cross-domain premises on which an AI-related GRE claim depends, the domain responsible for each premise, the evidential state of that premise, and the GRE conclusions that would require revision if the premise changes.

23.12.9 Limits of GRE Scope

The final interface concerns the limits of GRE scope. Artificial intelligence is economically consequential enough that economics cannot treat it as merely external technology. Yet economic relevance does not authorize GRE to become a general theory of AI. The strongest boundary discipline is therefore to state which conclusions GRE can support and which remain conditional on other domains.

Definition 23.299 (GRE AI-scope boundary)**.** The *GRE AI-scope boundary* distinguishes claims concerning economic capability realization, allocation, value, production, labor, ownership, dependence, power conversion, participation, institutional mediation, and future economic options from claims concerning technical safety, cognition, consciousness, subjecthood, moral standing, legal personality, political legitimacy, pedagogical adequacy, or other non-economic statuses whose warrant lies principally outside GRE.

The boundary is revisable rather than fixed. A new technical result can change what counts as substitutable capability. A new legal classification can change ownership, liability, or access. A political institution can alter authority over model deployment. Educational research can show that a productive AI workflow weakens or strengthens later human capability. Ethical or philosophical inquiry can alter the set of positions whose interests must be represented. Each correction can legitimately change GRE without requiring GRE to internalize the entire neighboring discipline.

Definition 23.300 (AI studies correction return)**.** An *AI studies correction return* is a documented finding from technical, epistemic, legal, political, educational, social, ethical, philosophical, or other AI-related inquiry that requires GRE to revise an artificial-agency classification, subject architecture, capability comparison, epistemic-asymmetry claim, dependency model, participation assessment, institutional mechanism, value-incidence map, or domain boundary.

The correction return should also be bidirectional. GRE can show that a technically capable system is economically inaccessible, that formal choice coexists with deep dependency, that verification costs are unevenly distributed, that an institutional de-

ployment changes participation or bargaining, or that ownership and infrastructure concentration alter who can benefit from technical progress. These are economic findings that neighboring AI research may need in order to characterize real-world deployment rather than isolated model behavior.

Proposition 23.301 (Economic-reduction limit for AI)**.** *An AI-related conclusion exceeds GRE scope when its validity depends principally on a technical, epistemic, legal, political, educational, ethical, social, or ontological judgment that is neither supplied by GRE's economic evidence nor imported through an explicit and answerable interface.*

Definition 23.302 (GRE–AI studies interface portfolio)**.** A *GRE–AI studies interface portfolio* is a versioned collection of artificial-agency profiles, subjecthood records, capability and epistemic interface profiles, dependence records, human-participation profiles, AI-mediated institution records, question-allocation records, cross-domain dependency graphs, correction returns, and unresolved scope questions across projects.

Proposition 23.303 (GRE–AI interface answerability)**.** *A GRE–AI studies interface is answerable when the artificial configuration, technical capability premise, economic realization pathway, affected positions, dependency and participation structure, institutional mediation, cross-domain premises, scope boundary, and possible correction returns are explicit enough that contrary technical or neighboring-domain analysis can revise the GRE interpretation or reclassify the inquiry.*

This condition keeps artificial intelligence inside GRE where economic relations genuinely depend on it while preventing economic consequence from becoming a proxy for a general ontology or normativity of AI. GRE can investigate how artificial capabilities are financed, accessed, incorporated, concentrated, converted into power, distributed through institutions, and coupled to future economic possibility. AI studies and neighboring GR domains retain independent responsibility for technical characterization, epistemic warrant, legal and political status, educational consequence, ethical standing, subjecthood, and other claims whose validity cannot be derived from economic performance. The next interface turns from artificial systems to social theory, where the principal boundary problem concerns institutions, culture, identity, social reproduction, collective meaning, and the extent to which economic relations remain embedded in wider social configurations.

23.13 Social Theory Interface

Chapter 2 reconstructed institutional economics, economic sociology, relational sociology, network analysis, and social field theory as intellectual resources for analyzing actors, institutions, positions, identities, and economic action through patterned relations rather than isolated attributes. Later chapters used some of those resources to develop GRE's accounts of economic subjecthood, value, power, participation, institutions, and generative capacity. The present section has a different role. It specifies the interface between GRE and social theory while preserving society as a wider field of inquiry than the economy. Its objective is to distinguish social relations that constitute economic positions, social mechanisms that mediate economic consequences, and social meanings or relations whose principal explanation remains social even

when they affect production, exchange, allocation, valuation, or future economic possibility. The discussion develops nine interface domains: social relations, institutions, social fields, culture, identity, social reproduction, collective meaning, economic embeddedness, and social relational remainders. The method is relational and comparative. It uses the containment and translation disciplines established in Sections 23.2–23.3, while treating sociological concepts as independently warranted constructs rather than as undeclared extensions of GRE terminology.

Relational sociology provides especially important background for this interface because it directs analysis toward transactions, interdependencies, positions, and dynamic relations rather than assuming that socially relevant properties reside entirely within pre-given actors (Emirbayer 1997). Economic sociology adds the further observation that economic action remains embedded in ongoing social relations (Granovetter 1985). Neither commitment implies that every social relation is economic or that society can be reconstructed from economic variables. The interface therefore requires explicit typing of the relation under investigation and an account of how social constitution becomes economically consequential.

Definition 23.304 (GRE–social theory interface record)**.** A *GRE–social theory interface record* specifies the social relation, institution, field, cultural formation, identity process, reproductive arrangement, or collective meaning under investigation; the economic positions and processes it conditions; the pathway through which the social object becomes economically consequential; the aspects whose explanation remains principally social-theoretical; the evidence required by each domain; and the GRE claims that would require revision if the social-theoretical characterization changes.

The record prevents "society" from becoming an undifferentiated background variable. A household norm, professional identity, religious practice, organizational field, neighborhood network, kinship relation, status hierarchy, or shared classification can enter an economic process through different mechanisms. Some affect access, bargaining, trust, valuation, labor supply, credit, care, recognition, or institutional legitimacy. Others may remain economically peripheral in the inquiry even while being socially central to the people involved.

Proposition 23.305 (Social-theory handoff condition)**.** *A GRE inquiry should hand a material subquestion to social theory when its resolution depends principally on the constitution, meaning, reproduction, classification, identity, legitimacy, or relational organization of social life and cannot be established from economic incidence, incentives, allocation, value conversion, or economic power alone.*

The handoff remains reciprocal. Social theory can show that GRE has misidentified an actor, boundary, institution, field, category, or reproductive process. GRE can show that a social configuration has economically unequal incidence, that access to a socially valued position depends on material resources, that institutional legitimacy is coupled to distributive consequences, or that a social practice changes later capability and option structure. Table 23.13 summarizes the principal interface operations developed below.

Table 23.13: Principal operations at the GRE–social theory interface

Interface object	GRE question	Social-theory question	Possible correction to GRE
Social relations	How does a relation alter access, allocation, bargaining, value, capability, or economic options?	What kind of social relation exists, how is it constituted, and what meanings or obligations organize it?	Revised relation type, actor boundary, or causal pathway
Institutions	How do institutional arrangements shape economic coordination and incidence?	How are rules, norms, legitimacy, roles, practices, and organizational forms reproduced?	Revised institutional mechanism or effective rule set
Social fields	How does position affect economic possibility or conversion?	What defines the field, its stakes, positions, boundaries, and recognized resources?	Revised field boundary, position map, or resource interpretation
Culture	How do cultural classifications or practices affect valuation and economic conduct?	How are meanings, repertoires, distinctions, and practices produced and sustained?	Revised valuation, preference, legitimacy, or participation account
Identity	How does identity condition opportunity, treatment, capability, or economic role?	How is the identity assigned, claimed, recognized, contested, or transformed?	Revised subject classification and heterogeneous-position model
Social reproduction	Which background processes sustain people, capabilities, institutions, and economic participation?	How are care, household, kinship, community, and reproductive relations organized and valued?	Revised reproduction cost, capability, and sustainability analysis
Collective meaning	How does shared interpretation affect coordination, trust, valuation, or institutional efficacy?	How is meaning collectively generated, stabilized, disputed, and changed?	Revised interpretation of signals, categories, or institutional effects
Economic embeddedness	Which social dependencies materially condition an economic mechanism?	Which networks, institutions, norms, and meanings constitute the surrounding social configuration?	Revised boundary and mechanism specification
Social relational remainders	Which economic consequences arise from a relation whose principal meaning remains social?	What social goods, obligations, identities, or meanings would be lost through economic reduction?	Explicit non-economic remainder and narrowed GRE claim

23.13.1 Social Relations

The first interface concerns the relation itself. Social theory contains several non-equivalent concepts of relation: interaction, exchange, interdependence, tie, transaction, membership, role relation, status relation, constitutive dependence, and position within a wider configuration. Simmel's analysis of forms of interaction, Elias's figurational account of interdependence, and later relational sociology all show that socially consequential properties can depend on relations among persons and collectivities rather than on isolated attributes alone (Simmel 1971; Elias 1978; Emirbayer 1997). GRE can inherit this relational attentiveness, but it needs a further question: when does a socially constituted relation become relevant to an economic explanation?

Economic relevance can arise through several pathways. A friendship relation may transmit job information. A kinship relation may organize care, inheritance, credit, or migration. A professional relation may confer reputation or access. A status relation may influence wages or bargaining. A neighborhood relation may organize mutual aid. None of these examples makes friendship, kinship, profession, status, or neighborhood reducible to an economic relation. The economic question concerns a specified consequence or conversion pathway within a socially richer relation.

Definition 23.306 (Social-to-economic relevance pathway)**.** A *social-to-economic rel-*

evance pathway identifies a socially constituted relation and the mechanism through which that relation changes an economically relevant position, including access, information, obligation, trust, bargaining, valuation, capability, resource flow, institutional treatment, or feasible future options.

The pathway is narrower than a claim that the social relation exists for economic purposes. It permits GRE to analyze economic effects while retaining the relation's wider social constitution. This distinction is particularly important for relations whose participants understand them through care, loyalty, belonging, ritual, status, friendship, kinship, vocation, or civic obligation rather than through exchange value.

Proposition 23.307 (Relation-typing condition)**.** *A socially observed relation should enter GRE as an economic relation only when the economic dimension is part of the relation's declared analytical type; otherwise GRE should represent the relation as a social condition, mediator, or source of economic consequence whose wider constitution remains outside the economic classification.*

This condition prevents analytical convenience from silently changing the object. A parent–child relation can contain transfers of money, time, care, and future opportunity while remaining more than a transfer relation. A friendship can support entrepreneurial coordination without becoming equivalent to a commercial partnership. Conversely, a formally economic contract can generate social ties and identities that later affect conduct beyond the contract. The interface therefore permits relations to be multiply consequential without requiring one disciplinary type to exhaust their meaning.

23.13.2 Social Institutions

Institutions form the second interface because GRE frequently analyzes rules, organizations, property structures, markets, firms, public agencies, and governance arrangements. Social theory broadens the institutional object beyond a set of incentive constraints. Institutions can include formal rules, informal norms, legitimate expectations, role classifications, routines, organizational forms, professional standards, and practices through which participants understand what conduct is possible or appropriate. Polanyi's account of the economy as an instituted process and sociological institutionalism's attention to legitimacy and organizational fields both demonstrate that economic coordination is socially organized in ways that exceed a purely parametric environment (Polanyi 1957; DiMaggio and Powell 1983).

GRE needs this broader institutional description because a rule's written form may differ from its practical operation. Access can depend on informal gatekeeping. A nominal right can be difficult to exercise. A professional norm can alter adoption even without legal compulsion. Organizational imitation can spread a practice before its efficiency is known. Institutional analysis must therefore distinguish the formal rule, enacted practice, legitimacy structure, enforcement relation, organizational carrier, and economic effect.

Definition 23.308 (Institutional interface profile)**.** An *institutional interface profile* records the formal rules, informal norms, roles, organizational carriers, legitimacy claims, enforcement or sanction practices, recurrent routines, affected positions, and economic mechanisms associated with an institution, together with discrepancies be-

tween formal design and enacted operation.

The profile is useful when GRE investigates institutions as generative economic infrastructure. A labor-market credential, for example, can influence access to employment through formal qualification rules, professional expectations, reputational meaning, organizational screening, and network recognition. Treating the credential only as information about productivity may omit the social processes that make it authoritative.

Proposition 23.309 (Institutional-description non-equivalence)**.** *An institution's economic effect, formal rule, enacted practice, and social legitimacy are distinct descriptions; evidence for one does not by itself establish the others.*

The distinction creates a direct correction channel. If social research shows that an apparently universal rule is interpreted differently across groups, GRE should revise its effective institutional architecture. If an organizational form is reproduced through legitimacy or professional convention rather than the efficiency mechanism assumed by an economic model, the causal interpretation should change. Law and governance may provide additional domain-specific corrections where formal authority, rights, duties, or public decision are material, as developed in Sections 23.8–23.9.

23.13.3 Social Fields

The third interface concerns social fields. Field language is especially sensitive because GRE also uses field-oriented descriptions for distributed relational conditions and, in some chapters, cautiously employs field-theoretic formalisms. Social field theory has its own intellectual history and should not be treated as interchangeable with those analytical devices. Bourdieuian field theory links positions, forms of capital, habitus, stakes, and symbolic power; other field approaches emphasize relative position, social skill, incumbency, challenge, governance units, or inter-field dependence (Bourdieu and Wacquant 1992; Martin 2003; Fligstein and McAdam 2012). These are sociological theories with domain-specific commitments, not generic synonyms for any relational configuration.

GRE can nevertheless benefit from field analysis when economic possibility depends on position inside a socially structured arena. Access to a profession, the convertibility of credentials, the legitimacy of a business practice, the prestige of an occupation, or the capacity to mobilize social capital can vary by field. The economic value of a resource may therefore depend on a social structure that defines where, by whom, and under which classifications that resource is recognized.

Definition 23.310 (Social-field translation record)**.** A *social-field translation record* identifies the source field concept, its actors or positions, stakes, recognized resources, boundary criteria, mechanisms of reproduction or change, and the specific economic question for which a translated representation is proposed; it also records which field-theoretical meanings are lost, transformed, or retained in the GRE use.

This record is necessary because similar vocabulary can conceal different objects. A "field" in Bourdieuian sociology, a strategic action field, a physical field, and a GRE relational field can all describe distributed or positional structure while differing in

ontology, measurement, mechanism, and explanatory purpose.

Proposition 23.311 (Field-vocabulary non-equivalence)**.** *Shared use of the term* field *does not establish theoretical equivalence among social field theory, formal field representations, and GRE relational-field language; translation requires an explicit mapping of positions, variables, mechanisms, and interpretive commitments.*

The proposition protects both sides of the interface. GRE should not redescribe a sociological field as a mathematical field merely because formalization is convenient. Social theory should likewise be able to show that the economically relevant boundary or position assumed by GRE fails to capture the field as socially organized. Field structure becomes an interface object precisely because its economic and social descriptions may overlap without coinciding.

23.13.4 Culture

Culture forms the fourth interface. In economic inquiry, culture is sometimes introduced as a residual explanation for differences left unexplained by prices, institutions, or individual attributes. Such usage is too coarse for an answerable interface. Cultural formations can include shared classifications, evaluative repertoires, narratives, symbolic distinctions, rituals, practical habits, styles of interpretation, and historically transmitted expectations. Their economic relevance depends on a specific mechanism rather than on the generic assertion that "culture matters."

Culture can affect valuation, consumption, saving, work, entrepreneurship, cooperation, status competition, trust, legitimacy, organizational practice, and the interpretation of economic signals. Yet the economic consequence is only one dimension of the cultural object. A ritual may influence expenditure while its principal meaning concerns belonging. A professional ethos may affect labor supply while also organizing vocation and dignity. A cultural classification may influence prices while simultaneously structuring status or identity.

Definition 23.312 (Cultural mediation profile)**.** A *cultural mediation profile* records the cultural classification, narrative, repertoire, norm, practice, or symbolic distinction under investigation; the actors or collectivities for whom it is meaningful; the historical and institutional setting of its reproduction; the economic behavior or relation it conditions; and the evidence connecting the cultural formation to that economic consequence.

The profile requires more than correlation between group membership and an economic outcome. It asks how the relevant meaning or practice is produced, recognized, enacted, and translated into an economically consequential mechanism.

Proposition 23.313 (Cultural-conversion condition)**.** *A cultural difference becomes a GRE explanatory object when a defensible pathway links the cultural formation to an economic relation, valuation, allocation, capability, constraint, participation pattern, or future option; the pathway does not exhaust the cultural formation's social meaning.*

This condition also makes correction possible. If ethnographic, historical, or sociological evidence shows that the meaning assigned by the economic model is mistaken, the GRE mechanism should be revised even where the statistical association remains. Cultural interpretation is therefore neither decorative context nor a license

for unmeasured explanation. It is an independently answerable component of the interface.

23.13.5 Identity

Identity forms the fifth interface because economic positions are often organized through categories that people claim, receive, negotiate, contest, or have institutionally assigned to them. Social theory cautions against treating identity as a fixed attribute whose meaning is stable across settings. Network and relational accounts show that identities can emerge and change through social formations, interaction, control efforts, stories, and positions (White 2008). GRE therefore needs to distinguish an identity category used in data, an identity recognized by an institution, an identity experienced or claimed by a participant, and an economic role associated with that identity.

The economic relevance of identity can arise through differential treatment, network access, occupational sorting, consumption, political or organizational recognition, credentialing, discrimination, trust, care obligations, or the distribution of unpaid work. The same category can have different effects across institutions and historical periods. Conversely, people occupying similar economic positions can understand those positions through different identities and social meanings.

Definition 23.314 (Identity–economic interface record)**.** An *identity–economic interface record* specifies the identity category or process under investigation, the mode of assignment or recognition, the relevant social setting, the economic position or mechanism with which it interacts, the evidence for that interaction, and the aspects of identity whose meaning cannot be inferred from the economic role alone.

The record prevents administrative categories from being treated as complete social subjects. It also permits identity to be endogenous to economic relations where appropriate. Occupational classifications, class positions, consumer identities, entrepreneurial identities, and organizational roles can be partly generated through economic participation, while retaining cultural, political, familial, or status dimensions that require wider social analysis.

Proposition 23.315 (Identity-role non-equivalence)**.** *An economic role and a social identity may mutually condition one another, but neither should be inferred as a complete representation of the other without evidence concerning recognition, meaning, institutional classification, and historical formation.*

This distinction matters for GRE's heterogeneous-subject architecture. Heterogeneity should not be represented only by scalar differences in resources or capabilities. Socially constituted identities can affect which resources are recognized, which actions are available, which obligations are expected, and which outcomes are experienced as losses or gains. Social theory can therefore return corrections to the very specification of the economic subject.

23.13.6 Social Reproduction

Social reproduction forms the sixth interface because economic activity depends on processes that sustain people, households, communities, institutions, skills, norms,

and future generations. Feminist economics and social-reproduction scholarship have long emphasized the economic significance of unpaid care, household labor, childrearing, and other background activities that standard market accounts can understate or omit (Folbre 1994; Fraser 2014). GRE's concern with generative capacity makes these processes especially important, but the conceptual overlap should not be treated as identity.

The term *social reproduction* itself carries several meanings. It can refer to daily and intergenerational reproduction of people and labor capacities; to care and household provisioning; to reproduction of institutions, inequalities, status relations, or cultural forms; or to the persistence of a wider social order. A GRE analysis should declare which meaning is operative before relating reproduction to economic generativity.

Definition 23.316 (Social-reproduction interface profile)**.** A *social-reproduction interface profile* records the persons, relations, activities, institutions, infrastructures, and temporal horizons through which a specified social capacity or social order is sustained; the distribution of material, temporal, emotional, and organizational burdens; the economic processes that depend on the reproduced capacity; and the social values or obligations that remain irreducible to the economic use of that capacity.

The profile makes visible a common asymmetry: an economic process can draw on reproduced capacities without fully financing, recognizing, or sustaining the relations that generate them. Care, education, public health, community trust, household coordination, and intergenerational support can therefore function as enabling conditions whose depletion appears only later as reduced capability, higher replacement cost, lower participation, or institutional fragility.

Proposition 23.317 (Reproductive-condition endogeneity)**.** *When an economic process materially depends on a socially reproduced capacity and also changes the conditions through which that capacity is reproduced, the reproductive process should be represented as endogenous to the economic analysis rather than as a fixed external background.*

Endogeneity does not imply economic ownership of the object. A caregiving relation can matter to labor-market participation while possessing meanings and obligations that cannot be evaluated through labor supply alone. Social reproduction therefore supplies a particularly clear example of reciprocal correction: social theory broadens GRE's account of the conditions of economic possibility, while GRE can analyze how allocation, compensation, ownership, public provision, and power affect the sustainability of those conditions.

23.13.7 Collective Meaning

Collective meaning forms the seventh interface. Economic coordination relies extensively on categories, expectations, narratives, classifications, symbols, and shared interpretations. Money, credentials, brands, professions, organizational offices, property categories, market conventions, and institutional procedures function partly because participants recognize and act through socially stabilized meanings. GRE's relational-reality architecture can accommodate the causal efficacy of such socially sustained configurations without claiming that shared meaning is reducible to indi-

vidual belief or that every collectively recognized object is economic.

A meaning can be shared unevenly, contested, institutionally enforced, or differently interpreted across positions. The same symbol can carry distinct meanings for workers, managers, regulators, consumers, or communities. Collective meaning therefore cannot be inferred merely from behavioral regularity. Repeated conduct may arise from coercion, habit, convention, shared interpretation, strategic compliance, or several mechanisms at once.

Definition 23.318 (Collective-meaning interface record)**.** A *collective-meaning interface record* identifies the category, symbol, narrative, classification, or interpretive convention under investigation; the community or positions among which it is recognized; the practices and institutions through which it is sustained; the degree and form of contestation; and the economic mechanism whose operation depends on that meaning.

The record can be used, for example, when the economic efficacy of a credential depends on social recognition, when a product category organizes valuation, when a narrative changes investment behavior, or when a status distinction shapes occupational choice. The relevant economic claim concerns the consequence of meaning; the social-theoretical claim concerns how that meaning is produced, distributed, and transformed.

Proposition 23.319 (Semantic-to-economic conversion condition)**.** *A collectively sustained meaning enters a GRE mechanism when changes in its recognition or interpretation can alter an economically relevant relation, valuation, access condition, institutional practice, capability, or feasible option through an identifiable pathway.*

This proposition creates an empirical vulnerability. If meaning changes while the proposed economic effect does not, or if the effect persists through a different mechanism, the GRE interpretation requires revision. Collective meaning is therefore neither an all-purpose explanation nor a merely subjective residue; it is a social object whose economic consequences must be traced.

23.13.8 Economic Embeddedness

Economic embeddedness is the eighth interface and provides the most direct bridge between economic sociology and GRE. Granovetter's critique of atomized economic action emphasizes that economic conduct is embedded in ongoing social relations, while Polanyi's substantive approach treats the economy as an instituted process organized through historically variable forms of integration (Granovetter 1985; Polanyi 1957). For GRE, the key implication is methodological: an economic mechanism should include the social dependencies that materially constitute its operation when excluding them would change the explanation.

Embeddedness should remain a discriminating concept rather than a statement that everything is connected to everything else. The relevant question is which social relation, institution, meaning, identity, or reproductive process changes the economic mechanism under study. An entrepreneur's access to finance may depend on networks. A market's operation may depend on legal and cultural classifications. A firm's labor process may depend on household care arrangements. A platform mar-

ket may depend on status, community norms, or trust. Different forms of embeddedness therefore require different evidence.

Definition 23.320 (Economic-embeddedness interface record)**.** An *economic-embeddedness interface record* specifies the focal economic process, the social relations or formations on which its operation materially depends, the mechanisms of dependence, the relevant boundary and timescale, the evidence that the social configuration changes the economic process, and the social-theoretical questions that remain independently open.

The record also guards against the opposite error of treating every social relation surrounding an economic activity as causally necessary. Social context may be descriptively present without carrying explanatory weight for the focal economic question. Embeddedness becomes analytically useful when removing, changing, or reclassifying the social condition would alter the economic mechanism or its expected consequences.

