

Prior Use and the Distribution of Observational Capacity in State-Dependent Governance

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Abstract

A governing rule whose content depends on the dynamical state of the system it governs requires that the state be determined. Where the system exhibits a critical value above which ordinary conduct produces irreversible foreclosure, the determination that the system has approached that value carries the whole of the rule's practical force, and the question of which party is competent to make it becomes the governing question. This paper argues that the competence and the interest converge. The capacity to determine the state of such a system consists in instruments, records and continuous observation, and these are acquired in the course of using the system. A determination that the system stands near its critical value contracts the permissions of every party and bears most heavily on parties whose use lies in prospect. The party best equipped to make the determination is accordingly, and systematically, the party the determination favours. The paper establishes the convergence formally under stated assumptions about the acquisition of observational capacity, distinguishes it from the classical problem of emergency authority by the respect in which the epistemic asymmetry is prior to the legal one, and establishes that the two responses developed for emergency authority both presuppose a separation between determining the state and being a party to the outcome that the present case denies. Three consequences are drawn: constraint by ex ante criteria requires an evaluator holding the instruments; termination conditions keyed to the state inherit the same defect as the trigger; and a party disadvantaged by a determination lacks the standing to contest it on evidential grounds. The paper closes by stating what a defensible arrangement would have to secure and by recording that it proposes none.

Keywords: criticality; emergency authority; state of exception; observational capacity; orbital

governance; epistemic injustice; generative relational governance.

Part I

The Object and Its Antecedents

1 Introduction

This section states the problem the paper addresses, establishes that the two responses developed for the classical form of that problem are unavailable here, states the thesis, and sets out the order of the argument. The method is analytical for the diagnosis and formal for the central result, which is stated in Section 7 and verified under the assumptions there declared.

1.1 The Determination Required by a State-Dependent Rule

A governing rule ordinarily attaches a consequence to a description of conduct. Rules of this form are assessed for generality, and their holding across circumstances is among the properties that recommend them.

A class of systems admits no adequate rule of that form. Where a system carries a critical value above which the accumulation of individually unremarkable conduct produces irreversible foreclosure, a rule attaching consequences to conduct alone is silent on every occasion at which the accumulation proceeds. A rule adequate to such a system attaches its consequence to conduct together with the condition of the system at the time, taking the form

$$\pi = \pi(X_t), \tag{1}$$

in which X_t denotes that condition. A companion paper establishes that a rule of this form is required by the dynamics of such systems, and the present paper takes the requirement as given.

Equation (1) carries a consequence that its formal statement conceals. The rule cannot operate until X_t has been determined, the determination is an act performed by some party, and the content of the rule for every other party follows from it. Whatever else is settled about the rule, the determination carries its practical force entirely.

1.2 The Classical Problem and the Responses Developed for It

A rule whose content depends on an authority's determination that ordinary circumstances have lapsed is the structure of emergency government, and two responses to it are well developed.

The first constrains the authority by law. Constitutional emergency provisions specify the conditions under which a declaration may be made, the powers it confers, the period for which it runs, and the body competent to review it. The literature on emergency powers has

established both the design of such provisions and the characteristic ways they fail.

The second removes the determination from the interested party and vests it in a body constituted for the purpose. Scientific advisory bodies attached to treaty regimes, standing panels of assessment, and expert committees within international organisations all take this form, and the arrangement is familiar wherever a legal consequence turns on a technical finding.

Each response presupposes a proposition, and the propositions differ. Constraint by law presupposes that a party other than the declaring authority can evaluate whether the declared conditions obtain, since a criterion no one else can apply constrains no one. Delegation to a body presupposes that the finding the body must make is available to a party constituted without a stake in the outcome.

Both propositions fail for the systems at issue, and they fail for the same reason. The condition X_t of a system of this kind is established by continuous observation carried out with instruments, and the observation is neither public nor cheap. The party holding the instruments is the party that acquired them, and instruments for observing a system are acquired by parties that use the system.

1.3 The Thesis

The paper's thesis concerns the relation between two rankings over the parties to such a system.

Rank the parties by their capacity to determine X_t , which consists in instruments deployed, records held, and observation sustained over the period from which a trend is established. Rank the parties separately by the benefit each derives from a determination that the system stands near its critical value, that benefit consisting in the contraction of the permissions of others relative to use already realised.

Thesis 1.1 (Convergence of competence and interest). For systems whose observation requires instruments acquired in the course of use, the two rankings coincide in order. The party best equipped to determine that the system has approached its critical value is the party that a determination to that effect most favours.

The convergence is established in Section 7 under assumptions declared there, and its three consequences occupy Part III. Constraint by ex ante criteria requires an evaluator holding the instruments, and the criteria are therefore applied by the party they were written to bind. Termination conditions keyed to the state inherit the defect of the trigger, since the determination that a system has left its critical region is made by the same party and rests on the same instruments. A party disadvantaged by a determination lacks the evidential standing to contest it, and its objection takes a form the arrangement answers by pointing to the record.