Proposition 23.321 (Embeddedness answerability)**.** *An embeddedness claim is answerable when the focal economic mechanism, the relevant social configuration, the pathway of dependence, and the counterfactual or comparative basis for judging material influence are explicit enough that social or economic evidence can weaken, revise, or reject the claimed dependence.*

This answerability requirement preserves disciplinary containment. GRE can investigate the economic consequences of embedded social relations while social theory retains responsibility for the constitution and meaning of those relations. The interface is strongest when the two descriptions are mutually revisable rather than when one is treated as contextual decoration for the other.

23.13.9 Social Relational Remainders

The final interface concerns social relations whose principal meaning and organization remain outside GRE even when economic consequences are present. Family relations, friendship, intimacy, ritual, religious community, civic association, status, solidarity, mourning, celebration, care, and forms of belonging can involve resources, labor, property, time, reciprocity, or economic inequality. Their economic dimensions can be legitimate GRE objects. Their social constitution, however, cannot be inferred from those dimensions alone.

The boundary matters because economic effects are pervasive. A friendship can affect employment; a religious community can organize mutual aid; a family can allocate assets; a civic association can influence local investment; a ritual can generate expenditure. If economic consequence were sufficient to classify the underlying relation as economic, GRE's domain would expand until almost every social relation became an economic relation. Such expansion would weaken rather than strengthen the research programme because the principal problem-space would cease to constrain explanation.

Definition 23.322 (Social relational remainder)**.** A *social relational remainder* is the set of constitutive meanings, obligations, identities, practices, affective relations, status structures, or collective purposes of a socially organized relation that remain an-

alytically material after its economic consequences have been represented and that cannot be warranted from the economic representation alone.

The remainder does not mean that social theory possesses an immutable jurisdiction over a fixed object. Domain boundaries remain revisable. It means that GRE should preserve the unresolved social content explicitly rather than translating it into utility, resource flow, preference, price, capability, or economic value without justification.

Definition 23.323 (Social-theory correction return)**.** A *social-theory correction return* is a documented social-theoretical finding that requires GRE to revise a relation type, subject boundary, institutional mechanism, field boundary, cultural interpretation, identity classification, reproductive dependency, collective-meaning claim, embeddedness pathway, or domain boundary.

Correction can also move in the other direction. GRE may reveal that a socially valued institution systematically redistributes risk, that a status order controls material access, that a cultural practice depends on uncompensated labor, that a reproductive arrangement narrows future capability, or that an apparently voluntary relation is sustained by economic dependency. These economic findings can become inputs to social theory without claiming to settle the relation's wider meaning or legitimacy.

Definition 23.324 (GRE–social theory interface portfolio)**.** A *GRE–social theory interface portfolio* is a versioned collection of social-to-economic relevance pathways, institutional profiles, social-field translation records, cultural mediation profiles, identity interface records, social-reproduction profiles, collective-meaning records, embeddedness records, social relational remainders, and correction returns across projects.

Proposition 23.325 (GRE–social theory interface answerability)**.** *A GRE–social theory interface is answerable when the social object, economic mechanism, translation pathway, retained social remainder, evidence, boundary, and possible correction returns are explicit enough that contrary social-theoretical or economic analysis can revise the interpretation, change the domain allocation, or withdraw the claimed economic mechanism.*

The interface thereby preserves a demanding form of embedded economic analysis. GRE can study how economic relations are socially constituted, how institutions and fields organize economic possibility, how culture and identity mediate valuation and access, how social reproduction sustains capacities, and how collective meanings stabilize or transform economic coordination. Social theory retains independent responsibility for the constitution and interpretation of social relations whose meaning exceeds their economic incidence. The resulting relation is one of reciprocal correction rather than disciplinary absorption. Section 539 turns to aesthetics, where salience, orientation, judgment, curiosity, and value formation create a different interface between economically consequential processes and a domain whose objects cannot be reconstructed from economic value alone.

23.14 Aesthetics Interface

Aesthetic judgment has already appeared at several points in the book without being treated as an economic synonym for preference. Chapter 6 distinguished salience, sig-

nificance, judgment, orientation, and aesthetic conditions within research and application praxis. Chapter 17 then examined aesthetic judgment as a source of epistemic orientation under conditions in which inquiry possibilities exceed available attention and resources. Section 23.10 extended that architecture to education, where aesthetic judgment can help learners orient among examples, explanations, forms, and possible questions without independently establishing educational quality or truth. The present section has a wider role. It specifies the interface between GRE and aesthetics while preserving aesthetic experience, judgment, value, and practice as domains whose significance is not exhausted by economic incidence. Its objective is to identify how aesthetic judgment can become economically consequential through salience, orientation, curiosity, valuation, production, consumption, participation, and institutional selection; how economic conditions can widen or narrow aesthetic possibility; and where economic translation leaves a domain-specific remainder. The discussion proceeds through eight interfaces: aesthetic judgment, salience, orientation, curiosity, value formation, economic conditions of aesthetic possibility, the relation between aesthetic and economic value, and the limits of economic translation. The method is relational and comparative. It uses the containment and translation disciplines established in Sections 23.2–23.3 while preserving the distinction between an economic consequence of aesthetic judgment and the aesthetic constitution of the judgment itself.

The interface requires restraint because aesthetic traditions do not supply one settled object that GRE can simply import. Kant's account of judgments of taste, Hume's account of cultivated judgment, Dewey's account of aesthetic experience, and Bourdieu's sociology of taste offer materially different descriptions of judgment, experience, cultivation, and social formation (Kant 1987; Hume 1985; Dewey 1934; Bourdieu 1984). Their non-equivalence is analytically useful. It prevents GRE from assuming that aesthetic value is merely subjective preference, social distinction, formal beauty, pleasurable response, or market willingness to pay. GRE instead asks a narrower economic question: through which relations do aesthetically organized experiences and judgments change attention, allocation, participation, capability, valuation, institutional practice, or future possibility, and through which economic conditions are those experiences and judgments themselves enabled or constrained?

Definition 23.326 (GRE–aesthetics interface record)**.** A *GRE–aesthetics interface record* specifies the aesthetic object, experience, practice, judgment, or evaluative relation under investigation; the positions and communities within which it is formed; the historically relevant standards, repertoires, or fields of comparison; the economic conditions that enable or constrain its formation and exercise; the pathway through which it becomes economically consequential; the aesthetic questions that remain independently open; and the GRE claims that would require revision if the aesthetic characterization changes.

The record is deliberately broader than a consumer-preference profile. It can apply to artistic production, design, architecture, scientific representation, education, public space, craft, interface design, organizational form, cultural participation, landscape experience, or everyday practices in which qualities such as coherence, fittingness, contrast, elegance, rhythm, surprise, depth, atmosphere, or expressive force become consequential. Some of these qualities can affect price or demand. Others can

Table 23.14: Principal operations at the GRE–aesthetics interface

Interface object	GRE question	Aesthetic question	Possible correction to GRE
Aesthetic judgment	How does judgment alter attention, selection, participation, valuation, or economic action?	What is being judged, through which standards, experiences, practices, or comparisons, and with what domain-specific significance?	Revised judgment type, preference interpretation, or causal pathway
Salience	Which formal or experiential qualities become prominent enough to attract scarce attention?	Why does the object become perceptually, affectively, or interpretively salient within the relevant field?	Revised attention mechanism or prominence measure
Orientation	How does aesthetic judgment direct commitment among alternatives under incomplete information?	How is orientation cultivated, exercised, contested, and revised within the practice?	Revised selection or persistence mechanism
Curiosity	Which aesthetic encounters open further exploration, question formation, or participation?	How do surprise, beauty, unfamiliarity, tension, or form generate or inhibit curiosity?	Revised account of demand, motivation, or option formation
Value formation	How do aesthetic judgments enter demand, reputation, symbolic differentiation, identity, or resource allocation?	How is aesthetic value formed, learned, disputed, and sustained within a field or community?	Revised valuation, preference, or status mechanism
Aesthetic possibility	Which economic conditions widen or narrow access to aesthetic experience, production, judgment, and participation?	Which practices, capacities, environments, and relations make aesthetic experience or creation possible?	Revised resource boundary or capability analysis
Aesthetic and economic value	Where do aesthetic evaluation and economic valuation interact without becoming identical?	What gives the object aesthetic worth within the relevant practice or experience?	Explicit value plurality and limited commensuration
Translation limits	Which economic consequences can be represented without absorbing the aesthetic object?	Which meanings, experiences, standards, or values remain irreducibly aesthetic for the inquiry?	Narrowed GRE claim and explicit aesthetic remainder

affect attention, trust, participation, learning, preservation, care, identity, or willingness to remain within a practice without ever becoming adequately represented by price.

Proposition 23.327 (Aesthetic handoff condition)**.** *A GRE inquiry should hand a material subquestion to aesthetics or a relevant neighboring discipline when its resolution depends principally on the constitution, experience, interpretation, cultivation, comparison, or domain-specific value of an aesthetic judgment and cannot be established from economic preference, demand, price, allocation, capability, or institutional incidence alone.*

The handoff remains reciprocal. Aesthetic inquiry can show that GRE has mischaracterized the object of judgment, confused popularity with quality, treated learned taste as a fixed preference, or ignored the experiential organization through which an intervention becomes attractive, alienating, legible, coherent, or oppressive. GRE can in turn identify material inequalities in exposure, time, training, production resources, cultural infrastructure, distribution channels, and institutional recognition that condition which aesthetic possibilities can be encountered, cultivated, expressed, or sustained. Table 23.14 summarizes the principal interface operations developed below.

23.14.1 Aesthetic Judgment

Aesthetic judgment is the first interface because economic analysis often encounters its effects before it possesses an adequate account of its constitution. Consumers choose among designs, audiences allocate attention, researchers prefer some representations, communities protect some landscapes, organizations adopt particular forms, and institutions recognize some works or practices as worthy of preservation. These decisions can have prices, budgets, labor requirements, distributional consequences, and long-term effects. Yet the existence of an economic consequence does not show that the judgment was economically constituted or that its significance can be recovered from the observed choice.

The philosophical diversity already noted is instructive. Kant does not treat a judgment of taste as an ordinary judgment of utility; Hume treats cultivated taste as involving practice, comparison, delicacy, and freedom from prejudice; Dewey locates aesthetic experience within temporally organized interaction between organism and environment; Bourdieu emphasizes the social formation of taste and its relation to classed dispositions and distinction (Kant 1987; Hume 1985; Dewey 1934; Bourdieu 1984). GRE need not adjudicate among these accounts in order to preserve a basic interface discipline: observed economic behavior does not uniquely identify the aesthetic judgment that helped produce it.

Definition 23.328 (Aesthetic-judgment interface profile)**.** An *aesthetic-judgment interface profile* records the object or experience judged, the relevant qualities and comparison field, the judging position or community, the practices and histories through which standards of judgment were formed, the degree of agreement or contestation, the economic consequences associated with the judgment, and the evidential boundary between those consequences and the aesthetic significance of the judgment itself.

The profile prevents a recurrent reduction. A high price may indicate scarcity, status competition, speculative expectation, institutional recognition, purchasing power, provenance, or a conjunction of these mechanisms. It cannot by itself establish aesthetic worth. Low market demand likewise cannot establish aesthetic failure. A work can be aesthetically important within a small community; a public space can possess qualities that are weakly monetized; a craft practice can be aesthetically rich while economically precarious; an aesthetically compelling product can succeed commercially for reasons unrelated to the judgment that specialists would regard as aesthetically relevant.

Aesthetic judgment can also have economic effects without being fully verbalized. Experienced practitioners often possess forms of taste that operate through comparison, sensitivity to proportion, rhythm, texture, fit, coherence, tension, or expressive force before they can state an explicit rule. Chapter 6 treated practical taste as historically formed and potentially expertise-bearing while remaining open to inherited exclusion. The same discipline applies here. Tacit judgment can carry information while also reproducing conventions, status hierarchies, and path-dependent standards.

Proposition 23.329 (Judgment–price non-equivalence)**.** *Market price, observed demand, institutional prestige, popularity, and stated willingness to pay can provide evidence about the economic incidence of aesthetic judgment, but none should be treated as*

a general measure of aesthetic value without an independently warranted translation for the relevant domain and question.

The proposition leaves room for empirical relations. Aesthetic evaluation can influence demand, and prices can influence later perceptions of quality. Institutional recognition can change exposure, while exposure can change familiarity and taste. The interface therefore studies reciprocal conditioning rather than requiring causal purity. What remains prohibited is the silent replacement of one evaluative domain by another.

23.14.2 Salience

Salience is the second interface because aesthetic qualities can make some objects, relations, or possibilities stand out within fields of abundance. Chapter 6 defined research salience as selective prominence before significance is established, and Chapter 17 extended that distinction to epistemic abundance. The aesthetics interface generalizes the problem beyond inquiry. A form, contrast, rhythm, atmosphere, arrangement, sound, image, phrase, or spatial organization can attract or hold attention before its wider practical, economic, epistemic, or normative significance is known.

Aesthetic salience is relational. What stands out depends on a background, expectation, repertoire, environment, and perceiving position. A minimalist form can be salient within visual density; an irregularity can be salient within a strongly patterned field; a quiet space can become salient within sensory overload; a traditional craft can become salient after industrial standardization; an unfamiliar style can become salient because it disrupts a learned expectation. Salience therefore cannot be represented adequately as an intrinsic amount of attractiveness attached to the object independently of context.

Definition 23.330 (Aesthetic-salience pathway)**.** An *aesthetic-salience pathway* identifies the object or relation that becomes prominent, the perceptual or interpretive field against which prominence arises, the aesthetic qualities involved, the positions for which the salience occurs, the institutions or technologies that amplify or suppress it, and the economic consequences that follow from the resulting allocation of attention.

The institutional component is important. Platforms, advertising systems, exhibition spaces, publishing channels, architecture, urban design, retail environments, recommendation systems, and professional gatekeeping can all organize what becomes visible or memorable. Some mechanisms intensify aesthetically salient features because they increase engagement. Others standardize form in ways that reduce exposure to unfamiliar possibilities. Economic organization therefore participates in the production of salience, not only in the monetization of already salient objects.

Salience also creates a selection hazard. What is striking can receive disproportionate resources even when less salient objects have greater long-term value. A visually dramatic infrastructure project may attract political investment while maintenance remains aesthetically inconspicuous. A memorable interface can draw use even when its underlying arrangement produces dependency or surveillance. A fashionable research representation can attract attention before its explanatory ade-

quacy is established. These cases parallel the warning developed earlier in the book: salience can open inquiry or participation, but it should not certify significance.

Proposition 23.331 (Aesthetic-salience non-certification)**.** *Aesthetic salience can alter the probability that an object receives attention, participation, preservation, investment, purchase, or further inquiry while leaving its aesthetic quality, economic value, epistemic significance, and normative desirability separately unresolved.*

This distinction is especially important under conditions of symbolic abundance. When images, designs, texts, performances, and generated artifacts multiply faster than attention, selection mechanisms acquire increasing economic power. An aesthetics interface can then identify which forms receive visibility without treating visibility itself as evidence that the selected forms are aesthetically superior.

23.14.3 Orientation

Orientation is the third interface. Salience describes prominence; orientation concerns the more durable direction of attention, commitment, practice, or resource allocation among alternatives. Chapter 6 treated research orientation as a provisionally stabilized configuration of judgments, commitments, attention, questions, and resources. Aesthetic judgment can play a similar orienting role in artistic practice, design, consumption, education, scientific representation, public-space formation, craft, and ordinary life.

Orientation matters economically because action often precedes complete information. A designer chooses among forms before later user response is known. A researcher commits time to a representation whose explanatory fertility remains uncertain. A publisher invests in a work before demand is established. A city preserves a building or landscape before every future use can be specified. A student pursues a field partly because certain forms of thought or expression appear compelling. In each case, aesthetic judgment can help direct commitment under uncertainty.

Definition 23.332 (Aesthetic orientation)**.** *Aesthetic orientation* is the historically and relationally formed use of form-sensitive, experiential, or taste-based judgment to direct attention, selection, persistence, representation, or practical commitment among alternatives whose wider significance or future consequences remain incompletely determined.

Definition 23.332 extends the narrower epistemic use developed in Chapter 17. The extension is not an assertion that all orientation is aesthetic. Institutional rules, moral commitments, prices, urgency, habit, coercion, professional standards, and strategic considerations can all orient action. The aesthetic interface asks when a form-sensitive judgment materially participates in that configuration and how its influence interacts with other judgment forms.

Orientation can be generative. A compelling form can lead a person into a practice, preserve persistence through uncertainty, or make a previously unnoticed relation worth exploring. It can also become conservative. Institutions can reproduce a narrow aesthetic canon, organizations can reward familiar forms, and professional fields can treat historically specific conventions as natural standards. Bourdieu's account of socially formed taste and McAllister's analysis of changing scientific aesthetic

criteria both caution against treating aesthetic orientation as historically invariant (Bourdieu 1984; McAllister 1996).

Proposition 23.333 (Aesthetic-orientation revisability)**.** *Where aesthetic judgment materially directs economic or practical commitment, the resulting orientation should remain revisable by later experience, evidence, changed relations, alternative aesthetic traditions, and relevant normative or institutional considerations rather than being treated as self-validating because it initially appeared fitting or beautiful.*

The proposition does not subordinate aesthetics to economics or epistemology. It preserves a more general principle of domain coexistence. Aesthetic orientation can legitimately matter while remaining one judgment relation among several in a complex praxis.

23.14.4 Curiosity

Curiosity is the fourth interface because aesthetic experience can open further exploration without first appearing as demand for a determinate good. Chapter 17 and Section 23.10 treated curiosity as a generative stage in inquiry and education. The aesthetics interface asks more broadly how beauty, surprise, unfamiliarity, tension, ambiguity, craftsmanship, atmosphere, expressive force, or formal relation can provoke the desire to look again, compare, learn, enter a practice, or discover what an object can become.

This relation should not be overstated. Curiosity can arise from danger, practical need, contradiction, moral concern, social interaction, or explicit problem solving without an aesthetic component. Conversely, an aesthetic experience can remain contemplative without producing further inquiry. The interface concerns cases in which aesthetic experience materially enlarges the horizon of possible engagement.

Definition 23.334 (Aesthetic-curiosity interface profile)**.** An *aesthetic-curiosity interface profile* records the encounter that attracts further exploration, the aesthetic qualities through which the encounter becomes inviting or puzzling, the prior repertoire and expectations of the position encountering it, the opportunities and costs of continued exploration, the practices or communities capable of sustaining curiosity, and the later economic or non-economic consequences of the resulting inquiry or participation.

The economic component often lies in whether curiosity can continue. Time, security, access, mobility, materials, mentorship, tools, public institutions, and freedom from immediate pressure affect whether a compelling encounter becomes sustained exploration or disappears as an unrealized possibility. Veblen's discussion of "idle curiosity" remains relevant because it identifies a form of inquiry not exhausted by immediate utilitarian purpose (Veblen 1914). GRE adds a distributional question: which positions possess sufficient slack and access to follow an aesthetically generated curiosity whose future usefulness is unknown?

Curiosity also resists simple preference models. A person may not possess a stable preference for an object before encountering it. The encounter itself can alter what becomes desirable, intelligible, or askable. Exposure to a musical form, mathematical proof, landscape, craft process, architectural space, language, or artistic tradition can

generate new standards of appreciation and new desires for participation. In such cases, the preference space is partly generated through the relation rather than fully specified before it.

Proposition 23.335 (Aesthetic-curiosity option condition)**.** *When aesthetic encounter can generate new questions, practices, preferences, or capabilities whose future significance is not known in advance, economic evaluation should distinguish the present cost of preserving exploratory possibility from a requirement that the encounter already possess demonstrable market or instrumental return.*

The distinction gives aesthetic curiosity a place within generative analysis without assigning it automatic priority. Scarce resources still require judgment. The point is narrower: immediate monetization is an incomplete criterion for deciding whether exploratory aesthetic possibilities deserve institutional or material support.

23.14.5 Value Formation

Value formation is the fifth interface because aesthetic judgment can participate in the generation of economic value without being reducible to it. Products, services, places, performances, crafts, interfaces, brands, institutions, and cultural practices can acquire economic significance partly through perceived form, style, atmosphere, symbolic association, authenticity, originality, coherence, or beauty. These qualities can influence willingness to pay, reputation, demand, differentiation, preservation, labor valuation, and investment. Yet the mechanism is not adequately described by attaching an exogenous preference parameter to a finished object.

Taste has histories. Bourdieu's analysis of distinction emphasizes that aesthetic dispositions are socially formed and implicated in classed practices (Bourdieu 1984). Hume's account of cultivated taste likewise emphasizes practice and comparison, though within a different philosophical project (Hume 1985). GRE can use the shared warning without collapsing their theories: valuation often depends on capacities, repertoires, institutions, and relations that develop over time. The economic value of an aesthetic object can therefore depend on prior investments in education, exposure, cultural infrastructure, communities of practice, criticism, preservation, and recognition.

Definition 23.336 (Aesthetic-to-economic value-formation record)**.** An *aesthetic-to-economic value-formation record* identifies the aesthetic judgments or qualities that are hypothesized to affect economic valuation; the positions and communities in which those judgments are formed; the institutions, classifications, reputations, or distribution channels that mediate conversion; the economic outcomes affected; and the aesthetic value claims that remain independent of the observed economic result.

The record makes several conversion pathways distinguishable. Aesthetic judgment can increase demand directly; institutional recognition can alter reputation and scarcity; a distinctive form can support brand differentiation; cultural prestige can change labor and asset valuation; an aesthetically coherent environment can increase participation or retention; and design can reduce cognitive or interaction costs. These pathways do not have identical normative or aesthetic meaning. The same aesthetic object can also be economically valuable through one pathway and economically marginalized through another.

Value formation is reciprocal. Economic institutions can influence aesthetic standards by changing which objects are produced, distributed, preserved, taught, exhibited, recommended, or rewarded. Market success can become a signal used in later judgment. Wealth can purchase exposure and training. Institutions can canonize some forms while leaving others weakly visible. Production technologies can expand the feasible design space while standardizing other dimensions. Economic conditions therefore enter the history of taste and aesthetic practice without fully determining them.

Proposition 23.337 (Aesthetic-economic conversion condition)**.** *A claim that aesthetic judgment generates or transforms economic value should identify the mediation pathway through which judgment changes demand, access, participation, reputation, differentiation, cost, capability, institutional recognition, or future options, rather than inferring economic value formation from the mere coexistence of aesthetic appraisal and economic outcome.*

This requirement creates empirical answerability. If demand persists when aesthetic appraisal changes, another mechanism may dominate. If institutional recognition changes price without changing local aesthetic judgment, the relevant pathway may be status or scarcity. If aesthetically valued design increases participation but not revenue, the economic consequence may lie in capability or institutional continuity rather than market price. GRE should preserve these differences instead of translating them prematurely into one scalar notion of value.

23.14.6 Economic Conditions of Aesthetic Possibility

The sixth interface reverses the direction of explanation. Rather than asking how aesthetic judgment affects economic outcomes, it asks how economic organization conditions what aesthetic experiences, practices, judgments, and forms of participation become possible. Aesthetic possibility is materially situated. Production requires time, tools, spaces, materials, training, infrastructures, and often communities. Reception likewise depends on access to environments, performances, texts, objects, languages, networks, mobility, and discretionary attention. The distribution of those conditions can widen or narrow the aesthetic world available to different positions.

Economic conditions operate at several levels. Household income can affect access to lessons, instruments, travel, museums, books, or performance spaces. Employment conditions can affect discretionary time and cognitive availability. Urban land prices can alter the survival of studios, workshops, informal venues, and public cultural spaces. Intellectual-property arrangements can shape access and reuse. Platform economics can affect discoverability and compensation. Public funding can preserve practices whose market demand is weak or volatile. Education can expand the repertoires through which unfamiliar forms become intelligible. None of these mechanisms determines what a person will find beautiful or worthwhile, but each can alter the feasible space within which aesthetic relations form.

Definition 23.338 (Aesthetic possibility profile)**.** An *aesthetic possibility profile* specifies the time, security, access, spaces, materials, tools, mobility, education, mentorship, communities, infrastructures, legal permissions, distribution channels, and institutional supports through which a position can encounter, create, interpret, com-

pare, preserve, or participate in aesthetically organized practices within a stated horizon.

The profile should not be mistaken for a measure of aesthetic achievement. Abundant resources do not guarantee compelling work or refined judgment. Scarcity does not preclude aesthetic richness. Economic conditions influence possibility, persistence, reach, and vulnerability rather than determining aesthetic outcome. This distinction parallels the capability architecture developed elsewhere in the book: resources require conversion into actual opportunities, and realized activity remains distinct from the value or quality of what is produced.

The profile also reveals collective dependence. Some aesthetic possibilities exist only because institutions preserve archives, maintain public spaces, support ensembles, teach traditions, maintain craft supply chains, conserve landscapes, or sustain communities of interpretation. Their economic conditions cannot be reconstructed from individual purchasing power alone. A financially affordable object may still be aesthetically inaccessible where language, training, mobility, social permission, or cultural familiarity is missing. Conversely, a public institution can widen access even when individual incomes remain unequal.

Proposition 23.339 (Condition–realization non-equivalence)**.** *Economic resources and institutions can enlarge or restrict aesthetic possibility by changing feasible access, production, learning, comparison, preservation, and participation, while the existence of those conditions does not by itself establish aesthetic realization, quality, significance, or value.*

This proposition protects the interface in both directions. Economic analysis should not infer aesthetic success from expenditure, and aesthetic inquiry should not ignore the material structures that make sustained creation and participation unequally possible.

23.14.7 Aesthetic Value and Economic Value

The seventh interface requires an explicit distinction between aesthetic value and economic value. The two can interact, but they are not automatically commensurable. Economic value in GRE already includes heterogeneous processes of generation, conversion, circulation, return, capture, dissipation, and regeneration. Even within the economic domain, value cannot always be reduced to price. Aesthetic value introduces a further domain-specific plurality because its relevant standards can involve beauty, expressive force, coherence, depth, originality, fittingness, experiential intensity, craft, form, atmosphere, or other qualities whose justification belongs to aesthetic practices and traditions.

The distinction is easiest to see in cases of divergence. A work can command a high price while being aesthetically disputed. A public artwork can have little market value but substantial significance to a community. A design can be commercially successful because it is familiar and legible while specialists regard it as aesthetically conventional. An experimental practice can possess high aesthetic importance within a field while lacking a stable market. A landscape can have aesthetic value for residents even where market valuation is weak or where monetization would alter the relation being valued.

Definition 23.340 (Aesthetic-value translation record)**.** An *aesthetic-value translation record* specifies the aesthetic value claim, the economic value concept to which a translation is proposed, the mechanism and institutional procedure through which the translation occurs, the scope within which comparison is intended, the evidence supporting the translation, and the aesthetic remainder that the economic representation does not preserve.

Translation can sometimes be legitimate. Insurance, compensation, budgeting, conservation, commissioning, procurement, or cultural-policy decisions may require economic representation of aesthetically valued objects. Such representation can be practically necessary without proving that the underlying values are identical. A public decision may assign a monetary amount to preservation because budgets require commensuration, while the justification for preservation continues to depend on aesthetic, historical, ecological, civic, or cultural reasons that exceed the assigned amount.

This is also where preference language requires care. Economic choice can reveal how a person acts under a specific budget, option set, information environment, and institutional arrangement. It does not reveal the complete structure of aesthetic value. Preferences can be learned, transformed by exposure, constrained by access, affected by status, or altered through participation. Bourdieu's account of socially structured taste reinforces the point that observed choice can reflect histories of formation rather than a timeless internal ordering (Bourdieu 1984).

Proposition 23.341 (Aesthetic-economic value non-equivalence)**.** *Aesthetic value and economic value should be treated as non-equivalent unless a bounded translation procedure is explicitly justified for the relevant object, institution, decision, and horizon; observed correlation between aesthetic appraisal and economic valuation does not establish identity between the two value relations.*

The proposition does not prohibit comparison. It requires scope. A museum may compare acquisition costs, expected attendance, conservation burdens, and curatorial judgments. A city may compare design alternatives through cost, accessibility, maintenance, public use, and aesthetic criteria. A household may choose among objects through price and taste simultaneously. In each case, practical judgment can combine several dimensions while preserving their distinct meanings.

23.14.8 Limits of Economic Translation

The final interface concerns what remains after economically consequential aspects of aesthetic life have been represented. GRE can study the distribution of artistic labor, the economics of cultural institutions, aesthetic differentiation in markets, the resource conditions of creation, the attention effects of design, the conversion of reputation into price, the role of aesthetic judgment in selection, and the inequalities that structure participation. None of these objects authorizes GRE to treat aesthetic experience or value as economically exhausted.

A first limit concerns phenomenology and experience. An account of expenditure, access, and demand does not reconstruct what an experience feels like, how form unfolds through time, or why a relation becomes moving, unsettling, beautiful, ugly, sublime, coherent, or expressive. Dewey's processual aesthetics is relevant precisely

because aesthetic experience is organized through interaction and temporal development rather than reducible to ownership of an object (Dewey 1934). Economic analysis can identify conditions of access and consequence while leaving the constitution of experience open.

A second limit concerns standards and criticism. Economic success can become one datum within an aesthetic field, but it cannot substitute for the field's critical practices. Whether a work is derivative, formally innovative, coherent, manipulative, profound, kitsch, technically accomplished, or historically important requires interpretive and comparative judgments whose warrants are not supplied by revenue or audience size alone. Those standards can themselves be disputed and historically formed, but contestation does not make them equivalent to market outcomes.

A third limit concerns relation-specific value. Some aesthetic relations are altered by commodification. A ritual object, shared landscape, vernacular practice, community performance, or public space can acquire a different meaning when access, ownership, reproduction, or display is reorganized around market exchange. GRE can study that transformation, including capture, exclusion, displacement, and changing participation. The transformation itself is evidence that economic translation may modify the object rather than merely measure a stable pre-economic value.

Definition 23.342 (Aesthetic relational remainder)**.** An *aesthetic relational remainder* is the set of experiential qualities, form-sensitive judgments, historically situated standards, meanings, practices, relations of participation, or domain-specific value claims that remain analytically material after the economic consequences and conditions of an aesthetic object have been represented and that cannot be warranted from the economic representation alone.

The remainder is not a declaration that aesthetics possesses a fixed and impermeable jurisdiction. Domain boundaries remain revisable. It is a discipline of nonerasure. When economic analysis translates aesthetic objects into demand, price, labor, access, attention, capability, or institutional cost, it should state what the translation does not preserve.

Definition 23.343 (Aesthetics correction return)**.** An *aesthetics correction return* is a finding from aesthetic inquiry or a relevant practice of criticism, design, art, architecture, craft, or cultural interpretation that requires GRE to revise an assumed judgment type, salience mechanism, orientation pathway, curiosity account, value-formation mechanism, possibility profile, or economic translation.

Correction can also move toward aesthetics. GRE may reveal that apparent freedom of taste depends on unequal access, that an institution's canon is reinforced by concentrated funding, that aesthetic labor is sustained through hidden unpaid work, that a design convention creates economic dependence, that platform ranking narrows exposure, or that a community's aesthetic practice becomes vulnerable through property or land-market change. These economic findings do not settle aesthetic value, but they can change how the conditions of judgment and practice are understood.

Definition 23.344 (GRE–aesthetics interface portfolio)**.** A *GRE–aesthetics interface portfolio* is a versioned collection of aesthetic-judgment profiles, salience pathways, orientation analyses, curiosity profiles, value-formation records, aesthetic possibility

profiles, value-translation records, aesthetic relational remainders, and correction returns across projects.

Proposition 23.345 (GRE–aesthetics interface answerability)**.** *A GRE–aesthetics interface is answerable when the aesthetic object or judgment, economic condition or consequence, translation pathway, domain-specific remainder, evidence, boundary, and possible correction returns are explicit enough that contrary economic or aesthetic analysis can revise the mechanism, narrow the claim, alter the proposed translation, or withdraw it.*

The interface therefore gives aesthetics a bounded but consequential position within GRE. Aesthetic judgment can shape salience, direct orientation, provoke curiosity, participate in value formation, influence design and participation, and alter how scarce attention and resources are allocated. Economic organization can in turn distribute the time, security, spaces, infrastructures, exposure, training, tools, and institutional recognition through which aesthetic possibility develops. These relations justify sustained economic inquiry while preserving the non-equivalence of aesthetic and economic value. The next section turns from neighboring domains to GRE's outward contribution. Section 540 asks which concepts GRE can export to other domains, under what translation conditions, and with what restrictions against treating economic formulations as universal GR vocabulary.

23.15 Cross-Domain Portability of GRE Concepts

The preceding interfaces examined how history, governance, law, political theory, education, ecology, artificial-intelligence studies, social theory, and aesthetics can correct or extend an economic inquiry without being absorbed into it. The present section reverses the direction of travel and asks which analytical resources developed within Generative Relational Economics can be useful to neighboring domains. Its role in Chapter 23 is therefore neither to enlarge GRE's jurisdiction nor to propose a completed general Generative Relational Theory. Its objective is to identify concepts whose internal structure may be portable while preserving the economic typing, evidential warrant, normative authority, and domain-specific remainders that made those concepts meaningful in their original setting. The discussion considers eight candidate resources: relational allocation, generative value, value conversion, value circulation, economic generativity, economic asymmetry, economic participation, and economic spacetime. The method is comparative and translation-sensitive. Each candidate is decomposed into a potentially portable analytical kernel and a set of economic commitments that require revalidation, modification, or removal when the concept enters another domain.

The language of "export" is therefore used only as shorthand for disciplined outward transfer. A concept developed in GRE can become useful elsewhere because it highlights a question, distinction, relational structure, or research operation that a neighboring domain also needs. Such usefulness does not establish that the GRE formulation is the most general formulation, that the receiving domain lacks its own prior concepts, or that the transferred vocabulary should displace domain-specific terminology. The translation discipline developed in Section 23.3 applies with partic-

ular force here because the originating framework has an obvious incentive to overestimate the generality of its own constructions.

Definition 23.346 (GRE outward-transfer record)**.** A *GRE outward-transfer record* identifies a GRE concept proposed for use in another domain, its original economic problem, the analytical structure proposed for preservation, the economic assumptions or value commitments that should not transfer automatically, the receiving domain's corresponding object and warrant, anticipated translation losses, domain-specific remainders, and the conditions under which the receiving domain should revise or reject the transfer.

The record turns outward contribution into an answerable interface rather than a vocabulary claim. For example, the distinction between nominal receipt and effective conversion can be useful in education, law, or governance, yet the relevant resource, recipient, capability, institution, and evaluative standard must be reconstructed locally. A relational-allocation model of educational opportunity cannot assume that an educational good is adequately specified by its economic cost. A value-conversion model of ecological restoration cannot assume that ecological value is an economic value form. A participation model used in political inquiry cannot infer political standing from economic participation.

Definition 23.347 (Portable analytical kernel)**.** A *portable analytical kernel* is the smallest explicitly stated structure of a GRE concept that can be proposed for cross-domain use without requiring the receiving domain to adopt the concept's full economic semantics, original evidential assumptions, or normative commitments.

The kernel is deliberately smaller than the source concept. It may consist of a distinction, a sequence of analytical questions, a typed relation, a provenance requirement, or a formal pattern. Portability becomes stronger when the receiving domain can reconstruct the kernel using its own objects and evidence rather than merely reusing economic terminology.

Proposition 23.348 (Portability without universalization)**.** *Successful use of a GRE concept in a neighboring domain supports the portability of the preserved analytical structure for the stated task; it does not by itself establish that the concept is a universal GR primitive, a domain-independent ontology, or a replacement for the receiving domain's own conceptual architecture.*

Table 23.15 summarizes the eight outward-transfer candidates developed below. The final column is as important as the portable kernel because it records what should remain open after translation.

23.15.1 Relational Allocation

Relational allocation was developed most fully in Chapters 12 and 13 to correct an overly narrow representation of allocation as a transfer of a quantity to a nominal recipient. GRE retains the administrative importance of recipients and holdings while asking additional questions about access, usability, control, enabling conditions, higher-order relations, temporal sequencing, spatial incidence, dependency, and later possibility. The potentially portable contribution is therefore not a particular economic allocation rule. It is an analytical discipline for examining how

Table 23.15: Candidate GRE resources for cross-domain analytical transfer

GRE resource	Portable analytical kernel	Illustrative receiving questions	Non-automatic transfer
Relational allocation	Allocation changes relations, enabling conditions, incidence, and later possibilities in addition to nominal holdings	Educational opportunity, legal access, governance authority, ecological stewardship, institutional capacity	Economic scarcity assumptions, monetary comparability, administrative recipient types
Generative value	Present processes can be evaluated partly through later valuable capacities or possibilities under an explicit standpoint and horizon	Learning, institutional capacity, ecological regeneration, cultural continuity, public knowledge	The receiving domain's value standard and normative authority
Value conversion	Heterogeneous value-bearing conditions may change type through identifiable interfaces with losses and asymmetries	Knowledge use, rights realization, capability formation, ecological or cultural translation	A common metric, exchange rate, or economic definition of value
Value circulation	Value-bearing effects can move, return, concentrate, dissipate, or be captured through traceable pathways	Knowledge circulation, institutional return, community benefit, cultural reproduction	Identity between physical movement, symbolic circulation, and value circulation
Economic generativity	Present relations can change later capacities, rules, option spaces, and conditions of further generation	Education, governance, history, law, ecology, technology	Positive value, progress, teleology, or economic mechanism
Economic asymmetry	Position-relative differences require typed comparison and a mechanism before being interpreted as dependence or power	Epistemic, legal, political, technological, educational, ecological relations	A universal metric of advantage or automatic inference to power
Economic participation	Participation includes practical access, consequential contribution, standing, recognition, capability effects, dependency, and exit	Education, governance, organizations, AI mediation, community processes	Citizenship, legal personality, moral standing, or political legitimacy
Economic spacetime	Temporal order and relational position can jointly condition accessibility, trajectory, delay, and later possibility	Historical process, policy timing, institutional change, education, ecology, AI diffusion	Physical spacetime ontology, relativistic structure, or one universal geometry

an intervention changes a relational configuration beyond the moment of formal assignment.

The kernel can be stated through a sequence of questions. What is being allocated or reorganized? Which position is formally recognized as recipient or bearer? Which complementary conditions determine effective use? Which relations among positions are altered? Which higher-order institutions or infrastructures change? How do incidence and consequences propagate across time and scale? Which later capacities, dependencies, or options become more or less reachable? Neighboring domains can reconstruct these questions around objects that are not primarily economic.

Education provides one example. A scholarship can be represented economically as a transfer of resources, but an educational analysis may also examine mentorship, admission, time, language access, institutional belonging, pedagogical attention, laboratory access, peer relations, and the capacity to continue learning. Law provides another example. A formal entitlement can allocate a right while practical access depends on information, representation, procedural capacity, enforcement, and institutional recognition. Governance can allocate decision authority, agenda access, or administrative capacity. Ecological governance can allocate stewardship duties, monitoring access, use rights, restoration responsibility, or burdens of conservation. In each case, the useful transfer lies in distinguishing nominal assignment from rela-

tionally realized consequence.

Definition 23.349 (Relational-allocation portability profile)**.** A *relational-allocation portability profile* specifies the receiving domain's allocable object or condition, formal recipient or bearer, conversion and enabling conditions, affected relations and higher-order structures, temporal and spatial incidence, later capability or option effects, relevant evidence, and the economic assumptions removed or modified during transfer.

The profile should preserve the receiving domain's own object types. In education, attention and pedagogical opportunity may require a different account from financial resources. In law, rights and duties are not interchangeable with commodities. In political inquiry, authority cannot be treated as a stock distributed without regard to legitimacy and institutional form. The relational-allocation kernel travels most successfully when it prompts a richer incidence analysis while allowing the receiving domain to specify what allocation means.

A further caution concerns causality. A relational consequence that follows an allocation is not necessarily the purpose of the allocation, and a later difference among positions is not necessarily attributable to the allocation alone. Cross-domain use therefore requires historical and comparative evidence adequate to the receiving question. Relational breadth should increase explanatory resolution rather than convert every downstream change into an allocative effect.

Proposition 23.350 (Recipient non-exhaustion across domains)**.** *Where an allocation-like intervention materially changes access, enabling conditions, relations, institutional structures, or later feasible possibilities, analysis of the formal recipient alone can be insufficient for the receiving domain's question; the additional relational effects should be specified using that domain's own object and evidence standards.*

Relational allocation is therefore portable mainly as a way of asking what an assignment changes around and after the recipient. Its economic origin remains visible, while its wider analytical value depends on reconstruction rather than lexical adoption.

23.15.2 Generative Value

Generative value in Chapter 14 distinguishes immediate realization from the value of conditions or processes that support later generation. The concept is explicitly evaluative. It therefore carries a greater translation burden than relational allocation. Its portable kernel is the requirement to examine whether present arrangements contribute to later valuable capacities, relations, institutions, opportunities, or regenerative conditions under a specified standpoint, for identified subjects or affected positions, across an explicit horizon. The kernel does not determine what counts as valuable in the receiving domain.

This distinction matters because neighboring domains frequently confront processes whose significance is temporally distributed. Education can create capacities for later inquiry and participation. Legal institutions can preserve procedural capabilities and expectations that make later action possible. Governance can develop institutional memory and coordination capacity. Ecological restoration can alter later

regenerative conditions. Cultural and aesthetic institutions can preserve practices, repertoires, spaces, and communities through which future creation becomes possible. In each case, a generative perspective asks how present activity changes the conditions of later possibility. The receiving discipline still determines the relevant good and the standards through which its value is warranted.

Definition 23.351 (Generative-value portability record)**.** A *generative-value portability record* identifies the receiving domain's value-bearing object or process, the standpoint from which value is attributed, affected subjects or positions, the later capacity or possibility claimed to be supported, the generative mechanism, temporal horizon, uncertainty, possible harms or foreclosures, and the domain-specific warrant for treating the generated condition as valuable.

The final element is indispensable. Generativity and value remain distinct. A process can be highly generative in the descriptive sense while producing capacities that are harmful, exclusionary, coercive, ecologically destructive, or otherwise undesirable. A propaganda institution can become more capable of reproducing itself. A discriminatory legal arrangement can stabilize expectations and generate institutional competence in exclusion. A technically efficient surveillance system can enlarge informational capability while narrowing freedom. The existence of later-producing capacity does not establish its desirability.

This distinction also guards against a teleological reading. Generative value does not mean that later states are inherently better because they are later or because more activity can be generated. The relevant standpoint may value preservation, repair, restraint, reversibility, diversity, continuity, or the maintenance of conditions that prevent destructive generation. A receiving domain can therefore use the generative-value kernel without adopting a growth orientation.

Proposition 23.352 (Domain-retained value authority)**.** *When a generative-value concept is transferred from GRE, the receiving domain retains responsibility for establishing what counts as valuable, for whom, under which normative or evaluative standard, and across which horizon; the existence of a generative mechanism does not transfer evaluative authority from economics.*

The portable contribution is consequently temporal and relational rather than normatively sovereign. It encourages inquiry into how present conditions reproduce or transform later valued possibilities while requiring the receiving discipline to defend the value claim in its own terms.

23.15.3 Value Conversion

Value conversion in Chapter 14 was introduced to analyze situations in which a value-bearing condition in one form becomes, enables, or is transformed into another. GRE uses the concept because monetary value, capability, knowledge, legitimacy, infrastructure, status, ecological condition, institutional capacity, and other value-bearing forms can interact without being reducible to one common unit. The portable kernel is therefore a typed interface analysis: identify the source form, target form, conversion mechanism, enabling conditions, losses, delays, asymmetries, and affected positions before claiming that one value relation produces another.

A neighboring domain can use this structure without accepting an economic theory of value. Knowledge can be converted into institutional practice through training, authority, documentation, and organizational routines. A legal right can become practical capability through information, representation, enforcement, and material support. Educational attainment can become occupational access through credential recognition, networks, labor-market institutions, and organizational selection. Ecological knowledge can become stewardship capacity through local authority, monitoring infrastructure, financing, and collective organization. Cultural recognition can become institutional support through curation, funding, public legitimacy, and organizational sponsorship. These examples differ in object and warrant, yet each contains a nontrivial interface between value-bearing states or capacities.

Definition 23.353 (Cross-domain conversion-interface profile)**.** A *cross-domain conversion-interface profile* records a source value-bearing condition, a target value-bearing condition defined by the receiving domain, the mechanism connecting them, necessary enabling conditions, institutional interfaces, temporal delay, conversion losses, possible capture or exclusion, uncertainty, and the evidence required to establish that the proposed conversion has occurred.

The profile keeps conversion distinct from several neighboring operations. Measurement represents a condition through an indicator. Translation maps concepts or evidence across representational systems. Exchange transfers claims or objects under institutional rules. Circulation traces movement or recurrence. Conversion claims a change in value-bearing form or realized function. These operations can occur together, but collapsing them can hide the mechanism under investigation.

Conversion analysis is especially useful where formal possession differs from realization. A right can exist without being exercisable. Information can exist without becoming knowledge usable by a particular position. Funding can exist without producing institutional capability. Recognition can exist symbolically without changing access or standing. The conversion question directs attention toward the interfaces that make a value-bearing condition actionable.

Proposition 23.354 (Typed conversion portability)**.** *A value-conversion structure is portable across domains when the receiving analysis can define the source and target types independently, identify a plausible conversion mechanism and enabling conditions, and state the losses or exclusions introduced by the interface without presuming a common metric between the two value-bearing conditions.*

This proposition makes non-commensurability compatible with analysis. Two value-bearing conditions can be related without being measured on one scale. Cross-domain conversion becomes a mechanism question first and a commensuration question only where the receiving task actually requires comparison.

23.15.4 Value Circulation

Value circulation and recirculation in Chapter 14 extend value analysis beyond a single generation event. The relevant questions concern where value-bearing effects travel, which positions receive or lose them, whether they return toward the conditions that supported their generation, where they accumulate, how they dissipate, and through which interfaces they are captured. The potentially portable kernel is

a pathway and provenance analysis rather than a claim that value behaves like a conserved substance.

This distinction matters when the concept enters neighboring domains. Knowledge can circulate among researchers, institutions, publics, and technologies, yet the movement of documents is not identical to the circulation of usable knowledge. Cultural forms can circulate while recognition, revenue, authority, and interpretive control remain concentrated. A legal innovation can diffuse across jurisdictions while practical rights remain uneven. Institutional learning can move through personnel and standards while local capability erodes. Ecological benefits can be produced in one place while burdens or risks are displaced elsewhere. A circulation vocabulary becomes informative only when the analyst specifies what is moving, what is being regenerated, and how the receiving position changes.

Definition 23.355 (Cross-domain value-circulation profile)**.** A *cross-domain value-circulation profile* specifies the value-bearing condition under study, originating relations and contributors, carriers or transmission media, intermediate conversions, recipient and affected positions, return pathways, sites of accumulation or capture, dissipation or loss mechanisms, temporal horizon, and the domain-specific evidence used to infer circulation.

The profile prevents a recurrent category error in which movement of a carrier is treated as movement of value itself. A dataset may be copied widely while remaining unusable without expertise. Money may return to a community while decision authority leaves it. A cultural work may receive global exposure while the community that sustains the practice receives little recognition or material support. Conversely, a value-bearing effect can circulate without a single material carrier moving intact, as when learning propagates through teaching, adaptation, imitation, and institutionalization.

The idea of return is similarly domain-sensitive. Return need not mean repayment to an original individual contributor. A receiving domain may identify maintenance of a shared institution, restoration of an ecological substrate, replenishment of a knowledge commons, preservation of a cultural practice, or expansion of future participation as a relevant return. Whether such a return is normatively appropriate remains an independent question.

Proposition 23.356 (Carrier–value distinction)**.** *Cross-domain claims of value circulation should distinguish the movement of physical, financial, informational, legal, symbolic, or organizational carriers from the generation, preservation, conversion, or realization of the value attributed to those carriers within the receiving domain.*

Value circulation is therefore portable when it improves provenance: who contributed, what moved, what changed form, who benefited, what returned, what was captured, and what conditions were reproduced or depleted. The concept should be withdrawn where no identifiable value-bearing pathway can be distinguished from ordinary movement, communication, or diffusion.