1.4 The Departure from the Classical Diagnosis

The classical diagnosis of emergency authority locates the difficulty in the legal relation: an authority competent to declare the exception is competent also to determine that it continues, and the arrangement tends toward permanence.

The present diagnosis locates the difficulty one step earlier, in the epistemic relation. The competence at issue is a competence to know, it is distributed by a process independent of any legal arrangement, and it is prior to the legal competence in the respect that a legal power to determine the state is exercised through the instruments that establish it. An arrangement conferring the legal competence on a neutral body leaves the epistemic competence where it was, and the neutral body determines the state by consulting parties that hold instruments.

This departure has a consequence for what a repair would have to accomplish, and Section 13 states it. A repair operating on the legal competence alone addresses the second relation and leaves the first in place.

1.5 Order of the Argument

Part I fixes the object. Section 2 states the scope, the restrictions accepted and the positions declined. Section 3 sets out the prior treatments of emergency authority and of determination by expert bodies, and states the claim each owns.

Part II establishes the structure. Section 4 decomposes the determination into its components and identifies which of them the instruments govern. Section 5 establishes the relation between observational capacity and prior use. Section 6 sets out the distribution of observational capacity and its sources.

Part III establishes the consequences. Section 7 states and verifies the convergence result. Section 8 treats termination. Section 9 treats contestation by a disadvantaged party.

Part IV examines two settings. Section 10 treats the determination of orbital state. Section 11 treats ecological monitoring and the relation between its density and the wealth of the party monitored.

Part V closes. Section 12 argues the positions declined. Section 13 states the limits and the conditions a defensible arrangement would have to secure.

2 Scope of the Account and the Restrictions It Accepts

This section fixes the object of the account, states the restrictions that confine it, names the resources imported, identifies the settings examined in Part IV, and states the positions declined at the outset. The relation to the companion paper is stated first, since the boundary between the two determines what the present account may assume.

2.1 The Relation to the Companion Paper

The companion paper establishes three results that the present account takes as given.

The first is a criterion allocating the burden of justification to a party whose course would irreversibly foreclose the generative capacity of a trajectory other than its own. The second is that the criterion fails to compose: a sequence of courses on none of which it fires may produce the foreclosure it exists to allocate a burden for. The third is that the repair which composition requires makes the governing rule a function of the dynamical state, in the form of equation (1), and that a rule of this form carries the structure of the exception.

The companion paper states three constraints bearing on that structure and identifies the questions each leaves open. The present paper takes those questions as its object. Nothing here re-argues the criterion, and a reader who rejects it may still hold the results of Parts II and III, which concern the determination of a system state under any rule that requires one.

2.2 The Object of the Account

The object is the determination that a system stands within a region in which the governing rule takes a particular form, together with the allocation of competence to make that determination.

Three features of this specification carry weight.

The determination concerns a state of the world, and its correctness is a factual matter. This distinguishes it from a decision, which selects among courses and admits assessment for wisdom. A party disputing a determination disputes a claim about how things stand.

The determination is made under the conditions established by the companion paper, in which the system exceeds what any party represents. A determination made under those conditions is defeasible, is made on partial evidence, and admits reasonable disagreement among parties observing the same system with different instruments. Such disagreement is what the description of a field as heterogeneous records throughout this series. A field is heterogeneous with respect to a party when no common measure over its participants is available to that party, so that estimates formed under different instruments admit no reconciliation by appeal to a scale both parties hold, and the companion synoptic paper treats the point at length.

The parties to the system are plural and their prior use is unequal. An account addressed to a single party governing its own conduct would raise none of the questions treated here, and the plurality together with the inequality is what generates them.

2.3 Restrictions Accepted by the Account

The account is restricted in four respects.

It concerns competence and remains silent about correctness. The account establishes which party is positioned to make a determination and establishes nothing about whether any particular determination is right.

It concerns the determination and remains silent about the consequence attached to it. What follows from a finding that the system stands near its critical value is settled by the rule, and the companion paper states the rule the present account assumes.

It concerns systems whose observation requires instruments acquired through use. Systems observable by instruments available independently of use fall outside the argument, and §2.6 declines the claim that all systems of governance interest are of the first kind.

It concerns the structure of the arrangement and remains silent about the motives of the parties within it. The convergence established in Section 7 obtains whether or not any party seeks the advantage it confers, and an account resting on bad faith would establish something weaker.

2.4 Resources Imported

Four resources are imported.

The analysis of the exception and of its tendency toward permanence is taken from the tradition running from Schmitt through Agamben, and the paper's departure from that tradition is stated at §1.4.

The design and the failure modes of constitutional emergency provisions are taken from the literature on emergency powers, which supplies the account of what constraint by law achieves and where it fails.

The analysis of testimonial and hermeneutical injustice supplies the vocabulary in which the contestation problem of Section 9 is stated, and the debt is recorded there.