23.15.5 Economic Generativity

Generativity is one of the most portable concepts used by GRE and therefore one of the concepts most vulnerable to premature generalization. Within the economic domain, generativity concerns the capacity of present relations, institutions, resources, events, or processes to alter what can be generated later. Chapters 12–20 apply this idea to capability, value, infrastructure, power, knowledge, artificial intelligence, participation, institutions, and economic order. The portable kernel is a future-forming mechanism: a present configuration modifies later capacities, relations, rules, state spaces, option structures, or conditions of further transformation.

This kernel can be reconstructed in many neighboring domains. Education can alter the capacity to learn and inquire later. Law can stabilize or modify the rules through which future claims and relations become possible. Governance can create administrative capacity, institutional memory, and revisable procedures. Historical processes can change the repertoire of available institutions or identities. Ecological processes can reproduce or degrade conditions for later life and regeneration. Technological systems can expand capacities while generating new dependencies. Social relations can reproduce categories, positions, expectations, or networks that condition later action.

Definition 23.357 (Cross-domain generativity kernel)**.** A *cross-domain generativity kernel* identifies a present relation, event, institution, or process; a receiving-domain object that can be generated, reproduced, transformed, or foreclosed; a mechanism connecting present and later conditions; a temporal horizon; relevant feedback or maintenance relations; uncertainty; and evidence capable of distinguishing the proposed generative pathway from mere temporal succession.

The last requirement is central. A later state following an earlier state does not establish generativity. The analyst needs a mechanism or evidential basis for claiming that the earlier configuration helped produce or constrain the later possibility. Historical path dependence, institutional reproduction, developmental learning, ecological regeneration, and technological lock-in can all support generative claims, but their mechanisms differ.

A second restraint concerns normativity. Generativity can support valued possibilities, reproduce harmful institutions, increase concentration, create dependence, amplify fragility, or narrow future option spaces. The same process can be generative along one dimension and depletive along another. The concept therefore gains analytical value when the object of generation is typed rather than when "generative" becomes an honorific adjective.

Proposition 23.358 (Typed generativity transfer)**.** *A generativity concept is portable across domains when the receiving analysis specifies what is generated or foreclosed, by which mechanism, for which positions or systems, across which horizon, and with what evidence; generativity alone does not establish improvement, desirability, progress, or normative priority.*

This condition also clarifies the relation between GRE and a possible future GRT. Repeated domain-specific success of a typed generativity kernel would provide comparative evidence for a broader relational language. It would still leave open whether different domains instantiate one sufficiently common structure to justify general

theory. Section 544 will return to that question after the chapter examines imports, non-equivalent concepts, and boundary disputes.

23.15.6 Economic Asymmetry

GRE treats asymmetry as a typed and relation-dependent difference rather than a single scalar ranking. Chapters 16 and 18 show why this discipline matters for power and artificial intelligence: two positions can differ in productive capacity, information, liquidity, legal protection, exit options, recognition, institutional authority, technological capability, or control over conversion interfaces. These differences do not have the same meaning and need not move together. The portable kernel is therefore a comparison architecture that identifies the dimension, relation, reference set, scale, and mechanism through which a difference becomes consequential.

Neighboring domains can benefit from this discipline because asymmetry is pervasive but heterogeneous. Epistemic inquiry can compare access to information, expertise, interpretive capacity, or verification resources. Law can examine asymmetry in procedural capability, enforcement access, legal representation, or institutional recognition. Political theory can examine agenda control, authority, participation, and coercive capacity. Education can examine differences in preparation, mentorship, institutional access, or capacity to convert formal opportunity into learning. AI studies can distinguish technical capability asymmetry from deployment authority, access, verification capacity, and institutional control. Ecological governance can examine asymmetric exposure to environmental burdens or unequal capacity to shape resource decisions.

Definition 23.359 (Cross-domain asymmetry profile)**.** A *cross-domain asymmetry profile* specifies the compared positions, relation in which comparison is meaningful, dimension or capability being compared, scale and horizon, relevant baseline, conversion conditions, dependence or vulnerability pathways, institutional mediators, and the receiving domain's evidence for treating the difference as analytically consequential.

Typed comparison prevents several shortcuts. A difference in one capability does not establish global superiority. A statistically unequal distribution does not automatically establish a relation of domination. Dependence requires a mechanism connecting the weaker position's options to the stronger position or to an institution that controls a relevant interface. Power requires further analysis of how asymmetry is exercised, reproduced, resisted, legitimated, or transformed. These requirements protect the receiving domain from importing GRE's conclusions together with its diagnostic vocabulary.

Asymmetry analysis is also inherently historical. A small initial difference can compound through feedback, while a large observed difference can be temporary or institutionally buffered. Formal equality can coexist with practical asymmetry where conversion conditions differ. Conversely, unequal capacities can coexist with protective institutions that prevent one position from controlling another. The receiving domain therefore needs both a typed comparison and an account of the mechanisms that translate difference into consequence.

Proposition 23.360 (Asymmetry–power non-identity across domains)**.** *A cross-*

domain asymmetry establishes a typed difference between specified positions; an inference to dependence, domination, authority, or power requires additional evidence concerning the mechanism through which that difference alters options, control, vulnerability, standing, or the conditions of relation formation.

The portable contribution is consequently diagnostic precision. It encourages researchers to ask "asymmetry of what, between whom, in which relation, over what horizon, and through which consequential pathway?" without presuming that the economic answer supplies the legal, political, social, or ethical interpretation.

23.15.7 Economic Participation

Economic participation is developed in Chapters 12, 18, and 20 as a broad relation through which subjects or collectives can gain practical access to economically consequential processes, contribute, be recognized, influence decisions, acquire capability, become dependent, and retain or lose viable exit and transition options. The portable kernel is a multidimensional account of participation that distinguishes formal presence from practical access and consequential standing.

This kernel has obvious relevance outside economics. Educational participation can involve admission, attendance, voice, access to instruction, capacity to contribute, recognition of learning, and later capability formation. Governance participation can involve information, agenda access, deliberation, representation, decision standing, and the practical capacity to contest outcomes. Organizational participation can distinguish membership from influence. AI-mediated systems can distinguish a human being present in a workflow from a human retaining consequential judgment or revision capacity. Community institutions can distinguish nominal consultation from durable participation in rule formation and maintenance.

Definition 23.361 (Cross-domain participation profile)**.** A *cross-domain participation profile* records eligibility or formal inclusion, practical access, modes of contribution, decision or interpretive standing, recognition, capability effects, dependencies created through participation, burdens and risks, contestation channels, and viable exit or transition conditions, using the receiving domain's own account of who or what can participate.

The final clause prevents a particularly serious overextension. GRE's use of economic participation does not determine political citizenship, legal personality, moral standing, ecological subjecthood, or the philosophical agency of artificial systems. A domain can use the participation profile for positions it independently recognizes without inheriting GRE's subject classification. The interface with AI studies in Section 23.12, for example, distinguished functional economic agency from broader agency or subjecthood. The same restraint applies here.

Participation also has generative consequences. Repeated involvement can produce skills, knowledge, networks, confidence, institutional memory, identity, dependence, or exclusion. These effects can alter who can participate later and on what terms. A receiving domain can therefore combine the participation kernel with generativity while keeping the two questions distinct: whether participation occurs now and what present participation generates for later relations.

Proposition 23.362 (Participation typing condition)**.** *A participation concept transferred from GRE is adequate only after the receiving domain independently specifies eligible positions, forms of consequential involvement, relevant standing, burdens, capability effects, and exit or revision conditions; economic participation does not confer legal, political, moral, or ontological status outside the economic problem-space.*

The portable contribution is thus an anti-tokenism architecture rather than a universal membership theory. It helps distinguish being counted, being present, being able to act, being heard, having standing, and being able to shape future conditions.

23.15.8 Economic Spacetime

Economic spacetime in Chapter 15 provides a joint representation of temporal order and relational or spatial position where both dimensions materially affect accessibility, trajectory, delay, propagation, and later economic possibility. The term is intentionally representational. GRE does not infer a physical spacetime ontology from the usefulness of modeling economic events through temporal and relational structure. The portable kernel is therefore weaker and potentially more useful: some processes cannot be represented adequately by chronology alone or by a static relational map because when an event occurs and where a position stands jointly condition what becomes reachable next.

Neighboring domains frequently encounter this joint dependence. Historical inquiry can compare trajectories whose later options depend on event order, institutional location, and path-dependent accessibility. Governance can examine policy timing relative to administrative capacity and affected regions or networks. Law can examine sequences in which jurisdiction, status, procedural stage, and timing jointly determine available remedies. Education can examine learning trajectories where prior knowledge, institutional position, and timing condition access to later opportunities. Ecology can examine spatially distributed processes with delayed effects and cross-scale propagation. AI studies can examine uneven diffusion of technical capability, infrastructure, institutional adoption, and regulatory response across heterogeneous locations and organizational positions.

Definition 23.363 (Cross-domain spacetime portability profile)**.** A *cross-domain spacetime portability profile* specifies the receiving domain's event or process types, temporal ordering, modeled positions or locations, accessibility relations, delays, trajectories, relevant boundaries, scale relations, observables, and the claim that would be lost if time and position were analyzed separately.

The final requirement keeps the representation proportional. Many questions need only chronology. Others need only a network, map, institutional hierarchy, or sequence model. Spacetime language earns its place when the interaction between temporal order and position changes the inference. A policy introduced at the same calendar date can reach regions at different effective times because administrative infrastructure differs. The same legal rule can generate different trajectories when jurisdictional position or prior procedural history differs. An educational opportunity can become available too late for one trajectory even if the nominal resource eventually reaches the learner.

The kernel can also preserve heterogeneous presents. Different positions may in-

habit different effective states at the same clock time because information, infrastructure, rights, capabilities, or institutional responses arrive unevenly. This observation can be useful without invoking relativity or a common geometry across domains. The receiving discipline defines the relevant notion of accessibility and the evidence through which it is observed.

Proposition 23.364 (Cross-domain spacetime proportionality)**.** *A spacetime-style representation is portable to a neighboring domain when temporal order and modeled position jointly alter the target mechanism, accessibility relation, trajectory, or reachable alternatives and when a simpler chronology or static relational representation would omit that joint dependence.*

Economic spacetime is therefore best exported as a disciplined representational question rather than a metaphysical template. It asks whether process, position, accessibility, and history need to be modeled together, then leaves the receiving domain to specify the geometry, topology, ordering, institutional structure, or qualitative narrative appropriate to its evidence.

The eight candidates considered in this section vary substantially in portability. Relational allocation, typed asymmetry, participation profiling, and spacetime representation can often travel as analytical question structures. Generative value and value circulation carry heavier evaluative and semantic burdens. Value conversion requires explicit source and target types. Generativity is highly portable as a future-forming question while remaining especially vulnerable to rhetorical overextension. These differences should be recorded rather than hidden under a generic claim of interdisciplinarity.

Definition 23.365 (GRE portability portfolio)**.** A *GRE portability portfolio* is a versioned collection of outward-transfer records, portable analytical kernels, receiving-domain reconstructions, translation-loss ledgers, domain-specific remainders, correction returns, rejected transfers, and evidence about which GRE structures remain useful after domain-specific revalidation.

Rejected transfers belong in the portfolio because failure is theoretically informative. A concept can prove too dependent on economic institutions, too normatively loaded, too vague outside its originating problem, or already better represented by a receiving discipline's own vocabulary. Such outcomes narrow GRE's claims and improve the comparative basis for any later generalization.

Proposition 23.366 (Outward-contribution answerability)**.** *A claimed GRE contribution to a neighboring domain is answerable when the originating economic concept, portable kernel, receiving object, reconstruction procedure, evidence, translation losses, retained domain-specific remainder, and revision or rejection conditions are explicit enough that researchers in the receiving domain can modify, localize, or refuse the proposed transfer.*

Outward portability strengthens GRE when it exposes the limits of GRE's own formulations. Successful reconstruction across several domains may reveal a reusable analytical structure, while failed transfer can reveal economic specificity. Neither outcome justifies disciplinary absorption. Section 541 examines the concepts and insights GRE must import from neighboring domains to remain empirically adequate and disciplinarily answerable.

23.16 Neighboring-Domain Contributions to GRE

Section 23.15 examined how analytical structures developed within Generative Relational Economics may travel outward without becoming universal claims. The present section examines the reciprocal direction. Its role in Chapter 23 is to specify how GRE can depend on knowledge generated elsewhere while preserving the disciplinary authority, evidential basis, conceptual distinctions, and normative judgments of the contributing domain. The objective is not to assemble a catalogue of external ideas around an otherwise self-sufficient economics. Economic relations are often historically formed, legally constituted, politically organized, educationally reproduced, ecologically bounded, aesthetically oriented, socially embedded, and technically mediated. A GRE claim can therefore become answerable only by making such dependencies visible. The section considers historical reconstruction, governance requirements, legal categories, political power, educational generativity, ecological constraint, aesthetic judgment, and domain-specific correction returns. The method is provenance-preserving and dependency-sensitive: an imported premise is translated for an economic question without being redescribed as if GRE had independently established it.

The language of "import" is used here as shorthand for disciplined incorporation. It does not imply ownership of the imported concept, priority over the source discipline, or semantic identity before and after translation. Some contributions enter GRE as constitutive categories, some as empirical constraints, some as interpretive warrants, some as normative limitations, and some as counterevidence. These different roles should remain distinguishable because a legal status, an ecological threshold, a historical reconstruction, and an aesthetic judgment do not acquire the same epistemic status merely because each affects an economic analysis.

Definition 23.367 (GRE inward-interface record)**.** A *GRE inward-interface record* identifies a contribution from a neighboring domain, the source-domain question and warrant supporting that contribution, the GRE question for which it becomes relevant, the translation required for economic use, the source-domain distinctions that remain authoritative, the economic claims that depend on the contribution, and the conditions under which correction or withdrawal in the source domain requires revision inside GRE.

Definition 23.368 (External-warrant dependency)**.** An *external-warrant dependency* exists when a GRE claim materially relies on a premise whose principal evidential, conceptual, or normative justification belongs to a neighboring domain rather than to GRE itself.

External-warrant dependency is not a defect. It is one consequence of disciplinary containment. The defect would arise when a cross-domain dependency is hidden and GRE presents the resulting conclusion as if its economic evidence also established the historical, legal, political, ecological, educational, aesthetic, social, or technical premise on which the conclusion rests.

Proposition 23.369 (Provenance-preserving incorporation)**.** *When a GRE conclusion depends materially on a neighboring-domain premise, disciplined incorporation preserves the provenance and epistemic status of that premise, states the economic transformation applied to it, and leaves the dependent GRE conclusion revisable if the source-*

Table 23.16: Principal neighboring-domain contributions to GRE

Source domain	Contribution to GRE	Economic claims potentially revised	Authority retained outside GRE
History and GRH	Formation sequence, contingency, inherited constraint, path dependence, multiple timescales	Causal interpretation, counterfactuals, persistence, transition, temporal scope	Historical reconstruction, periodization, source interpretation, event significance
Governance and GRG	Authority, coordination, implementation, learning, response horizons, uncertainty management	Intervention feasibility, institutional response, policy transmission, adaptive capacity	Governance design, legitimate authority, administrative practice, institutional evaluation
Law and jurisprudence	Property, contract, personhood, rights, duties, recognition, legal infrastructure	Control, entitlement, liability, exchange conditions, standing, enforceability	Legal validity, doctrinal meaning, institutional recognition, juridical status
Political theory	Power, authority, legitimacy, publicness, collective action, political recognition	Power attribution, bargaining environment, public allocation, institutional stability	Political legitimacy, authority, public standing, political interpretation
Education	Learning, capability formation, curiosity, epistemic participation, developmental conditions	Human capability, knowledge formation, participation, long-horizon generativity	Educational quality, learning warrant, pedagogical judgment, developmental interpretation
Ecology	Biophysical constraint, metabolism, non-human affectedness, ecological value, intergenerational conditions	Feasibility, resource reproduction, externalization, risk, long-horizon value	Ecological measurement, system boundaries, ecological value, non-human standing
Aesthetics	Judgment, salience, orientation, curiosity, form-sensitive evaluation	Attention, demand formation, cultural production, innovation pathways, valuation processes	Aesthetic quality, aesthetic warrant, domain-specific standards of judgment
Other neighboring domains	Domain-specific objects, counterevidence, categories, mechanisms, and correction returns	Any GRE claim whose premises cross the disciplinary boundary	Source-domain evidence, semantics, normative authority, and rejection rights

domain warrant is materially revised.

Table 23.16 summarizes the principal contribution classes developed below. The final column records the aspect over which GRE should not silently assume source-domain authority.

23.16.1 Historical Reconstruction of Economic Processes

GRE requires historical contribution whenever the meaning of a present economic configuration depends on how that configuration was formed. Section 23.4 already established the GRE–GRH interface around historical generation, inherited constraint, path dependence, multiple timescales, contingency, and retrospective re-epistemization. The inward contribution is more specific than the general claim that history matters. Historical inquiry can alter the object being explained, the relevant temporal boundary, the admissible comparison class, and the interpretation of persistence or change.

A current property regime, occupational hierarchy, market category, organizational routine, or pattern of access can look similar across two settings while arising through substantially different sequences of law, conflict, technology, migration, institutional adaptation, or accumulated convention. GRE may describe the present

relational configuration, but a formation-sensitive explanation requires evidence about those sequences. Historical reconstruction can therefore correct an economic model that treats an inherited institution as a contemporaneously selected equilibrium, mistakes a contingent sequence for a structural necessity, or chooses a temporal window too short to identify the process of interest.

Definition 23.370 (Historical reconstruction input)**.** A *historical reconstruction input* is a source-supported account of formation, sequence, inherited constraint, temporal scale, contingency, or changing interpretation that modifies the object, mechanism, comparison, or scope of a GRE analysis.

The contribution remains historically typed after incorporation. GRE can ask how the reconstructed sequence changes an economic explanation, but it should not convert archival interpretation, periodization, or historical significance into an economic conclusion merely because those judgments enter an economic model.

Proposition 23.371 (Formation-sensitive import condition)**.** *For an economic claim whose interpretation materially depends on formation history, present-state evidence alone does not complete the claim; the relevant formation, temporal boundary, and historical contingency require independently warranted historical support.*

This principle also limits formalization. A path-dependent, fast–slow, or multiscale representation can organize an economic question, yet the historical evidence determines whether the chosen state variables, transitions, and rate distinctions correspond to the case. Formal elegance cannot substitute for reconstruction of the historical process being represented.

23.16.2 Governance Requirements for Economic Intervention

GRE can diagnose how an allocation, institution, incentive, infrastructure, or value-conversion interface changes economic relations. Such diagnosis does not by itself determine how collective intervention should be authorized, coordinated, implemented, monitored, revised, or terminated. Sections 23.6 and 23.7 therefore supply a governance interface in which authority structures, institutional learning, response times, uncertainty management, and cross-frequency mismatch can correct an economically attractive intervention that is administratively unavailable or dynamically mistimed.

The inward contribution from governance is especially important when a GRE recommendation presupposes that a public or organizational actor can act coherently. Administrative capacity, jurisdiction, information flow, delegated discretion, interagency coordination, implementation sequencing, review procedures, and institutional learning can all mediate whether the proposed economic mechanism is realizable. Governance analysis can also show that an intervention changes the governing system itself. A policy may alter not only prices or resources but also monitoring capacity, trust, institutional workload, participation, or future responsiveness.

Definition 23.372 (Governance realization input)**.** A *governance realization input* specifies the authority, coordination capacity, implementation pathway, response horizon, learning mechanism, and uncertainty conditions required for an economically described intervention to become institutionally realizable.

The contribution changes the status of intervention claims. An economically coherent mechanism may remain a scenario until governance analysis supplies a plausible realization pathway. Conversely, governance evidence may identify a feasible institutional operation that requires GRE to revise its assumed transmission mechanism.

Proposition 23.373 (Intervention realization dependency)**.** *When the expected economic effect of an intervention materially depends on institutional authority, coordination, implementation, or response timing, the intervention claim inherits a governance-warrant dependency that should be represented separately from the economic mechanism itself.*

This distinction prevents GRE from treating governance as a residual transaction cost. Governance can be constitutive of the pathway through which an economic intervention exists at all.

23.16.3 Legal Categories

Many economic relations are not merely regulated by law after their formation. Legal categories can partly constitute the positions that GRE subsequently analyzes. Section 23.8 showed this for property, contract, legal personhood, rights, duties, institutional recognition, and legal infrastructure. The inward contribution is therefore not limited to adding a legal constraint to an otherwise complete economic relation. It can determine who or what can hold a right, which transfer is valid, which obligation exists, which claim is enforceable, and which institution recognizes the relevant status.

This matters directly for relational allocation and power analysis. Practical control over an asset can diverge from legal title. A contractual arrangement can be economically consequential while its validity, interpretation, or enforceability remains a legal question. A person or organization can have economic capacity without possessing the legal status that a particular transaction, entitlement, or institutional role requires. GRE must retain these distinctions rather than translating them into a single variable of effective control.

Definition 23.374 (Legal-constitutive input)**.** A *legal-constitutive input* is a juridically warranted category, status, relation, entitlement, duty, recognition condition, or institutional rule whose legal meaning partly determines the economic positions or transactions represented in GRE.

The legal contribution can be empirically consequential without becoming economically definable. GRE may study how a legal category redistributes capability, changes bargaining relations, or reorganizes value circulation, while jurisprudence and applicable legal institutions retain authority over the validity and meaning of the category itself.

Proposition 23.375 (Legal-status dependency)**.** *When an economic relation presupposes a legal status or juridical relation, economic evidence about control, exchange, behavior, or consequence cannot by itself establish that legal status; the GRE analysis should preserve the external legal warrant on which the economic representation depends.*

The resulting economic analysis is stronger because its object is more accurately

typed. Legal contribution does not narrow GRE to doctrinal analysis; it prevents economic explanation from quietly replacing the legal relations that partly constitute its subject matter.

23.16.4 Political Power

GRE develops a relational account of economic asymmetry and power, but political power requires additional distinctions concerning authority, legitimacy, collective action, public institutions, recognition, and political membership. Section 23.9 established that an economic asymmetry can become politically relevant without thereby exhausting the political relation. The inward contribution from political theory is therefore corrective at the point where an economic description begins to make claims about public authority, legitimate rule, political standing, or collectively binding decision.

A concentration of resources can condition political influence. Dependence on employment, credit, infrastructure, information, or platforms can reshape bargaining positions and participation. Yet the move from economic leverage to political power is mediated by institutions, public norms, organizational capacities, procedures of authorization, and collective recognition. Political theory can identify these mediations and can also show where apparently economic outcomes are partly generated by prior political settlements.

Definition 23.376 (Political-power correction input)**.** A *political-power correction input* specifies the political institutions, authority relations, legitimacy conditions, collective-action structures, recognition practices, or public decision mechanisms required to interpret an economically observed asymmetry as politically consequential power.

This contribution protects the distinction between power relevance and political-power attribution. It also makes reciprocal constitution visible: economic structures can condition politics, while political authority can constitute property, market access, public infrastructure, taxation, labor rules, and other economic relations.

Proposition 23.377 (Political-power attribution condition)**.** *Economic asymmetry or dependence can support a claim of political relevance, but attribution of political power requires an independently warranted account of the political mechanism through which that asymmetry enters authority, collective decision, public standing, or institutional control.*

GRE should therefore import political distinctions where the economic question crosses into political explanation rather than stretching economic power vocabulary until it contains the political domain by default.

23.16.5 Educational Generativity

Education is a central source of long-horizon capability formation, but its generativity cannot be inferred from expenditure, credential acquisition, labor-market return, or resource provision alone. Section 23.10 identified learning relations, capability generation, curiosity, aesthetic judgment, epistemic participation, educational infrastructure, and knowledge communities as objects requiring educational inter-

pretation. The inward contribution to GRE lies in specifying what kind of learning or developmental transformation has occurred and which relations enable its continuation.

This contribution can revise familiar economic categories. A resource that appears equal in nominal allocation may generate unequal educational possibility because learners differ in language access, time, mentoring, prior preparation, institutional recognition, health of the knowledge community, or capacity to convert the resource into sustained inquiry. Conversely, an educational practice with limited short-run market return may generate curiosity, judgment, interpretive range, or collective epistemic capacity that becomes economically consequential only much later and through indirect pathways.

Definition 23.378 (Educational-generativity input)**.** An *educational-generativity input* is an educationally warranted account of learning, capability formation, curiosity, judgment, epistemic participation, or knowledge-community reproduction that specifies what developmental change an economic analysis may legitimately treat as generated.

GRE can then study the resources, relations, access conditions, conversion interfaces, and later economic consequences associated with the educational change. It should not replace the educational warrant by treating wages, test outcomes, credentials, or participation counts as universally adequate proxies for learning.

Proposition 23.379 (Resource-to-learning non-deduction)**.** *An observed educational resource allocation or economic return does not by itself establish the kind, quality, or durability of learning generated; a GRE claim about educational generativity therefore requires an independently warranted educational account of the developmental transformation at issue.*

This inward contribution is especially important for the book's broader treatment of generativity. It supplies counterevidence against any tendency to equate later monetizable output with the full value of capability formation.

23.16.6 Ecological Constraint

Economic activity is materially situated within ecological systems whose dynamics are not defined by economic categories. Section 23.11 therefore treated ecological constraint, resource flows, social metabolism, stewardship, intergenerational relations, non-human affected positions, and ecological value as an interface rather than as objects that GRE can fully reconstruct internally. The inward contribution from ecology is strongest where economic feasibility, persistence, or valuation depends on biophysical conditions.

An economic process can appear viable within a monetary or institutional accounting horizon while relying on resource regeneration, waste absorption, climatic stability, biodiversity, ecosystem function, or other conditions whose dynamics are measured and interpreted ecologically. Ecological inquiry can revise the boundary of an economic system, reveal delayed or displaced incidence, and identify conditions under which a resource flow cannot be treated as indefinitely reproducible. It can also challenge a value analysis that counts only humanly monetized manifestations while

excluding non-human affectedness or ecological loss.

Definition 23.380 (Ecological feasibility input)**.** An *ecological feasibility input* is an ecologically warranted condition concerning biophysical constraint, regeneration, system interaction, non-human affectedness, ecological value, or intergenerational continuity that materially bounds an economic process or the interpretation of its consequences.

The term *constraint* should be read broadly here. Ecology can contribute limiting conditions, but it can also identify enabling relations, regenerative capacities, thresholds, and coupled processes that an economic account would otherwise omit. The source domain retains authority over the ecological object and its measurement.

Proposition 23.381 (Ecological admissibility dependency)**.** *When an economic scenario materially depends on ecological conditions for its feasibility or persistence, the scenario's economic warrant remains conditional on independently supported ecological assumptions; revision of those assumptions requires re-evaluation of the dependent economic claim.*

This principle prevents economic optimization from converting an uncertain ecological premise into a fixed background condition merely because the premise lies outside the economic model.

23.16.7 Aesthetic Judgment

Section 23.14 established that aesthetic judgment can influence salience, orientation, curiosity, value formation, cultural participation, and demand while remaining non-equivalent to price or revealed preference. Its inward contribution to GRE is therefore not a supplementary taste parameter. Aesthetic inquiry can correct the way GRE identifies what becomes perceptually salient, what attracts sustained attention, how evaluative standards are learned, and why an object or practice acquires significance before any stable market valuation exists.

This matters for cultural production, design, research orientation, innovation, place-making, education, and other domains in which aesthetic judgment can reorganize attention and possibility. Market manifestations can provide evidence about access, popularity, scarcity, prestige, or willingness to pay. They do not settle whether the relevant aesthetic judgment is warranted, historically informed, cultivated, derivative, contested, or transformed through practice.

Definition 23.382 (Aesthetic-judgment input)**.** An *aesthetic-judgment input* is an aesthetically warranted account of salience, form, orientation, quality, or evaluative discrimination that alters how GRE represents attention, curiosity, valuation, participation, or the generation of later possibilities.

The contribution can also revise causal ordering. Instead of assuming a fixed preference that precedes economic interaction, GRE may need to represent preference, salience, and orientation as historically and relationally formed. Aesthetic theory helps identify which part of that formation is aesthetic rather than economic.

Proposition 23.383 (Market-manifestation non-exhaustion)**.** *Economic manifestations of aesthetic judgment, including price, demand, prestige, and audience size, can inform an economic analysis but do not exhaust the aesthetic warrant or value on*

which the underlying judgment may depend.

This inward contribution protects both domains. GRE gains a richer account of orientation and value formation, while aesthetic judgment is not reduced to its economically visible consequences.

23.16.8 Domain-Specific Correction Architecture

The preceding seven contribution classes do not exhaust GRE's external dependencies. Social theory can revise assumptions about institutions, identity, culture, collective meaning, social reproduction, and economic embeddedness, as developed in Section 23.13. Artificial-intelligence studies can revise assumptions about technical capability, model behavior, infrastructure, deployment conditions, verification, or task-relative performance, as developed in Section 23.12. Other domains may become relevant when an economic question depends materially on their objects. The common requirement is not a fixed list of disciplines but an architecture that makes correction possible.

Domain-specific correction can operate at several levels. It may retype the object under analysis, revise a causal mechanism, narrow an empirical claim, alter a normative evaluation, change a feasible-set assumption, relocate a boundary, or show that an apparently economic category is constituted partly elsewhere. These corrections need not invalidate the whole GRE analysis. They should propagate only through the claims that actually depend on the revised premise.

Definition 23.384 (Cross-domain dependency register)**.** A *cross-domain dependency register* records, for each materially external premise used in a GRE analysis, its source domain, warrant, translation into the economic problem-space, dependent claims, current uncertainty, correction pathway, and revision status.

Definition 23.385 (Domain-specific correction return)**.** A *domain-specific correction return* is a source-domain revision, counterexample, reclassification, measurement update, normative objection, or boundary correction that bears on a premise previously incorporated into GRE and therefore requires review of the economic claims that depend on it.

This architecture also preserves intellectual debt. Once translated into GRE language, an imported distinction can become easy to mistake for an internally generated GRE concept. Recording provenance keeps visible which domain supplied the object, which transformation GRE performed, and which parts of the claim remain answerable elsewhere. Provenance is therefore epistemic as well as scholarly: it identifies where correction can originate.

Proposition 23.386 (Correction-propagation discipline)**.** *When a source-domain premise is materially revised or withdrawn, GRE should re-evaluate the conclusions that depend on that premise in proportion to the dependency; conclusions without that dependency are not thereby invalidated.*

Definition 23.387 (GRE inward-contribution portfolio)**.** A *GRE inward-contribution portfolio* is a maintained set of inward-interface records and dependency registers covering the neighboring-domain premises that materially condition a GRE inquiry, including accepted contributions, contested contributions, rejected translations, un-

resolved dependencies, and correction returns.

The portfolio complements the outward portability portfolio developed in Section 23.15. Together they prevent interdisciplinarity from becoming a one-way expansion of GRE. GRE can offer analytical structures outward, but it must also remain corrigible by historical evidence, governance knowledge, legal categories, political analysis, educational theory, ecological science, aesthetic judgment, social theory, AI studies, and other domains relevant to the case. The resulting relation is reciprocal without requiring theoretical identity.

Proposition 23.388 (Inward-contribution answerability)**.** *A cross-domain contribution strengthens GRE when its provenance, translation, dependent economic claims, retained source-domain authority, and correction pathway remain explicit enough that the contribution can revise GRE rather than merely be cited by it.*

This inward architecture prepares the next problem in the chapter. Reciprocal borrowing still leaves a difficult semantic question: concepts with the same names can occupy different roles across domains. Relation, subject, value, constraint, power, justice, generativity, institution, and historical specificity therefore require explicit comparison before cross-domain recurrence can support any stronger generalization.

23.17 Domain-Specific Semantics of Shared Concepts

Sections 23.15 and 23.16 established reciprocal movement across disciplinary interfaces: GRE can offer portable analytical structures to neighboring domains, and neighboring domains can return premises and corrections that materially revise economic inquiry. Reciprocal movement creates a further problem. The same words recur across economics, history, law, political theory, education, ecology, artificial-intelligence studies, social theory, and aesthetics, yet lexical recurrence does not establish that the words denote the same objects, perform the same inferential work, or carry the same normative authority. The role of the present section is to make that semantic problem explicit before Chapter 23 turns to boundary disputes and possible cross-domain generalization. Its objective is to compare nine recurrent conceptual families—relation, subject, value, constraint, power, justice, generativity, institution, and historical specificity—while preserving the conditions under which their meanings diverge. The method is task-relative conceptual comparison. For each family, the analysis identifies what must be typed locally, what can sometimes be compared structurally, what cannot travel without renewed warrant, and which differences should remain visible rather than being forced into one vocabulary.

The comparison extends the shared-concept profile introduced in Section 23.1. It also adds a stricter distinction between *lexical recurrence*, *structural correspondence*, and *conceptual equivalence*. Two domains can use the same term while sharing little more than a broad family resemblance. Conversely, differently named concepts can preserve a useful structural correspondence for a bounded task. Equivalence is therefore not a property inferred from words alone; it is a claim about a sufficiently specified mapping.

Definition 23.389 (Domain-specific semantic profile)**.** A *domain-specific semantic profile* records, for a recurrent concept in one domain, its object of application, identity

Table 23.17: Comparison dimensions for recurrent concepts across domain interfaces.

Comparison dimension	Guiding question	Typical source of non-equivalence
Object and identity	What is being classified, and what makes it the same object across observations or time?	Different units, memberships, boundaries, or constitutive criteria
Constitutive rule	What makes the concept obtain rather than merely appear?	Legal rule, social recognition, ecological process, pedagogical relation, or economic mechanism
Inferential role	What follows when the concept applies?	Different causal, descriptive, classificatory, or normative consequences
Evidence	How can the claim be warranted or revised?	Different manifestations, methods, records, measurements, or interpretive standards
Normative authority	Who or what can justify the evaluative conclusion?	Domain-specific standards of justice, legitimacy, value, right, stewardship, or quality
Temporal and spatial scale	Over which histories, horizons, places, or relational scales does the concept retain meaning?	Path dependence, rate differences, jurisdiction, ecosystem boundary, or institutional change
Correction source	Which domain can authoritatively challenge the classification or inference?	External expertise, affected positions, doctrine, historical evidence, or domain-specific counterexample

conditions, constitutive rules, inferential role, evidential access, normative authority, temporal and spatial scale, relations to neighboring concepts, correction source, and conditions of revision.

Definition 23.390 (Task-relative conceptual equivalence)**.** Two domain-specific concepts have *task-relative conceptual equivalence* only when the semantic dimensions required for a stated cross-domain task correspond sufficiently to support the intended inference, with non-corresponding dimensions and domain-specific remainders recorded explicitly.

The definition deliberately makes equivalence local rather than global. A legal institution and an economic institution can be comparable as durable rule-bearing arrangements for one descriptive task while remaining non-equivalent with respect to validity, authority, membership, sanction, or normative status. An ecological constraint and an economic constraint can both narrow a feasible set while differing in origin, reversibility, observability, and the authority required to modify them. Table 23.17 summarizes the dimensions used below.

Proposition 23.391 (Semantic-equivalence burden)**.** *The burden of a cross-domain equivalence claim lies with the proposed mapping: shared terminology or superficial*

functional similarity is insufficient unless the dimensions required by the target inference are shown to correspond and material remainders are retained.

This burden does not make comparison prohibitively strict. It prevents a local correspondence from silently becoming a universal identity claim. The following subsections apply the discipline to concepts that recur throughout the book and that are plausible candidates for later GR-oriented comparison.

23.17.1 Relation

Relation is the most obvious shared term in a generative relational programme and therefore one of the easiest to overgeneralize. A relation can denote exchange, dependence, obligation, recognition, authority, kinship, pedagogical interaction, ecological coupling, informational dependence, aesthetic orientation, or a formally represented connection. These relations can share structural features while differing in what constitutes the tie, who or what can occupy its positions, what evidence makes it observable, and what consequences follow from its existence.

GRE therefore should not begin a cross-domain comparison by asking whether two domains are "relational." It should ask which relation is being asserted, between what typed positions, through which mechanism or constitutive rule, over which horizon, and for which inference. An exchange relation can carry prices and transfers; a legal relation can carry rights and duties; a political relation can carry authority or subjection; an educational relation can organize learning and capability formation; an ecological relation can involve material or biological dependence without human recognition. A common graph can depict each pair as connected while preserving none of those differences by itself.

Definition 23.392 (Typed relation profile)**.** A *typed relation profile* specifies the relata, relation type, constitutive conditions, directionality, symmetry or asymmetry, persistence, scale, observable manifestations, relevant third-party or institutional mediation, and inferential consequences of a relation in its source domain.

Proposition 23.393 (Relational-form non-equivalence)**.** *Similarity in relational form does not establish semantic equivalence when the constitutive conditions or inferential consequences of the relations differ materially across domains.*

This distinction is especially important for formalization. Network, field, category-theoretic, or dynamical representations can preserve selected relational structures while abstracting from legal validity, social meaning, ecological mechanism, pedagogical content, or economic valuation. Such abstraction can be useful, but the formal edge or coupling should not inherit the full semantics of every domain-specific relation it represents.

23.17.2 Subject

Subject terminology carries even heavier domain commitments. An economic subject can be a position whose choices, capabilities, dependencies, or affectedness are relevant to an economic process. Legal personhood depends on juridical recognition and constitutive rules. Political subjecthood can involve membership, participation, representation, standing, or subjection to public power. Educational inquiry may cen-

ter a learner whose developmental and epistemic participation cannot be reduced to labor-market role. Ecology can require attention to non-human affected positions without settling philosophical or legal subjecthood. AI studies can identify functional agency while leaving consciousness, moral standing, legal personality, and political membership unresolved, as Section 23.12 emphasized.

The recurrent word therefore conceals several distinct questions: who can act, who can be affected, who can bear rights or duties, who can claim reasons, who can participate in collective decisions, who can be represented, and whose future possibilities count within a domain-specific evaluation. One answer does not automatically determine the others.

Definition 23.394 (Subject-status vector)**.** A *subject-status vector* records, for a candidate position, its domain-specific statuses concerning functional agency, affectedness, capability, recognition, legal personality, rights and duties, political membership, epistemic participation, moral standing where relevant, and the evidence or authority by which each status is assigned.

Proposition 23.395 (Subject-status non-propagation)**.** *Assignment of subject status in one domain does not by itself propagate to another domain when the receiving status depends on different constitutive rules, normative warrants, or evidential criteria.*

The vector is not intended as a universal ontology of subjects. It is an interface device for preventing one domain's status from doing unauthorized work elsewhere. A corporation's legal personality, for example, does not establish sentience; an AI system's task-level functional agency does not establish political membership; ecological affectedness does not by itself settle legal standing. Cross-domain inquiry becomes stronger when such distinctions remain explicit.

23.17.3 Value

Value is central to GRE and simultaneously one of the least suitable concepts for unqualified cross-domain equivalence. Earlier chapters distinguish heterogeneous value forms, conversion, circulation, capture, return, regeneration, and partial or absent commensurability. Chapter 23 has further shown that ecological, educational, legal, political, social, and aesthetic evaluations can enter economic inquiry without receiving their justificatory authority from economics.

The semantic problem is therefore not solved by multiplying value categories inside one economic taxonomy. Aesthetic value may depend on historically cultivated judgment and critical practice. Ecological value can involve integrity, regeneration, non-human affectedness, or stewardship. Legal and political evaluation can concern rights, legitimacy, recognition, or public justification. Educational value can concern learning, capability, curiosity, or epistemic participation. Economic value can concern heterogeneous capacities and consequences within an economic problem-space. These evaluations can interact, conflict, convert imperfectly, or become institutionally linked without becoming one substance measured in different units.

Definition 23.396 (Value-warrant profile)**.** A *value-warrant profile* identifies the object or relation being valued, the evaluative question, relevant subjects or affected positions, source of evaluative reasons, evidential manifestations, comparison proce-

dure if any, conversion conditions, non-commensurable remainder, and the domain that retains authority over the judgment.

Proposition 23.397 (Value-recurrence non-commensuration)**.** *Recurrence of value language across domains does not establish a common metric, a common source of normative authority, or a generally valid conversion rule among the relevant value forms.*

A bounded conversion can still be legitimate. A public institution may assign monetary compensation to an ecological loss, a museum may price access to aesthetic goods, or an educational programme may compare costs with learning outcomes. Such procedures can support decisions while leaving the source value partly unconverted. Practical commensuration should therefore be recorded as an institutional operation, not mistaken for proof of underlying value identity.

23.17.4 Constraint

Constraint appears comparatively neutral, but its semantics also vary. GRE can represent budgetary, infrastructural, institutional, relational, informational, and capability constraints. Historical inquiry can identify inherited constraints whose force depends on path-dependent arrangements. Law can constrain through valid rules, rights, duties, jurisdiction, or enforceability. Political structures can constrain through authority, coercion, agenda control, or dependence. Ecology can impose biophysical limits or regenerative conditions that are not created by economic valuation. Education can constrain or enable learning through access, pedagogical design, time, institutional capacity, and prior capability.

The important distinction concerns *constraint provenance*. Two domains may agree that an option is unavailable while disagreeing about why, how durably, and under whose authority it is unavailable. A model can encode both as a restricted feasible set, but intervention depends on the provenance. A financial limit might change through redistribution or credit; a legal prohibition through lawful institutional change; an ecological threshold might be physically irreversible on the relevant horizon; a historically sedimented constraint can persist even after its original cause disappears.

Definition 23.398 (Constraint-provenance record)**.** A *constraint-provenance record* identifies the constrained position or process, unavailable or costly possibilities, source mechanism, constitutive or causal basis, temporal persistence, scale, reversibility, authority capable of modification where applicable, evidential warrant, and interactions with other constraints.

Proposition 23.399 (Feasible-set non-equivalence)**.** *Two constraints that produce similar observed feasible sets remain non-equivalent for explanation or intervention when their provenance, reversibility, authority, or temporal structure differs materially.*

This proposition protects policy analysis from a common compression. The fact that two mechanisms yield the same short-run choice set does not imply that the same intervention can alter them. Cross-domain constraint analysis should therefore preserve source mechanisms even when a shared formal representation is convenient.

23.17.5 Power

Power has already required careful differentiation within the book. GRE investigates economically relevant power through asymmetry, dependence, control over access and conversion interfaces, concentration of alternatives, institutional position, and the capacity to alter another position's future possibilities. Political theory adds questions of authority, legitimacy, collective action, public institutions, domination, representation, and contestation. Law can constitute or limit powers through rights, duties, jurisdiction, standing, and enforceability. Social theory can locate power in fields, reproduction, cultural classification, identity, status, or symbolic structures. Educational and epistemic relations can generate asymmetries in knowledge, evaluation, credentialing, and participation.

These perspectives can describe one event simultaneously without being redundant. An employer's decision may involve economic dependence, contractual authority, legal constraint, organizational hierarchy, social status, and political regulation. A single generic variable called "power" would conceal which mechanism is doing explanatory work and which domain can challenge the attribution.

Definition 23.400 (Cross-domain power composition)**.** A *cross-domain power composition* records the distinct economic, political, legal, social, epistemic, organizational, or other power mechanisms materially operating in a case, the positions they connect, their sources, manifestations, conversion pathways, limits, and possible interactions without presuming that the mechanisms are instances of one identical relation.

Proposition 23.401 (Power-composition discipline)**.** *When several domain-specific power mechanisms jointly shape an outcome, explanatory adequacy requires preserving their distinct warrants unless a stronger equivalence or derivation among them has been independently established.*

This allows relations among powers to become an object of inquiry. Economic resources can purchase access to political influence; legal authority can stabilize property relations; social status can affect bargaining; epistemic authority can influence institutional decisions. Such conversions and couplings can be studied relationally without collapsing the source mechanisms into one undifferentiated power substance.

23.17.6 Justice

Justice is especially resistant to semantic collapse because the term often marks a justificatory question rather than a descriptive mechanism. GRE can examine distribution, effective options, participation, dependence, capture, conversion opportunities, burden incidence, intergenerational effects, and the generative consequences of institutional arrangements. Those analyses can supply premises to arguments about justice. They do not establish a complete criterion of justice merely by identifying economic asymmetry or generative loss.

Legal justice may involve rights, procedure, standing, remedy, equality before law, or institutional validity. Political justice can involve citizenship, legitimacy, representation, collective self-government, or the distribution of public power. Ecological justice can introduce non-human affectedness, intergenerational responsibility, envi-

ronmental burdens, and stewardship. Educational justice can concern access, learning relations, capability formation, recognition, and epistemic participation. Different traditions within each domain can also disagree internally about the relevant standard.

Definition 23.402 (Justice-authority profile)**.** A *justice-authority profile* identifies the domain-specific object of evaluation, affected positions, candidate principles, empirical premises, source of normative reasons, institutional or practical decision context, conflicts among principles, and the authority and evidence required to revise the judgment.

Proposition 23.403 (Justice non-derivation condition)**.** *A descriptive diagnosis of asymmetry, dependence, exclusion, inefficiency, or generative loss can be normatively relevant without by itself determining that the arrangement is unjust; the justice judgment requires an explicit normative warrant appropriate to the domain and case.*

The converse also matters. A justified legal or political commitment can constrain economic design even when the resulting allocation is not economically optimal under a narrower criterion. Cross-domain justice analysis therefore coordinates reasons rather than converting every reason into one metric.

23.17.7 Generativity

Generativity is perhaps the most tempting candidate for a shared GR concept because the book repeatedly asks how present relations produce later capacities, structures, meanings, options, or states. Yet the target of generation differs substantially across domains. GRE studies economically relevant generation of capabilities, value forms, relations, institutions, participation, and future possibility. Education concerns learning, curiosity, judgment, and capability formation. Ecology concerns regeneration, reproduction, resilience, metabolism, and coupled environmental processes. Social theory can examine reproduction and transformation of institutions, identity, culture, or collective meaning. History studies emergence and path-dependent formation across time. Aesthetic practice can generate salience, orientation, forms, and new standards of judgment.

The shared family resemblance is therefore future-forming structure, not a pregiven universal quantity called generativity. Each domain must specify what is generated, through which process, for whom or what, over which horizon, and by what evidence the generation is distinguished from correlation, persistence, transfer, or mere change.

Definition 23.404 (Typed generativity profile)**.** A *typed generativity profile* identifies the source configuration, generated object or capacity, generative mechanism, mediating relations, temporal horizon, affected positions, observable manifestations, counterfactual or comparative basis where available, and the domain-specific criteria by which generation is warranted.

Proposition 23.405 (Generativity target-typing condition)**.** *A cross-domain claim about generativity is informative only when the generated target and the mechanism relating present conditions to that target are typed sufficiently to distinguish generation from persistence, conversion, circulation, reproduction, correlation, or evaluative*

approval.

This condition also preserves the distinction between generativity and goodness. A process can generate new capabilities, institutions, dependencies, or forms of coordination while being normatively objectionable. Conversely, a valuable institution may preserve rather than continually generate. Generativity can therefore travel as a disciplined question structure more readily than as a shared evaluative standard.

23.17.8 Institution

Institution is another recurrent label whose apparent familiarity can hide major differences. GRE studies institutions as historically sustained relational configurations that organize allocation, access, conversion, circulation, participation, incentives, expectations, and future possibilities. Law can treat an institution partly through constitutive rules, recognized offices, jurisdiction, procedures, rights, and duties. Political theory can emphasize public authority, legitimacy, representation, and collective decision. Social theory can emphasize norms, roles, fields, reproduction, shared meaning, identity, and patterned practice. Education includes organizations and practices whose institutional form matters for learning relations and knowledge communities. AI-mediated institutions can redistribute operational roles without automatically transferring legal or political authority.

The difficulty is that an institution can be identified through different criteria even within one case. A central bank, university, family, court, market, research community, or platform may have legal, organizational, social, economic, and political dimensions whose boundaries do not coincide. Cross-domain comparison should therefore resist the assumption that one observed organization corresponds to one institution with one stable perimeter.

Definition 23.406 (Institution-constitution profile)**.** An *institution-constitution profile* records the domain-specific rules, practices, roles, memberships, authorities, resources, meanings, infrastructures, reproduction mechanisms, boundaries, and historical conditions through which an institution is identified and sustained for a stated inquiry.

Proposition 23.407 (Institutional-boundary non-coincidence)**.** *Legal, economic, political, social, educational, technical, and other institutional boundaries need not coincide even when the participating domains refer to the same named organization or practice.*

This non-coincidence is analytically productive. It can reveal where authority lies outside ownership, where economic dependence exceeds formal membership, where social norms persist despite legal reform, or where technical infrastructure reorganizes practice without changing formal governance. The institution interface should preserve these cross-cutting boundaries rather than average them into one representation.

23.17.9 Historical Specificity

Historical specificity differs from the preceding eight concepts because it functions partly as an indexing discipline for all of them. Relations, subjects, values, constraints, powers, justice claims, generative processes, and institutions can change their mean-

ing as the surrounding relational structure changes. A category that is adequate in one period can become misleading when transported backward or forward without reconstructing the institutions, vocabulary, practices, technologies, conflicts, and expectations that constituted it.

The problem is not limited to obvious anachronism. Contemporary categories can also obscure historical alternatives by making the present arrangement appear natural or inevitable. Conversely, historical analogy can become too permissive when similarities in surface form are treated as identity despite different infrastructures or institutional meanings. GRH therefore contributes more than chronological context: it supplies a correction against dehistoricized semantic equivalence.

Definition 23.408 (Historical semantic index)**.** A *historical semantic index* records the period, place, institutional configuration, relevant vocabulary and practices, technological and material conditions, salient conflicts, evidential sources, and known transformations that condition the meaning and inferential role of a concept in a historical setting.

Proposition 23.409 (Historical-indexing condition)**.** *A cross-period conceptual comparison is warranted only to the extent that the historical conditions material to the target inference have been reconstructed sufficiently to distinguish preserved structure from semantic, institutional, or practical transformation.*

Historical specificity also constrains claims about a future GRT. If a concept appears across several present-day GR domains, that recurrence may reflect common contemporary institutions, shared scholarly vocabulary, or diffusion among adjacent disciplines rather than a domain-general structure. Comparative evidence becomes stronger when a candidate concept survives both cross-domain and cross-historical variation.

Definition 23.410 (Shared-concept comparison dossier)**.** A *shared-concept comparison dossier* is a versioned set of domain-specific semantic profiles, historical semantic indices, proposed task-relative correspondences, translation-loss records, remainders, failed equivalence claims, correction returns, and evidence concerning which conceptual structures persist across domains and periods.

Proposition 23.411 (Cross-domain semantic answerability)**.** *A claim that a concept is shared across domains is answerable when the relevant domain-specific meanings, historical indices, task, proposed correspondence, preserved dimensions, remainders, evidence, and rejection conditions are explicit enough that participating domains can narrow, revise, or reject the claimed equivalence.*

These comparisons establish a stricter basis for the remaining Chapter 23 argument. Recurrent vocabulary guides inquiry but does not substitute for comparison. Some concepts may support wider GR formalization; others may remain domain families linked only by partial correspondences. Failed equivalence is informative because it identifies where domain-specific constitution remains material. Section 543 therefore turns to boundary disputes over conceptual ownership, explanatory location, classificatory authority, and the limits of borrowing.

23.18 Disciplinary Boundary Disputes

Section 23.17 established that recurrent vocabulary across domains does not by itself establish conceptual equivalence. The present section addresses the institutional and explanatory consequence of that semantic result. Its role in Chapter 23 is to examine cases in which GRE and a neighboring domain can each make a legitimate claim on the same empirical situation while asking different principal questions, using different warrants, and retaining different correction authorities. The objective is to distinguish productive overlap from disciplinary overreach without assuming that one domain possesses automatic priority. The discussion considers economic–political, economic–legal, economic–social, economic–educational, economic–ecological, and economic–epistemic boundaries before developing a procedure for productive disagreement and boundary revision. The method is jurisdictional and case-sensitive: for each dispute, the analysis asks which object is being explained, which predicates are being asserted, which evidence warrants them, which normative authority is required, and which domain is competent to revise the claim.

A disciplinary boundary dispute need not indicate conceptual failure. It can arise because one event participates simultaneously in several relational structures. A housing policy can be an allocation mechanism, a legal regime, a political decision, a social reproduction process, an ecological intervention, and an epistemic controversy over evidence. The relevant question is therefore rarely which single discipline "owns" the event. The sharper question concerns the jurisdiction of particular claims made about the event.

Definition 23.412 (Disciplinary boundary dispute)**.** A *disciplinary boundary dispute* is a contest over which domain has principal analytical, evidential, classificatory, normative, or revision authority for a stated claim concerning an object that is accessible through more than one disciplinary interface.

Definition 23.413 (Claim-jurisdiction profile)**.** A *claim-jurisdiction profile* records the object under analysis, the predicate asserted of that object, the principal problem-space to which the predicate belongs, the evidence used, the inferential rule applied, any normative warrant required, the neighboring-domain dependencies involved, and the domain or domains authorized to correct the claim.

The claim-jurisdiction profile shifts boundary analysis away from ownership of whole objects. One domain can have principal jurisdiction over one predicate while another domain has principal jurisdiction over a different predicate concerning the same case. GRE may be well placed to analyze how a licensing rule redistributes access while remaining unable, by economic evidence alone, to establish the legal validity of the license, the political legitimacy of the authority issuing it, or the ecological adequacy of the activity it permits.

Proposition 23.414 (Predicate-specific jurisdiction)**.** *For a cross-domain case, disciplinary jurisdiction is more precisely assigned to specified claims and predicates than to the empirical object as a whole; multiple domains can therefore hold non-identical and simultaneously legitimate jurisdictions over the same object.*

Table 23.18 summarizes the principal boundary-dispute classes considered below. The diagnostic is deliberately asymmetric across columns: the domains can share an

Table 23.18: Diagnostic structure of recurrent GRE boundary disputes

Boundary	Typical GRE question	Neighboring-domain jurisdiction	Common overreach risk
Economic–political	Allocation, bargaining position, dependence, conversion interfaces, economic power	Authority, legitimacy, publicness, collective decision, political recognition	Inferring political legitimacy or authority from economic effectiveness or resource control
Economic–legal	Access, control, exchange, liability incidence, enforceability effects	Legal validity, rights, duties, personhood, jurisdiction, doctrinal classification	Treating economic control as legal title or incentive compatibility as legal validity
Economic–social	Economic embeddedness, distribution, reproduction of positions, market incidence	Identity, culture, norms, collective meaning, social reproduction, relational belonging	Reclassifying socially meaningful relations as economic merely because they have economic consequences
Economic–educational	Resource allocation, capability conditions, access, long-horizon economic consequences	Learning, pedagogy, educational aims, developmental quality, epistemic participation	Treating later income or productivity as an exhaustive measure of educational value
Economic–ecological	Resource use, feasibility, externalization, intergenerational allocation, economic value	Biophysical dynamics, ecological integrity, non-human affectedness, ecological value, system boundaries	Converting ecological constraint or value into a price without preserving ecological warrant
Economic–epistemic	Information distribution, knowledge access, research incentives, epistemic labor, capability asymmetry	Truth, justification, evidential quality, expert competence, inquiry norms, correction procedures	Treating market success, attention, possession, or information advantage as epistemic warrant

object while retaining distinct questions, warrants, and overreach risks.

23.18.1 Economic–Political Boundary

Economic and political analysis overlap strongly where resources affect collective decision and public authority shapes allocation. GRE already treats power as relationally mediated through control over access, conversion interfaces, alternatives, dependencies, and future possibilities. Political theory adds predicates that economic analysis does not independently establish: authority, legitimacy, representation, public standing, political membership, collective obligation, and the justification of binding decisions. A boundary dispute arises when one vocabulary is used to infer the other without the necessary warrant.

Economic resources can alter political feasibility. Wealth can finance organization, media, expertise, litigation, lobbying, campaigning, or sustained participation. Employment dependence, ownership concentration, infrastructure control, and unequal exit options can shape the effective bargaining position of political actors. These are legitimate economic contributions to a political analysis because they identify material conditions under which political action occurs. Their presence does not settle whether an actor has lawful or legitimate authority, whether a public decision is justified, or whether a collective procedure constitutes adequate representation.

The reverse direction is equally important. Political decisions can constitute the economic environment by determining taxation, public expenditure, regulation, monetary institutions, public ownership, social insurance, borders of market participation, and the recognized scope of collective provision. GRE can analyze the economic consequences of these decisions, while the political predicates attached to

them remain answerable to political theory and relevant public institutions.

Definition 23.415 (Economic–political jurisdiction split)**.** An *economic–political jurisdiction split* distinguishes claims concerning resource-mediated capacities, constraints, dependencies, allocations, and economic power from claims concerning public authority, legitimacy, representation, political membership, and justified collective decision.

A dispute can become especially difficult when the same relation has both economic and political effects. Control of a communication platform, energy network, payment infrastructure, or large employer can produce economic dependence and also alter public discourse or collective bargaining. The proper response is not to force the relation into one domain. The claim-jurisdiction profile should instead identify which mechanism is economic, which predicate is political, and where causal coupling occurs.

Proposition 23.416 (Political-authority non-derivation)**.** *Economic control, efficiency, bargaining strength, or capacity to implement an outcome does not by itself establish political authority or legitimacy; such predicates require political warrants in addition to any economic analysis of the underlying resource relation.*

This condition also protects GRE from the opposite error. A politically legitimate decision can have economically unequal, inefficient, dependency-producing, or capability-reducing consequences that remain proper objects of economic analysis. Political legitimacy therefore does not immunize an allocation from GRE criticism, just as economic performance does not establish political legitimacy.

23.18.2 Economic–Legal Boundary

The economic–legal boundary is constitutive rather than merely adjacent. Property, contract, corporate form, personhood, liability, inheritance, bankruptcy, licensing, labor status, intellectual property, and many other legal categories partly constitute the positions through which economic relations become possible. GRE therefore depends on law in cases where the economic object cannot be adequately typed without a legal classification. At the same time, legal doctrine and institutional recognition have their own criteria of validity that economic analysis cannot replace.

One recurrent dispute concerns property and control. An actor can exercise substantial economic control without holding full legal title, while a legal owner can have limited practical control because of regulation, contractual delegation, fiduciary duty, debt, organizational structure, or dependence on infrastructure controlled elsewhere. GRE can investigate control, access, exclusion, incidence, and downstream generativity. Jurisprudence and positive law determine the legal rights, duties, powers, liabilities, immunities, procedures, and recognized statuses involved.

Contract produces a similar distinction. An exchange can be economically advantageous while legally invalid, unenforceable, voidable, or prohibited. A legally valid contract can also generate severe economic dependence or unequal future capability. Economic analysis can therefore test the relational consequences of a contract without converting those consequences into a conclusion about legal validity.

Definition 23.417 (Economic–legal constitution record)**.** An *economic–legal consti-*

tution record identifies the legal categories and institutional acts that constitute an economic position, the economic relations that arise through those categories, the legally authoritative predicates that GRE imports, and the economic consequences that remain available for independent GRE analysis.

This record is especially important for heterogeneous subjecthood. Economic participation, functional agency, legal personhood, organizational standing, liability-bearing capacity, and ownership eligibility need not coincide. A platform, corporation, automated system, household, association, or informal group can occupy a complex combination of these statuses. The legal interface determines some of them; GRE should not infer the others by analogy.

Proposition 23.418 (Legal-constitution preservation)**.** *When a legal category materially constitutes the economic relation under study, GRE should preserve that legal provenance and should not substitute economic performance, control, incentive compatibility, or observed exchange for the source-domain determination of legal status.*

The boundary remains reciprocal. Legal analysis can also benefit from GRE when formally identical legal categories generate different economic capacities because of unequal resources, information, alternatives, or relational positions. The interface therefore supports mutual correction without collapsing legal validity into economic effect or economic effect into legal validity.

23.18.3 Economic–Social Boundary

The economic–social boundary is difficult because economic relations are commonly embedded in social relations whose meanings exceed exchange or resource allocation. Families, friendships, status groups, professional communities, neighborhoods, religious communities, civic associations, and cultural networks can organize labor, care, trust, access, reputation, information, and opportunity. These consequences make them economically relevant. Their economic relevance does not exhaust their social constitution.

A boundary dispute often appears when an economically consequential social relation is redescribed as a market-like exchange. Reciprocity within kinship, care, friendship, or community can involve resources and expectations, yet the relation may be constituted through identity, obligation, belonging, affection, ritual, history, or collective meaning that cannot be reconstructed from price, contract, or utility alone. GRE can analyze how the relation affects access, capability, distribution, dependence, or future possibility while leaving the social-theoretical remainder intact.

The opposite dispute occurs when social explanation absorbs economic structure. Culture, identity, norms, and collective meaning can shape economic behavior, but they do not eliminate material asymmetries in property, income, bargaining alternatives, infrastructure, or institutional access. Social theory can therefore correct a thin economic account of motivation, while GRE can correct a social account that underrepresents material constraints or conversion mechanisms.

Definition 23.419 (Socially embedded economic object)**.** A *socially embedded economic object* is an economic relation whose operation or meaning materially depends on social identities, norms, institutions, fields, practices, or collective meanings that

require independent social-theoretical description.

The social boundary is therefore crossed by specifying the economic predicate rather than by retyping the whole relation as economic. For example, a family relation may be economically relevant because it redistributes care time and income; a professional network may affect job access; a status order may shape consumption or credit. Those predicates can be studied economically while the family, network, or status relation remains a broader social object.

Proposition 23.420 (Economic-incidence non-absorption)**.** *The presence of economically measurable consequences in a social relation is sufficient to motivate an economic interface, but it is not sufficient to absorb the relation's social constitution, identity conditions, meanings, or normative structure into GRE.*

This principle preserves the social relational remainder developed in Section 23.13. It also prevents disciplinary containment from becoming isolation: GRE can remain sensitive to culture, identity, and social reproduction while acknowledging that these objects are not exhausted by their economic incidence.

23.18.4 Economic–Educational Boundary

Education creates economic capabilities and is also a practice with educational aims that exceed later economic output. The boundary dispute therefore concerns the relation between economic conditions of learning and the internal standards by which learning, understanding, judgment, curiosity, participation, and development are evaluated. GRE has legitimate jurisdiction over resource access, opportunity cost, institutional funding, labor conditions, unequal participation, capability conversion, and long-horizon economic consequences. Educational theory retains authority over pedagogical adequacy and educational value where those judgments require educational warrants.

The category of human capital illustrates the problem. Income, productivity, employability, and occupational mobility can capture important economic consequences of education. They cannot by themselves establish whether a learner developed understanding, intellectual autonomy, curiosity, aesthetic or normative judgment, civic capacity, or the ability to participate in knowledge communities. Conversely, educational ideals can be materially constrained by tuition, time poverty, housing, health infrastructure, family responsibilities, labor markets, digital access, and institutional funding. An educational account that ignores these conditions can overstate the practical availability of its own aims.

Definition 23.421 (Economic–educational profile)**.** An *economic–educational boundary profile* separates the economic conditions and consequences of learning from the educational objects, aims, developmental processes, and evaluative standards through which learning quality is judged.

The boundary is especially important for generativity. A learning process can generate later economic capabilities while also generating epistemic, social, civic, aesthetic, or personal capacities. GRE can study one subset of these transformations, including interactions among them, without turning economic realizability into the measure of the others.

Proposition 23.422 (Educational-end non-exhaustion)**.** *Economic outcomes of education can constitute relevant consequences and constraints, yet they do not exhaust the educational ends or developmental qualities of the learning process unless an independently defended educational theory establishes that narrower evaluative scope.*

Boundary disagreement here can be productive because it reveals mismatches between what institutions fund and what education seeks to cultivate. GRE can make the resource structure visible; educational theory can show which valued capacities disappear when economic metrics become the dominant proxy.

23.18.5 Economic–Ecological Boundary

The economic–ecological boundary concerns both feasibility and value. Economic production, consumption, infrastructure, settlement, and trade operate through material and energetic relations whose dynamics are not constituted by economic categories. Ecology can identify system boundaries, regeneration processes, coupled populations, ecological thresholds, non-human affectedness, and long-horizon conditions that constrain economic possibilities. GRE can analyze how institutions allocate access to ecological resources, distribute exposure and risk, shape incentives, mediate conversion, and transmit consequences across subjects and generations.

A boundary dispute arises when ecological objects are translated into economic value. Pricing can be useful for specified decisions, accounting regimes, or policy instruments. A price does not thereby become an exhaustive representation of ecological integrity, non-human standing, irreversible loss, or ecological value. The translation can be pragmatically admissible while leaving a substantial ecological remainder. Conversely, ecological constraint does not itself determine a unique economic distribution or policy. Multiple institutions can respond to the same ecological condition, and GRE can compare their distributive and generative consequences.

Definition 23.423 (Ecological boundary condition for GRE)**.** An *ecological boundary condition for GRE* is a source-domain determination concerning biophysical feasibility, regeneration, ecological interaction, system limits, non-human affectedness, or ecological value that materially constrains an economic claim while retaining ecological provenance.

The distinction matters particularly when economic models treat ecological variables as external parameters. If the ecological process changes endogenously with economic activity, the background condition becomes a coupled relation. GRE can represent the economic side of that coupling, but ecological evidence remains necessary for the ecological dynamics.

Proposition 23.424 (Ecological-warrant preservation)**.** *Economic valuation, optimization, compensation, or institutional design can incorporate ecological information, but these operations do not replace the ecological warrant required for claims about ecological state, regeneration, threshold, integrity, or non-human affectedness.*

The boundary therefore permits partial commensuration without requiring complete commensurability. A policy can use economic instruments while acknowledging ecological constraints or values that remain independently specified.

23.18.6 Economic–Epistemic Boundary

Knowledge and information have economic conditions, yet epistemic warrant is not an economic predicate. Research requires labor, time, institutions, infrastructure, data access, publication channels, education, and often substantial material investment. Information asymmetry, intellectual property, platform control, expert labor markets, and unequal access to computational resources can therefore be legitimate GRE objects. The epistemic domain contributes different questions: whether a claim is supported, whether evidence is adequate, whether an inference is valid, whether expertise is competent, and whether an inquiry process contains credible correction procedures.

The distinction becomes important when economic manifestations are used as proxies for epistemic quality. Market demand for advice, citation advantage, institutional prestige, funding success, information scarcity, or possession of proprietary data can alter epistemic influence without establishing truth or justification. Conversely, a well-supported claim can fail to circulate because of economic constraints on access, attention, language, infrastructure, or institutional participation. GRE can illuminate those constraints while leaving the warrant of the claim to the relevant epistemic and disciplinary standards.

Definition 23.425 (Economic–epistemic jurisdiction split)**.** An *economic–epistemic jurisdiction split* distinguishes claims about the production, access, distribution, control, incentives, labor, and material conditions of knowledge from claims about truth, justification, evidential adequacy, inferential validity, expertise, and epistemic reliability.

AI-mediated inquiry intensifies this boundary. A system can lower the cost of producing candidate explanations, summaries, translations, or analyses while also changing verification burdens, dependence on infrastructure, access to expertise, and the distribution of epistemic labor. These are partly economic questions. Whether an output is warranted remains an epistemic question that cannot be settled by productivity gain alone.

Proposition 23.426 (Epistemic-warrant independence)**.** *Economic success, scarcity, possession, attention, institutional funding, or information advantage can affect the circulation and influence of knowledge claims but does not by itself establish their epistemic warrant.*

The reverse correction is also material. Epistemic findings can alter economic decisions by changing beliefs about risk, feasibility, causation, or expected outcomes. When GRE depends on such findings, the dependency architecture developed in Section 23.16 should preserve the external warrant and its revision pathway.

23.18.7 Boundary Disagreement as Corrective Inquiry

The preceding cases suggest that boundary disagreement can function as a research instrument. A dispute becomes productive when it exposes an untyped predicate, hidden external premise, misplaced normative warrant, missing mechanism, inappropriate proxy, or disagreement about the principal problem-space. The aim of adjudication is therefore not necessarily to assign the case permanently to one discipline. It is to identify which claims require which forms of answerability.

Several disagreement types should be separated. A *semantic dispute* concerns the meaning or identity conditions of a concept. An *explanatory dispute* concerns which mechanism accounts for the target outcome. A *classificatory dispute* concerns how the object should be typed. An *evidential dispute* concerns what counts as adequate support. A *normative dispute* concerns the authority of a value judgment. A *scope dispute* concerns how far a domain's explanation may travel. A *revision dispute* concerns which source of counterevidence should trigger reconsideration.

Definition 23.427 (Boundary-dispute dossier)**.** A *boundary-dispute dossier* is a versioned record containing the disputed object and claims, participating domains, domain-specific semantic profiles, claim-jurisdiction profiles, evidence and warrants, competing mechanisms, normative dependencies, translation losses, domain-specific remainders, counterevidence, unresolved disagreements, and explicit conditions for revision.

The dossier creates a practical alternative to two unhelpful responses. One response is conceptual imperialism, in which a domain treats its preferred variables or predicates as sufficient for the whole case. The other is disciplinary closure, in which a domain refuses relevant external correction because the evidence was generated elsewhere. A boundary-dispute dossier allows each domain to retain its standards while making the interface inspectable.

Definition 23.428 (Disciplinary overreach)**.** *Disciplinary overreach* occurs when a domain extends a claim beyond the predicates, evidence, constitutive categories, normative authority, or correction competence warranted by its principal problem-space and the explicitly supported translations available at the interface.

Overreach is claim-specific. A domain can legitimately contribute one part of an explanation while overreaching on another. GRE may correctly identify a material dependency and overreach if it concludes that the dependency is politically illegitimate without a political argument. Legal analysis may correctly identify formal rights and overreach if it assumes that formal equality establishes equal economic capability. Educational theory may correctly identify a pedagogical aim and overreach if it treats material access as irrelevant to practical realization.

Proposition 23.429 (Productive-boundary-disagreement condition)**.** *A boundary disagreement becomes analytically productive when it makes the disputed predicates, warrants, dependencies, remainders, and correction authorities more explicit and thereby yields a narrower, better typed, or more revisable account than any participating domain could justify through unexamined extension of its own categories.*

This conception makes disagreement a positive part of the GRE research programme. A failed attempt to assign a phenomenon to one domain can reveal that the phenomenon is genuinely interface-constituted. The resulting explanation can remain plural without becoming incoherent because each component claim retains a specified jurisdiction.

23.18.8 Criteria for Boundary Revision

Disciplinary boundaries are historically formed and should remain revisable, but revisability requires more than a general commitment to openness. A boundary should

change when recurrent inquiry shows that the existing division of labor systematically obscures constitutive dependencies, excludes necessary evidence, misclassifies a stable class of objects, or produces repeated translation failures that are better explained by a different interface architecture. Revision can take several forms: expansion of a domain's principal problem-space, creation of a durable interface, recognition of a hybrid research field, narrowing of an earlier claim, or explicit deference to a neighboring domain.

Boundary revision should also be asymmetric when the evidence is asymmetric. GRE may need to incorporate a legal category without law adopting GRE vocabulary. Ecology may constrain an economic model without ecological inquiry becoming economically defined. A new interface can therefore be important even when conceptual movement is stronger in one direction than the other.

Definition 23.430 (Boundary-revision trigger)**.** A *boundary-revision trigger* is recurrent evidence that an existing disciplinary boundary materially impairs explanation, classification, empirical adequacy, normative answerability, or correction because a stable dependency or object repeatedly crosses the current division of labor.

Not every overlap constitutes such a trigger. Occasional borrowing can remain local. Revision becomes more plausible when the interface recurs across cases, the dependency is constitutive rather than incidental, and participating domains can identify a stable set of questions for which the current boundary produces systematic loss.

Definition 23.431 (Revisable boundary register)**.** A *revisable boundary register* records the current principal problem-space of a domain, recurring interfaces, accepted jurisdiction splits, unresolved disputes, known overreach risks, boundary-revision triggers, rejected expansions, and the evidential basis for later changes in disciplinary scope.

The register prevents revision from becoming silent disciplinary expansion. If GRE extends its scope, the extension should be documented together with the problem that motivated it, the external disciplines involved, the concepts imported or exported, the counterevidence considered, and the claims that remain outside GRE. Such versioning is especially important for a young research programme whose boundaries are still being formed.

Proposition 23.432 (Boundary-revision discipline)**.** *A disciplinary boundary is responsibly revised when the proposed change responds to recurrent interface evidence, preserves the independent warrants that remain outside the domain, states the new jurisdiction with sufficient precision, and remains open to reversal or further narrowing if subsequent cases fail to support the expansion.*

Proposition 23.433 (Cross-domain jurisdiction answerability)**.** *A cross-domain claim is jurisdictionally answerable when its object, predicate, principal problem-space, evidential and normative warrants, external dependencies, participating correction authorities, overreach conditions, and boundary-revision implications are explicit enough for the affected domains to contest or revise the allocation of explanatory responsibility.*

These disputes also provide comparative evidence for the next section's assessment of the conditions under which any future Generative Relational Theory could be generalized responsibly.

23.19 Cross-Domain Generalization Criteria

Sections 23.15–23.18 established a two-way interface architecture: GRE can offer portable analytical kernels, receive externally warranted corrections, preserve domain-specific semantics, and revise disciplinary boundaries when recurrent evidence justifies doing so. The present section asks what, if anything, can be inferred at a higher level from such cross-domain comparison. Its role in Chapter 23 is to specify the evidential discipline required before recurrent structures in GRE, GRH, GRG, law, political theory, education, ecology, aesthetics, social theory, AI studies, or other prospective domains are treated as candidates for a more general Generative Relational Theory (GRT). The objective is neither to construct GRT in this book nor to deny the possibility of a future general theory. It is to distinguish domain instantiation, recurrent structure, candidate invariance, counterexample, and justified generalization so that later work can assess general claims without converting shared vocabulary into evidence by assumption. The method is comparative and adversarial: candidate structures are evaluated through independent domain reconstruction, semantic typing, historical variation, failed translation, non-transferable assumptions, and counterexamples before any broader scope is assigned.

The principal difficulty is that the present domains are not statistically independent observations. Several were formulated through a partially shared GR vocabulary. If relation, generation, constraint, difference, subjecthood, value, power, or historical dependence are intentionally carried into more than one domain, their recurrence can reflect common intellectual ancestry rather than discovery of a domain-transcending structure. Cross-domain comparison therefore requires a distinction between recurrence that was built into the domains and recurrence that reappears after domain-specific inquiry has been allowed to transform, reject, or reconstruct the inherited concept.

Definition 23.434 (Cross-domain generalization problem)**.** The *cross-domain generalization problem* is the problem of determining which structures observed across several domain theories can responsibly be assigned a broader scope, given differences in semantic constitution, evidence, methods, histories, normative authority, and the possibility that apparent recurrence reflects shared theoretical ancestry.

Definition 23.435 (Shared-origin confound)**.** A *shared-origin confound* arises when recurrence across domains is partly produced by common inherited concepts, modeling choices, or foundational assumptions, so that the recurrence cannot be treated as independent evidence for the generality of the repeated structure.

This confound does not make cross-domain comparison uninformative. It changes what the comparison can establish. A structure that survives domain-specific reconstruction, loses some inherited features, acquires new semantics, encounters counterexamples, and nevertheless remains useful across several independently warranted problem-spaces provides stronger evidence than a structure repeated verbatim because each domain was instructed to use the same vocabulary.

Proposition 23.436 (Generalization-burden principle)**.** *Broader GR claims require stronger comparative evidence: independently reconstructed cross-domain recurrence supports more generality than single-domain or shared-origin recurrence, especially when it survives historical variation, failed translation, and counterexamples.*

Table 23.19: Evidential ladder for cross-domain generalization toward a future GRT

Status	What has been observed	Additional burden before stronger scope is justified	Permissible interpretation
Domain instantiation	A structure is useful within one principal problem-space	Local semantic, evidential, historical, and methodological adequacy	Domain-specific construction
Designed recurrence	Similar vocabulary or structure appears in several domains through shared inheritance	Independent reconstruction and explicit control for common ancestry	Comparative prompt, not general evidence by itself
Discovered recurrence	A related structure reappears after domain-specific reconstruction	Typed correspondence, translation-loss analysis, and counterexample search	Candidate cross-domain pattern
Historically robust recurrence	The candidate survives materially different historical or institutional settings	Scope conditions, failure cases, and mechanism or structural rationale	Conditional candidate invariant
General-theory candidate	The structure survives heterogeneous domains, histories, methods, and adverse cases with explicit limitations	Continued testing in new domains and openness to revision or rejection	Provisional GRT-level hypothesis

Table 23.19 summarizes the evidential ladder used throughout this section.

23.19.1 Domain Instantiations

The appropriate starting point for generalization is a set of domain instantiations rather than a presumed universal template. GRE, for example, develops relational allocation, heterogeneous value, conversion, circulation, generative capacity, power over interfaces, historical economic structure, and economic spacetime because these objects answer economic questions. A legal domain can require validity, rights, duties, jurisdiction, recognition, and personhood. An educational domain can require learning, pedagogy, capability formation, curiosity, and epistemic participation. An ecological domain can require biophysical processes, ecological integrity, non-human affectedness, metabolism, and intergenerational constraint. Similar relational language can occur in each domain while the objects and warrants remain different.

A domain instantiation should therefore be understood as a theory constructed under a principal problem-space, not as a local example of a general theory whose full form has already been settled. This ordering matters. If a general architecture is specified first and domains are subsequently required to instantiate it, cross-domain agreement can become circular. If domains are allowed to develop from their own problems, evidence, methods, and correction authorities, later comparison can reveal which inherited structures survived genuine reconstruction.

Definition 23.437 (GR domain instantiation)**.** A *GR domain instantiation* is a domain-

specific theoretical construction that uses only those GR resources that remain analytically defensible for its principal problem-space and supplements, modifies, or rejects them according to domain-specific objects, evidence, methods, histories, and correction authorities.

This definition places domain autonomy inside the evidence for future generalization. A domain that cannot reject an inherited GR concept cannot provide strong evidence that the concept is genuinely general. The possibility of divergence is therefore methodologically valuable. Domain-specific modification, non-translation, and even rejection can help separate indispensable structure from inherited convenience.

Definition 23.438 (Domain-independence gradient)**.** A *domain-independence gradient* records how far a domain's relevant concepts and results were independently reconstructed from its own problem-space, evidence, and methods rather than inherited unchanged from a shared GR vocabulary.

The gradient need not be binary. GRE and GRH can share more intellectual ancestry than GRE and an independently developed ecological or jurisprudential framework. Cross-domain evidence should therefore be weighted qualitatively by the degree of independent reconstruction rather than counted as though each domain were an independent replication.

Proposition 23.439 (Domain-autonomy contribution)**.** *A domain contributes stronger comparative evidence to a future GRT when its relevant structures can be justified from the domain's own problem-space and remain open to rejection or substantial transformation of inherited GR vocabulary.*

23.19.2 Candidate Invariants

The word *invariant* requires restraint in this context. In mathematics and physics, invariance can have precise meanings relative to specified transformations. Cross-domain theory comparison usually operates with weaker evidence. A recurring conceptual or structural relation should therefore be called a *candidate invariant* only when the relevant transformation or variation has been stated. The candidate might concern persistence across domain translation, historical change, changes of representation, methodological access, or institutional setting. Each is a different claim.

For example, the book's sparse primitives of change, structure, constraint, and difference may appear useful across several domains. Their recurrence is suggestive, but it does not yet establish that they are metaphysically fundamental or sufficient for every prospective GR domain. Their current status is better understood as low-assumption analytical starting points whose adequacy can be tested through domain construction. Similarly, the recurrence of relational dependence, path-sensitive generation, asymmetric access, or heterogeneous manifestation can motivate comparison without establishing universal validity.

Definition 23.440 (Candidate cross-domain invariant)**.** A *candidate cross-domain invariant* is a structure, relation, distinction, or constraint that remains identifiable under a specified class of domain, historical, methodological, or representational variations after domain-specific semantics and translation losses have been taken into account.

The phrase "remains identifiable" is intentionally weaker than "remains identical." Section 23.17 showed that relation, subject, value, power, institution, and generativity can recur while changing semantic constitution. A future GRT candidate may therefore preserve a higher-order relation among typed objects even when the objects themselves are non-equivalent. Such preservation must be demonstrated rather than inferred from shared words.

Definition 23.441 (Invariance specification)**.** An *invariance specification* states the candidate structure, the class of variations under which persistence is claimed, the domain-specific semantics that may change, the features required to remain stable, the evidence used to identify persistence, and the observations that would count as failure.

Proposition 23.442 (Specified-variation condition)**.** *A cross-domain invariance claim is interpretable only relative to a stated class of variations and a stated persistence criterion; recurrence without these specifications remains a similarity observation rather than an invariant claim.*

23.19.3 Recurrent Structures

Cross-domain comparison can still be productive before invariance is established. Recurrent structures occupy an intermediate status. They are patterns that appear in multiple domains with enough typed correspondence to justify comparison, while their generality remains unsettled. Examples suggested by the present book include historically conditioned relations, constraints on feasible transformation, differential access to generative possibilities, conversion among heterogeneous forms, dependence on relational position, and the role of mediation in turning one capacity into another.

The central methodological distinction is between *designed recurrence* and *discovered recurrence*. Designed recurrence arises when a concept appears across domains because it was intentionally imported from the common framework. Discovered recurrence arises when domain-specific inquiry reconstructs a comparable structure for reasons that are independently warranted within each domain. Most early GR research will contain mixtures of the two. The task is to document the mixture rather than to classify every case as purely one type.

Definition 23.443 (Designed recurrence)**.** *Designed recurrence* is cross-domain similarity produced materially by deliberate reuse of a shared conceptual, formal, or methodological resource.

Definition 23.444 (Discovered recurrence)**.** *Discovered recurrence* is cross-domain similarity that remains after participating domains independently reconstruct the relevant object or relation from their own evidence, problems, and correction standards and are permitted to alter or reject the inherited formulation.

A discovered recurrence need not be surprising in order to be evidentially stronger. The point concerns warrant rather than psychological novelty. If legal, ecological, educational, and economic inquiry each require a distinction between formal status and practical accessibility for different reasons, the recurrence can be theoretically important even if researchers anticipated it. Conversely, repeated use of the word

"relation" is weak evidence when each domain inherited relational vocabulary from the same source without an independent adequacy test.

Definition 23.445 (Recurrent-structure comparison record)**.** A *recurrent-structure comparison record* documents the participating domains, local definitions, independent grounds for reconstruction, shared-origin dependencies, typed correspondences, translation losses, historical variation, non-equivalent predicates, observed failures, and the current evidential status of the proposed recurrence.

Proposition 23.446 (Recurrence-evidence condition)**.** *Cross-domain recurrence provides stronger evidence for a broader GR structure when the recurrence survives independent reconstruction, semantic retyping, and exposure to domain-specific failure conditions rather than arising principally from unchanged inheritance.*

23.19.4 Domain-Specific Failures

Failure is especially informative for a comparative programme. A concept can work well in GRE and fail in law because legal validity does not reduce to effective control. A participation concept can work economically and fail politically if it does not capture representation or public authorization. A generative-value description can illuminate economic conversion while remaining inadequate for aesthetic value or ecological integrity. These failures do not necessarily refute the domain theory that generated the concept. They delimit the scope of the proposed cross-domain transfer.

The relevant question is therefore not whether a concept has a failure case in some neighboring domain. Many useful concepts should. The question is what the failure teaches about the architecture of the concept. A failure may reveal an economic premise, a human-centered assumption, a requirement of commensurability, a hidden legal status, a temporal scale, a specific institutional form, or a normative warrant that had been treated as if it were general.

Definition 23.447 (Domain-specific generalization failure)**.** A *domain-specific generalization failure* occurs when a candidate cross-domain structure loses explanatory adequacy, semantic coherence, evidential support, or normative answerability in a receiving domain for reasons traceable to that domain's constitutive features rather than to a merely terminological mismatch.

Definition 23.448 (Failure-extraction record)**.** A *failure-extraction record* identifies the failed transfer, the domain in which it failed, the constitutive feature producing the failure, the assumption exposed by the failure, the portion of the candidate structure that remains usable, and the resulting restriction or revision of the broader claim.

This record turns negative results into constructive theoretical evidence. If a structure survives only in domains with exchangeable value forms, the resulting theory should state that scope. If it survives only where subjects are legally recognized persons, that dependency should be visible. If it fails when system boundaries are biophysical rather than institutionally defined, the difference can guide later abstraction.

Proposition 23.449 (Failure-information principle)**.** *A well-characterized domain-specific failure can strengthen a future general theory by revealing the conditions*

under which a candidate structure ceases to travel and thereby narrowing, retyping, or decomposing an overbroad generalization.

23.19.5 Non-Transferable Assumptions

Some cross-domain failures arise from assumptions that are useful within one domain and inappropriate outside it. GRE, for example, can legitimately use prices, budgets, ownership, exchange, production, income, or institutionalized economic scarcity in analyses where those categories are empirically relevant. None should be silently carried into ecology, aesthetics, law, education, or political theory as though it were part of GR itself. The same caution applies in the reverse direction: legal personhood, political citizenship, ecological integrity, educational achievement, or aesthetic judgment are not general GR primitives merely because they matter at an interface with economics.

Non-transferable assumptions can be substantive, methodological, formal, or normative. A substantive assumption concerns the kind of objects present. A methodological assumption concerns which observations and evidential procedures are available. A formal assumption concerns mathematical structure such as metricity, continuity, closure, reversibility, scale separation, or comparability. A normative assumption concerns what counts as improvement, justice, legitimacy, value, or acceptable intervention. Each can generate false generality when left implicit.

Definition 23.450 (Non-transferable assumption)**.** A *non-transferable assumption* is an assumption that is warranted within a source domain or modeling context but lacks independent warrant in one or more receiving domains and therefore cannot be included in a broader GR claim without additional argument.

A future GRT should consequently be thinner than the aggregate vocabulary of its domains. Generalization usually requires subtraction before synthesis: remove domain-specific assumptions, preserve the remainder only if it continues to carry analytical content, and then test whether that remainder can be reconstructed in domains that did not generate it.

Definition 23.451 (Generalization residue)**.** A *generalization residue* is the portion of a candidate cross-domain structure that remains after domain-specific assumptions, unsupported semantic carryover, and non-transferable normative or methodological commitments have been removed.

The residue can become too thin to be useful. That outcome is theoretically legitimate. A statement such as “contexts contain differences and changes” may survive almost every domain but explain very little. Generality and analytical fertility are therefore separate dimensions. A future GRT needs sufficiently broad scope and sufficient structure to generate discriminating questions, while avoiding the reintroduction of domain-specific assumptions merely to regain explanatory richness.

Proposition 23.452 (Generality–content discipline)**.** *A candidate GRT structure should be evaluated separately for breadth of admissible scope and for analytical content; removal of domain-specific assumptions can increase portability while simultaneously reducing explanatory discrimination.*

23.19.6 Cross-Domain Counterexamples

Counterexamples deserve a stronger role than routine limitations language. A candidate general structure should be tested against domains and cases selected because they are likely to strain its assumptions. If a framework was developed mainly from human institutions, non-human ecological relations can provide an adverse case. If it relies heavily on stable institutional identity, rapidly changing AI-mediated configurations can test the assumption. If it was developed in modern market settings, historical cases with different property, monetary, legal, or political arrangements can test historical dependence. If it presumes coherent subjects, collective, distributed, fragmented, or ambiguous agency can provide counterevidence.

Cross-domain counterexamples can take several forms. A *semantic counterexample* shows that a recurrent term lacks a stable enough higher-order correspondence. A *constitutive counterexample* shows that the object exists through a different kind of constitutive relation. A *mechanism counterexample* shows that similar manifestations arise through materially different processes. A *normative counterexample* shows that a proposed evaluative extension lacks authority. A *historical counterexample* shows that the structure depends on a specific institutional period. A *formal counterexample* shows that a mathematical assumption such as continuity, metricity, closure, equilibrium, or separable scale fails in a relevant domain.

Definition 23.453 (Cross-domain counterexample)**.** A *cross-domain counterexample* is a case from a relevant domain, history, or methodological setting that satisfies the proposed scope of a candidate general claim but fails one or more of its required structural, semantic, evidential, formal, or normative conditions.

The definition distinguishes a counterexample from an excluded case. A theory can responsibly limit its scope. The stronger test arises when a case appears to fall within the claimed scope and nevertheless violates the proposed structure. Scope narrowing after such a case is legitimate when the new boundary has substantive justification and is recorded as a revision rather than introduced only to protect the theory from falsification.

Definition 23.454 (Adversarial comparison portfolio)**.** An *adversarial comparison portfolio* is a deliberately heterogeneous set of domains, histories, institutional forms, subject configurations, scales, and methodological access conditions selected to test the assumptions most likely to fail in a candidate cross-domain generalization.

Proposition 23.455 (Counterexample priority)**.** *For a proposed expansion in theoretical scope, a well-matched counterexample can carry greater revisionary significance than several confirmatory cases whose agreement is partly explained by shared vocabulary, common institutional history, or related modeling assumptions.*

23.19.7 Conditions for Generalization

The preceding distinctions permit a more disciplined account of generalization. A future GRT claim should be supported by more than breadth of vocabulary. At minimum, the proposed structure should be locally adequate in several domains; reconstructed with meaningful domain independence; semantically typed; robust to relevant historical variation; explicit about non-transferable assumptions; tested against

failed translations and adverse cases; and narrow enough that its correction conditions can be stated. The evidential base should also include domains whose methods and objects differ materially from those in which the candidate was first formulated.

Generalization should remain modular. Some structures may generalize farther than others. The primitive distinction among change, structure, constraint, and difference could eventually receive broader support than specific claims about subjects, value, power, institutions, fields, or spacetime. A future GRT need not therefore emerge as one indivisible package. It may consist of layers with different evidential maturity, domain range, and dependence on stronger assumptions.

Definition 23.456 (Cross-domain generalization dossier)**.** A *cross-domain generalization dossier* is a versioned record containing the candidate structure, participating domain instantiations, domain-independence gradients, local semantic profiles, designed and discovered recurrences, invariance specifications, historical tests, translation losses, non-transferable assumptions, generalization residues, domain-specific failures, cross-domain counterexamples, rejected formulations, current scope conditions, and explicit revision triggers.

The dossier gives a future GRT programme a cumulative memory. A claim that survives three domains today can later be revised when a fourth domain exposes a hidden assumption. A generalization narrowed after a historical counterexample can retain the earlier failed version as evidence about why the boundary changed. This form of versioning is compatible with the broader GRE commitment to research as a revisable, historically situated practice.

Proposition 23.457 (Conditional generalization criterion)**.** *A recurrent GR structure becomes a defensible candidate for broader generalization when its cross-domain correspondence is independently warranted, its semantic and historical variations are explicit, relevant failures and counterexamples have been sought, non-transferable assumptions have been removed or scoped, and the remaining claim retains enough analytical content to generate contestable consequences.*

Proposition 23.458 (Modular maturity principle)**.** *Different components of a prospective GRT can justifiably remain at different levels of evidential maturity; support for one recurrent structure does not automatically transfer to other GR concepts that have not survived comparable cross-domain testing.*

23.19.8 General-Theory Restraint

The present book does not provide the evidential base required to claim a completed GRT. It develops GRE as the principal domain, uses preliminary GR foundations sufficient for that task, and examines a limited set of neighboring interfaces. Several of those neighboring domains are represented only through interface questions rather than mature, independently developed domain theories. The comparative sample is therefore theoretically informative but too dependent, too historically concentrated, and too incomplete to warrant a universal synthesis.

General-theory restraint is consequently a methodological commitment rather than rhetorical modesty. Premature synthesis can make later domain work less informative because researchers may begin fitting evidence to the announced general

structure. It can also obscure failed translations by redescribing them as special cases of an increasingly flexible theory. A research programme gains more from a candidate that can fail clearly than from a vocabulary capable of absorbing every outcome after reinterpretation.

Definition 23.459 (Premature generalization)**.** *Premature generalization* occurs when a cross-domain claim is assigned broader theoretical scope than is supported by independent domain reconstruction, semantic typing, historical variation, explicit assumption control, and available counterevidence.

Definition 23.460 (Provisional GRT candidate)**.** A *provisional GRT candidate* is a cross-domain structure whose current evidence justifies testing beyond its source domains while its universality, ontological status, and final theoretical form remain explicitly unsettled.

The distinction between a provisional candidate and a general theory preserves room for ambitious inquiry. Researchers can formulate broad conjectures, compare structures, construct formal representations, and search for invariants without presenting the resulting architecture as settled. The appropriate next step after a promising recurrence is therefore wider and more adversarial testing, including domains whose objects, histories, methods, and normative structures make agreement difficult rather than likely.

Proposition 23.461 (Future-GRT research discipline)**.** *A future GRT is more responsibly approached as the revisable outcome of comparative domain research than as a template imposed in advance on domains whose independent development is still incomplete.*

Proposition 23.462 (Cross-domain generalization answerability)**.** *A prospective GRT claim is cross-domain answerable when its source domains, shared-origin dependencies, comparison dimensions, invariance specifications, non-transferable assumptions, counterexamples, historical limits, current scope, and revision conditions are explicit enough for later domains to confirm, narrow, decompose, or reject the proposed generalization.*

The resulting position is intentionally open. Chapter 23 has shown that relational interfaces can connect disciplines without erasing their differences, and the present section shows how those differences become evidence rather than obstacles in the search for broader structure. The immediate task for GRE remains more local: its own explanatory scope, partial explanations, deferrals, and claims that should remain outside the domain must be stated before the chapter can close responsibly.

23.20 Explanatory Scope of GRE

Chapter 23 has developed disciplinary interfaces, translation rules, reciprocal correction, concept-specific semantics, boundary-dispute procedures, and criteria for cross-domain generalization. The chapter can close only by applying those disciplines reflexively to Generative Relational Economics (GRE) itself. The role of the present section is therefore to state the kinds of claims for which GRE can presently bear primary explanatory responsibility, the kinds it can address only partially, the points at which it must defer to neighboring domains, and the claims that remain outside

its warrant. The objective is not to create an impermeable disciplinary border. It is to make GRE's current scope answerable: a reader should be able to identify why a question is economic, which premises come from elsewhere, what evidence could revise the boundary, and which unresolved limitations should become explicit research problems rather than being hidden by broad relational vocabulary. The method is claim-centered and provenance-preserving. Scope is assigned to particular explanatory predicates and warrants rather than to whole empirical objects, and boundary revision remains possible when domain counterevidence accumulates.

This reflexive task follows directly from Sections 23.15–23.19. GRE can contribute portable analytical kernels without universalizing them, can import externally warranted premises without appropriating their source authority, can preserve non-equivalent meanings across domains, can share empirical objects without claiming exclusive jurisdiction, and can treat failed generalization as evidence. The same discipline implies that GRE should not infer explanatory authority merely because an object has economic consequences. A school, watershed, court, family, AI system, artwork, political institution, or historical event can be economically consequential while requiring educational, ecological, legal, social, technical, aesthetic, political, or historical explanation for features that GRE does not constitute or warrant.

Definition 23.463 (GRE scope condition)**.** A *GRE scope condition* is a stated condition under which an economic claim falls within GRE's direct explanatory domain, partial explanatory reach, domain-deference architecture, or current non-claim space, together with the evidence, assumptions, correction sources, and revision triggers relevant to that assignment.

Definition 23.464 (GRE explanatory-scope profile)**.** A *GRE explanatory-scope profile* records for a claim its principal problem-space, economically typed objects and relations, mechanism or constitutive pathway, evidential basis, external premises, normative dependencies where present, current scope status, neighboring correction authorities, and conditions under which the status should be revised.

Table 23.20 summarizes the four statuses used throughout the section. They are not ranks of intellectual importance. They describe different distributions of explanatory responsibility.

Proposition 23.465 (Scope answerability)**.** *A GRE claim is scope-answerable when its economic predicate, evidential warrant, external dependencies, domain remainders, and revision conditions are explicit enough for another inquiry to confirm the claim, narrow it, retype it, transfer part of it to a neighboring domain, or reject it without requiring rejection of unrelated GRE claims.*

The proposition makes scope a property of accountable inquiry rather than a defensive boundary. A theory with no way to say where its authority weakens cannot learn reliably from neighboring domains. Conversely, a theory that treats every external dependency as evidence that economics has nothing to contribute would surrender precisely the relational interactions that GRE is designed to study. The relevant task is to type explanatory responsibility carefully.

Table 23.20: Scope statuses for GRE claims at disciplinary interfaces.

Scope status	GRE responsibility	Typical condition	Required discipline
Direct explanation	Bear primary responsibility for the economic predicate and its warrant	Principal question concerns economically constituted relations, allocations, capabilities, value processes, institutions, or economic power	State mechanism, evidence, historical scope, and correction conditions
Partial explanation	Explain an economic component of a mixed-domain object or process	Economic mechanism is material but not sufficient to constitute the full object or conclusion	Mark the remainder and identify the additional domain warrants required
Domain deference	Use a premise whose validity is warranted principally outside GRE	Legal validity, political legitimacy, ecological integrity, educational quality, aesthetic judgment, technical capability, or another external status is material to the economic conclusion	Preserve provenance and revise dependent GRE claims when the external premise changes
Current non-claim	Decline to present GRE as warranting the predicate	The claim concerns ultimate ontology, domain-specific normativity, subject status, validity, quality, or universality beyond available evidence	Keep the question open, transfer it to the appropriate domain, or formulate only a conditional economic consequence

23.20.1 Primary Explanatory Domain

GRE's primary explanatory domain is defined by its principal economic problem-space rather than by a closed list of empirical objects. The framework is most directly concerned with how economic positions, resources, capabilities, access conditions, allocations, institutions, value forms, conversion interfaces, circulation pathways, dependencies, and historically structured constraints participate in the generation or contraction of later economic possibilities. The object can be a household, firm, platform, public institution, educational setting, ecological intervention, legal arrangement, or AI-mediated workflow. What makes the claim directly economic is not the object's label but the predicate being explained and the mechanism through which that predicate is constituted.

This distinction is important because GRE was developed to move beyond an econ-

omy imagined as already-given agents exchanging already-given resources. Earlier chapters treated allocation as relational intervention, value as heterogeneous and capable of conversion, circulation, capture, return, dissipation, and regeneration, economic subjects as historically positioned rather than metaphysically fixed, and economic structures as capable of altering future capacities and option spaces. These remain economic objects when their constitutive questions concern access, feasible action, resource control, production, allocation, exchange, conversion, circulation, participation, dependence, economic power, or the generation of economically relevant capabilities.

Definition 23.466 (Economic explanatory target)**.** An *economic explanatory target* is a typed claim about an allocation, access condition, resource relation, capability, value process, economic institution, economic dependency, conversion or circulation interface, economically relevant participation, or historically structured economic possibility whose constitution or change can be investigated with economic evidence and mechanisms.

The definition intentionally avoids equating "economic" with monetary. A non-priced care relation can contain an economic explanatory target when it structures labor availability, material dependence, capability, access, or resource allocation. A public archive can become economically relevant when funding, access infrastructure, property arrangements, or labor conditions shape who can use it and what later capabilities become feasible. Conversely, a priced artwork does not become exhausted by economic explanation merely because exchange produces a monetary manifestation.

Definition 23.467 (Direct GRE explanation)**.** A *direct GRE explanation* is an explanation for which the principal explanandum is an economic explanatory target and the decisive constitutive or generative mechanism can be warranted predominantly through economically typed relations, evidence, and historically situated institutional conditions without an unresolved neighboring-domain premise being required to establish the target itself.

Direct explanation can still use interdisciplinary evidence. Historical records, legal documents, ecological measurements, technical audits, or interviews can be indispensable manifestations of an economic process. Their use does not by itself make the explanation partial. Partiality arises when the conclusion depends on a predicate whose constitution or warrant remains principally external to GRE. A historical record showing that access to credit changed after a legal reform can support an economic explanation of changed financing conditions; a further conclusion that the reform was legally valid or politically legitimate requires different authority.

GRE is particularly well positioned to study several classes of direct target. One is *relational allocation*: who or what is enabled, constrained, connected, displaced, or made dependent when resources and opportunities are allocated. Another is *heterogeneous value process*: how value forms are generated, translated, converted, circulated, captured, returned, dissipated, or regenerated without presuming a universal common measure. A third is *generative economic capacity*: how present interventions change the later ability of persons, organizations, communities, or infrastructures to participate in economic processes or generate subsequent possibilities. A fourth concerns *economic power*: control over access, conversion, circulation, recog-

nition interfaces, and the feasible transformations available to other positions. A fifth concerns *historically structured economic dynamics*: path dependence, multiscale timing, institutional persistence, and the conditions under which an economic configuration becomes self-sustaining or difficult to revise.

Proposition 23.468 (Principal-problem criterion)**.** *An empirical object can fall within GRE's direct explanatory scope for one predicate while remaining outside it for others; direct scope is justified by the principal economic problem and its warrant, not by disciplinary ownership of the object as a whole.*

The criterion preserves the predicate-specific jurisdiction developed in Section 23.18. A university can be directly analyzed as an employer, allocator of research resources, producer of credentials with economic consequences, or infrastructure for capability generation. The same university also contains pedagogical, legal, political, social, aesthetic, and epistemic objects whose constitution is not settled by the economic account. Direct economic explanation therefore coexists with domain plurality rather than displacing it.

Proposition 23.469 (Economic-incidence restraint)**.** *The presence of economic consequences is insufficient to establish that the full constitution, meaning, quality, validity, legitimacy, or value of the affected object lies within GRE's direct explanatory scope.*

23.20.2 Partial Explanatory Reach

Many important GRE questions are neither purely internal nor merely deferred. They concern mixed-domain processes in which an economic mechanism explains a material part of the outcome while other domains are required to explain what the object is, why a status obtains, or how a conclusion should be evaluated. Partial explanation is therefore not a defect to be hidden. It is a positive scope category that permits GRE to contribute without representing its contribution as complete.

Consider educational capability. GRE can analyze unequal access to time, digital infrastructure, mentoring, housing stability, income, or institutional resources that shape whether learning opportunities can be realized. It can also study how educational capability affects later economic participation. Those analyses do not establish educational quality, pedagogical adequacy, or the meaning of learning. Similarly, GRE can analyze how property rights, liability rules, or contractual classifications alter feasible economic relations while leaving questions of legal validity and doctrinal interpretation to law. In ecology, GRE can investigate resource extraction, externalized costs, livelihood dependence, investment incentives, and intergenerational allocation while ecological science and ethics retain independent authority over ecosystem dynamics, ecological integrity, non-human affectedness, and environmental value.

Definition 23.470 (Partial GRE explanation)**.** A *partial GRE explanation* identifies and warrants an economically material mechanism, relation, or consequence within a broader explanandum whose adequate constitution or evaluation also requires one or more non-economic predicates that GRE does not independently establish.

Partial explanation should be distinguished from weak explanation. An economic component can be demonstrated with high confidence while the whole phenomenon

remains multi-domain. A careful account of financing constraints on artistic production can be strong economic research even if it says little about aesthetic quality. Likewise, a robust estimate of the income effect of a health policy remains partial with respect to medical efficacy, legal permissibility, distributive justice, or lived experience. The scope label describes the breadth of the explanandum, not the reliability of the economic subclaim.

Several forms of partiality recur. *Constitutive partiality* occurs when another domain helps determine what the object is, as when legal status constitutes ownership or organizational form. *Mechanistic partiality* occurs when several mechanisms jointly produce an outcome. *Semantic partiality* occurs when economic manifestations do not exhaust the meaning of a practice or relation. *Normative partiality* occurs when GRE can describe consequences but cannot alone justify a judgment of legitimacy, justice, quality, or worth. *Historical partiality* occurs when present economic categories depend on historical formations that require reconstruction beyond contemporary measurement. *Observational partiality* occurs when the available manifestations identify only some relations relevant to the economic process.

Definition 23.471 (Explanatory-completion map)**.** An *explanatory-completion map* records which parts of a mixed-domain explanandum are currently warranted by GRE, which require neighboring-domain explanation, which interfaces connect the parts, and which residual questions remain unresolved even after the available domain accounts are combined.

The map prevents an interdisciplinary project from assuming that several partial explanations automatically sum to a complete one. Domains can leave gaps between them. A legal classification can be known, an economic consequence estimated, and a political process reconstructed while the mechanism connecting them remains uncertain. Domain accounts can also conflict because they individuate the object differently or work at different temporal scales. Partial explanation therefore requires interface research rather than simple accumulation.

Proposition 23.472 (Partiality-preservation principle)**.** *When a GRE explanation depends materially on constitutive, semantic, normative, mechanistic, or observational content that it does not itself warrant, the explanation should preserve that partiality explicitly rather than absorb the external content into an expanded economic vocabulary.*

This principle also guards against conceptual inflation. A theory becomes difficult to challenge when every important external relation is redescribed as economic simply because it affects economic outcomes. GRE's relational openness is better served by preserving the additional domain than by renaming it.

23.20.3 Domain Deference

Partial explanation identifies a shared explanandum. Domain deference identifies a different configuration: a GRE conclusion depends on a premise whose warrant lies principally elsewhere. The economic analysis can still be rigorous and consequential, but it should treat the imported premise as a typed dependency rather than silently re-establishing it through economic evidence. Section 23.16 developed this architecture for neighboring-domain contributions; the present subsection states its scope

implication.

Legal validity is a clear example. GRE can ask what follows economically if a contract is enforceable, a person has a recognized legal status, or a property relation is valid. It can also study how anticipated legal recognition affects behavior before adjudication. Yet an econometric association between recognition and investment does not itself establish doctrinal validity. Political legitimacy supplies another example. GRE can investigate the distributional and generative consequences of a governance arrangement without concluding from efficiency, stability, or growth that the arrangement is legitimate. Similar distinctions apply to ecological integrity, educational quality, aesthetic judgment, social identity, technical capability, cybersecurity properties, and claims concerning consciousness or moral standing in AI-related inquiry.

Definition 23.473 (GRE deference point)**.** A *GRE deference point* is a location in an economic argument where a materially relevant premise is constituted or warranted principally by a neighboring domain and is therefore imported conditionally, with its source authority and revision pathway preserved.

Definition 23.474 (External-warrant dependency)**.** An *external-warrant dependency* records the source-domain premise on which a GRE claim depends, the economic inference that uses it, the strength and scope of the dependency, the source of authoritative correction, and the downstream GRE claims that require reconsideration if the premise changes.

Deference is not intellectual disengagement. GRE can test the economic sensitivity of alternative external premises. It can show that two plausible legal classifications produce very different patterns of access or dependence, that alternative ecological thresholds change investment feasibility, or that different educational judgments imply different interpretations of a capability policy. Such analysis can return useful questions to the source domain without claiming authority to settle the source-domain dispute.

Proposition 23.475 (Conditional-deference principle)**.** *GRE can reason rigorously from a neighboring-domain premise without independently warranting that premise when the premise is typed as external, its economic consequences are stated conditionally, and revision of the premise propagates to the materially dependent economic conclusions.*

Difficult cases can contain several deference points with different authorities. A climate-transition policy may depend on ecological evidence, engineering feasibility, legal authority, political legitimacy, and economic financing conditions. The relevant domains can disagree or update on different schedules. GRE should therefore avoid replacing multiple external premises with a single synthetic variable whose provenance becomes invisible. A dependency graph can preserve where each warrant enters and which conclusions it affects.

Definition 23.476 (Multi-domain deference record)**.** A *multi-domain deference record* is a provenance-preserving representation of multiple external premises entering one GRE inquiry, including their source domains, compatibility or conflict, update timing, affected economic claims, and unresolved interface questions.

23.20.4 Claims Beyond GRE Warrant

An open research programme also needs a current non-claim space. Some questions can be economically relevant yet remain outside the kinds of warrant developed in this book. Stating those exclusions is part of theoretical content because it makes overreach identifiable and permits later evidence to justify principled expansion rather than retrospective reinterpretation.

The first excluded class concerns *ultimate ontology*. GRE uses relational, generative, historical, field-theoretic, dynamical, operator, geometric, and spacetime representations where they clarify economic questions. Their analytical success does not prove that reality is fundamentally relational, that economic reality literally has the mathematical structure of a chosen formal model, or that the preliminary GR vocabulary exhausts possible ontology. Ontological suspension remains the default.

A second class concerns *domain-specific status and normativity*. Economic evidence does not by itself establish legal validity, political legitimacy, moral standing, aesthetic quality, educational quality, ecological integrity, religious truth, medical efficacy, consciousness, or the full social meaning of an identity or practice. GRE can analyze the economic consequences of classifications in each domain and can sometimes expose material conditions that shape their realization. It cannot infer the underlying status merely from those consequences.

A third class concerns *unwarranted universality*. The fact that a relational or generative distinction is productive across several economic cases does not establish a universal social law, a transhistorical invariant, or a completed GRT. Section 23.19 made the generalization burden explicit. The present book provides a comparatively rich GRE domain, not the independent cross-domain evidence required for universal theory.

A fourth class concerns *causal strength beyond design*. GRE's interest in generation does not license strong causal attribution whenever a sequence is historically plausible or a formal model contains a transformation. Observational, historical, qualitative, experimental, quasi-experimental, and computational evidence each support different claims under different assumptions. A generative interpretation remains answerable to those evidential differences.

Definition 23.477 (GRE non-claim)**.** A *GRE non-claim* is a proposition or predicate that the current framework treats as economically relevant or potentially interface-relevant but does not present as established by GRE because the required ontology, evidence, constitutive authority, normative warrant, or cross-domain generalization exceeds the framework's present basis.

Proposition 23.478 (Non-claim discipline)**.** *A question's importance to economic life does not by itself authorize GRE to answer it; where the required warrant lies outside GRE, the framework should state a conditional consequence, defer the constitutive judgment, or retain the question as an explicit non-claim.*

Non-claims are revisable. A future GRE programme may develop stronger evidence, new methods, or a more mature interface with another domain. The relevant claim can then move from non-claim to deference, from deference to partial explanation, or in some cases into direct scope. The present exclusion is therefore epistemic and disciplinary rather than an assertion that the question could never be studied

economically.

Proposition 23.479 (No-authority-from-incidence)**.** *Economic incidence, economic measurability, or economic policy relevance does not by itself confer authority to determine the non-economic status from which the measured consequence arises.*

23.20.5 Domain Counterevidence

Scope conditions become meaningful only when evidence can move a claim among them. Counterevidence can arise inside economics, but Chapter 23 has shown why neighboring domains also matter. A legal reconstruction can show that an assumed property relation did not exist in the relevant form. Historical evidence can show that a present category was unavailable to the actors being modeled. Ecological evidence can show that an economically represented resource flow omitted a binding biophysical constraint. Social research can show that an assumed independent choice was constituted through a relation the economic model treated as background. Technical evidence can show that an AI capability presumed in an economic scenario was not actually available. Each can change the economic explanation without requiring the external domain to become economics.

Definition 23.480 (Domain counterevidence to GRE)**.** *Domain counterevidence to GRE* is evidence or warranted reconstruction from a relevant neighboring domain that materially undermines an economic classification, premise, mechanism, boundary, interpretation, generalization, or normative dependency used in a GRE claim.

Counterevidence should be typed by what it challenges. *Classification counterevidence* shows that an object or relation was misidentified. *Constitutive counterevidence* shows that the economic object depends on a different rule or relation than assumed. *Mechanism counterevidence* challenges the pathway linking economic conditions to outcomes. *Historical counterevidence* changes the relevant sequence, category, or path dependence. *Translation counterevidence* shows that a cross-domain mapping failed to preserve the structure required by the economic inference. *Formal counterevidence* shows that a mathematical assumption does not hold for the represented process. *Normative counterevidence* matters when GRE has explicitly relied on an external normative premise and the source domain revises that premise.

Definition 23.481 (GRE counterevidence record)**.** A *GRE counterevidence record* identifies the challenged claim, source and type of counterevidence, affected assumptions, dependent conclusions, plausible alternative explanations, current response, and whether the appropriate revision is local correction, scope narrowing, retyping, decomposition, or abandonment.

The record prevents two symmetrical errors. One is defensive insulation, in which external counterevidence is dismissed because it did not originate inside economics. The other is indiscriminate collapse, in which criticism of one imported premise is treated as refutation of GRE as a whole. The claim-centered architecture permits targeted revision.

Proposition 23.482 (Targeted revision principle)**.** *Domain counterevidence should revise the GRE claims that materially depend on the challenged premise or mapping, while broader framework revision is warranted only when the failure propagates to more cen-*

tral distinctions or recurs across sufficiently independent cases.

This principle is compatible with strong criticism. If repeated counterevidence shows that a central GRE distinction cannot be operationalized, that value-conversion analysis consistently adds no explanatory discrimination, or that relational typing repeatedly obscures rather than clarifies causal structure, the required revision can become framework-level. Chapter 24 will make those stronger failure conditions explicit. The present section establishes the interface route by which such evidence can enter.

23.20.6 Scope-Boundary Revision

A revisable boundary can change in several directions. GRE can *expand* when recurrent research shows that a previously deferred predicate has developed a defensible economic formulation with distinct evidence and mechanisms. It can *contract* when purportedly economic claims prove dependent on external warrants that the framework cannot reconstruct. It can *retype* an object when the relevant economic predicate was misidentified. It can *decompose* a broad claim into a direct economic component and one or more external components. It can create a more explicit *interface* when neither absorption nor separation represents the problem adequately. In some cases it should *abandon* a claim that lacks evidential or conceptual support.

Definition 23.483 (GRE scope-boundary revision)**.** A *GRE scope-boundary revision* is a documented change in the framework's assignment of explanatory responsibility caused by new evidence, repeated interface dependence, failed translation, conceptual retyping, methodological development, historical change, or domain counterevidence.

Boundary revision should not be opportunistic. A theory that expands whenever a neighboring domain produces a useful result and contracts whenever counterevidence appears would be difficult to test. Expansion and contraction therefore require explicit reasons, affected claims, and retained records of previous scope.

Definition 23.484 (GRE scope ledger)**.** A *GRE scope ledger* is a versioned record of direct-scope claims, partial-scope claims, deference points, non-claims, boundary disputes, counterevidence, rejected classifications, and subsequent expansions, contractions, retypings, decompositions, or abandoned claims.

The ledger can serve both theoretical and practical purposes. Theoretically, it permits future researchers to see whether GRE's domain has changed because evidence improved or because terminology became more elastic. Practically, it helps interdisciplinary teams identify which conclusions can be revised locally when one domain updates. It also preserves the history of failed formulations, which Section 23.19 treated as valuable evidence for future generalization.

Proposition 23.485 (Symmetric boundary burden)**.** *Expansion and contraction of GRE's domain should both be justified by explicit evidence and conceptual reasons; neither disciplinary ambition nor disciplinary modesty is sufficient by itself to determine the boundary.*

Proposition 23.486 (Boundary-revision locality)**.** *A justified revision should be as local as the evidence permits: retype or revise the affected claim first, enlarge the bound-*

ary revision only when the failure or new capability is shown to propagate across a wider part of the framework.

The locality principle helps preserve cumulative knowledge. GRE need not choose between doctrinal rigidity and repeated reinvention. It can retain distinctions that continue to work while changing those that fail. This form of theoretical memory is especially important for a research programme intended to develop across long historical horizons and changing institutional conditions.

23.20.7 Interface Research Questions

The scope architecture leaves several open questions that cannot be settled by definition. One concerns the *threshold of economic typing*. Economic incidence is too broad, yet a narrow focus on prices, markets, or money would exclude many relations central to the book. Future research needs more discriminating criteria for when access, capability, recognition, dependency, or institutional constraint becomes an economic explanatory target rather than merely a background condition with economic effects.

A second question concerns *composition of partial explanations*. Even when several disciplines offer well-warranted accounts, there is no guarantee that their explananda, temporal scales, causal units, or normative objects align. Research is needed on how partial accounts can be composed without forcing equivalence, and how unresolved gaps should be represented when no common decomposition is available.

A third question concerns *conflicting correction authorities*. Law, ecology, political theory, education, social theory, technical disciplines, and affected communities can return corrections that are each authoritative within different predicates yet jointly difficult to satisfy. GRE requires procedures for recording such conflicts without collapsing them into one metric or allowing economic optimization to decide which external authority prevails.

A fourth question concerns *endogenous boundary change*. New institutions and technologies can alter the disciplinary object itself. AI-mediated contracting, programmable assets, ecological accounting, platform governance, new forms of collective organization, and changing legal personhood can create economic relations whose boundaries were not available to earlier theory. Scope conditions therefore need historical updating rather than being treated as a timeless taxonomy.

A fifth question concerns *empirical diagnostics of interface failure*. Chapter 23 has developed conceptual distinctions among translation loss, domain remainder, deference, overreach, and counterevidence. Future work needs empirical designs capable of identifying when a failed prediction or policy outcome arose from an economic mechanism, an imported premise, a cross-domain translation, or an omitted domain altogether.

A sixth question concerns the relation between *domain scope and future GRT*. Section 23.19 argued that cross-domain generality becomes more credible when domain theories retain enough independence to reject inherited concepts. GRE therefore faces a productive tension: its own scope must be explicit enough to make comparison possible while remaining revisable enough that future cross-domain evidence

can transform the concepts being compared.

Definition 23.487 (GRE interface research agenda)**.** A *GRE interface research agenda* is a versioned set of unresolved questions concerning economic typing, partial-explanation composition, conflicting domain authority, historical boundary change, interface diagnostics, and cross-domain comparison whose answers can alter GRE's scope rather than merely add applications within a fixed framework.

The agenda distinguishes open problems from empty placeholders. Each question should eventually be connected to cases, evidence, methods, and possible outcomes that can revise the framework. An open research programme remains open because its concepts and boundaries are answerable to future inquiry, not because every result can be accommodated without consequence.

23.20.8 Limits Agenda for Chapter 24

Chapter 23 has treated primarily *interface limits*: boundaries of jurisdiction, translation failures, non-equivalent semantics, external-warrant dependencies, domain counterevidence, and restraints on generalization. These mark where GRE's authority ends because another domain has distinct objects, evidence, methods, or normative authority. They do not exhaust limitations internal to economic claims.

Chapter 24 takes that complementary object. It examines ontological restraint, epistemic and representational limits, relational and historical reconstruction, formalization, closure, heterogeneous value, power, justice, applied praxis, empirical identification, and normative underdetermination. It also asks which persistent failures would count against GRE or require major revision. The transition is from explicit scope to internal fallibility.

Definition 23.488 (Scope–limit handoff)**.** The *scope–limit handoff* is the transition from identifying where GRE bears, shares, defers, or declines explanatory responsibility to examining limitations within the claims GRE undertakes.

A domain boundary is not itself a weakness: economics need not determine legal validity or aesthetic quality. Conversely, a direct-scope claim can still fail through poor evidence, misspecified relations, historical error, formal overreach, unobserved mechanisms, normative underdetermination, or superior rival explanations.

Proposition 23.489 (Scope-before-limit principle)**.** *Evaluation of GRE's limitations should distinguish claims it undertakes from claims it addresses partially, imports conditionally, or declines; failure inside GRE's own responsibilities can then be separated from justified disciplinary restraint.*

Proposition 23.490 (Chapter 23 closure principle)**.** *GRE remains an open research programme only if its interfaces both extend and constrain inquiry: neighboring domains can return corrections, and GRE can state where its explanations are direct, partial, deferred, unsupported, or boundary-revising.*

Chapter 23 therefore closes with bounded openness: GRE retains a recognizable economic problem-space while remaining corrigible through neighboring domains. Chapter 24 turns to limitations within the claims GRE itself undertakes.

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