The account of the first repair's limits, and the classification of transitions on which those limits rest, is taken from the companion paper and through it from the dynamical systems literature.

2.5 Settings Examined

Two settings are examined in Part IV and are chosen for the difference in the source of the inequality.

The first is the determination of the state of a congested orbital region. The inequality there arises from deployment, since the instruments that establish orbital state are held by the parties that operate in orbit and by the states that launched them.

The second is ecological monitoring, where the inequality arises from the wealth of the party in whose territory the system lies. The determination of an ecosystem's condition rests on records whose density varies with the resources available to maintain them, and the variation is unrelated to the ecological significance of what is monitored.

2.6 Positions Declined at the Outset

Four positions are declined and each is argued in Section 12.

The account asserts no claim that determinations are made in bad faith. The convergence is structural, and §2.3 records that an account resting on motive would establish less.

The account asserts no general thesis that observation requires use. The relation holds for the systems specified at §2.3 and fails for others, and the argument is confined accordingly.

The account proposes no allocation of the competence to determine. Section 13 states what a defensible arrangement would have to secure and stops there.

The account proposes no scheme for equalising observational capacity. A scheme of that form would be an institutional design, the companion paper's grounds for declining institutional design apply here, and the second setting of §2.5 supplies a further ground, since the capacity in question is expensive and its distribution tracks a distribution of resources that no governance arrangement establishes.

3 Prior Treatments of Emergency Authority and of Determination by Expert Bodies

This section sets out the treatments already available of the problem the paper addresses and states for each the claim it owns. The order proceeds from the treatments locating the difficulty in sovereign competence, through those locating it in constitutional design and in the politics of expert advice, to those locating it in the credibility accorded to a speaker. The section closes with Claim 3.1, which states the class of cases surviving every treatment surveyed.

3.1 The Exception and the Competence to Declare It

Schmitt [4] locates sovereignty in the competence to determine that the ordinary situation has lapsed, and the claim owned is that this competence is logically prior to the legal order it suspends, since no norm specifies the conditions of its own suspension in a manner that removes the judgement.

Agamben [1] establishes the tendency of such arrangements toward permanence, and the claim owned is that the authority competent to declare the exception is ordinarily the authority competent to determine that it continues, so that the temporary measure becomes a technique of ordinary government.

Both accounts treat the competence as a legal and political one. The determination they analyse concerns a situation whose lapse is a matter of political judgement, and the difficulty they identify lies in the absence of a party positioned to review that judgement. Section 4 establishes that the determination at issue in the present paper differs in kind, since it concerns a state of a physical system and its correctness is a factual matter.

3.2 The Constraint of Emergency Authority by Constitutional Design

Ferejohn and Pasquino [7] set out a typology of emergency powers and establish that constitutional systems address the problem by specifying in advance the conditions of a declaration, the powers it confers, its duration, and the body competent to review it. Gross and Ní Aoláin [3] examine the models available and establish the characteristic failures of each, including the migration of emergency measures into ordinary law.

The claim owned by this literature is that the exception admits partial constraint by prior specification, and that the constraint operates through the availability of the specified conditions to a reviewing body.

The availability of the conditions to a reviewing body is the presupposition identified at §1.2, and Section 7 establishes that it fails for the determinations at issue here. The literature treats conditions whose obtaining is establishable by a court on evidence a court can receive, such as the presence of hostilities or the interruption of ordinary government. A finding that a system stands within a region of its state space is establishable on evidence of a different kind.

3.3 Emergency Framing in Environmental Politics

Wainwright and Mann [5] establish that the response to planetary environmental crisis tends toward the constitution of an authority competent to declare emergency and thereby to determine which parties are spared, and the claim owned is that this tendency is a political consequence of the crisis and stands independent of any party's intention. Earlier arguments in the tradition running through Ophuls [9] hold that ecological limits require the concentration of authority, and the present literature is largely addressed to resisting that inference.

The debate concerns whether authority should be concentrated. The present paper takes no position in it and establishes a result that holds whichever position is adopted, since the result concerns which party is positioned to make a determination under any arrangement in which some party must.

3.4 Determination Removed to a Body Constituted for the Purpose

Where a legal consequence turns on a technical finding, the finding is characteristically removed from the interested party and vested in a body constituted for the purpose. Scientific committees attached to treaty regimes, standing assessment panels, and expert advisory bodies within international organisations all take this form.

Jasanoff [8] establishes that such bodies perform work that is neither purely technical nor purely political, that the boundary between the two is itself negotiated in the course of their operation, and that the authority of their findings rests on the maintenance of that boundary. The claim owned is that the removal of a finding to an expert body relocates a political question and leaves it in place.

The present paper's difficulty is adjacent to this one and differs from it. Jasanoff's analysis concerns the composition of the finding and the interests operating within the body. The present analysis concerns the provenance of the evidence the body receives. A body of impeccable composition, deliberating without any interest in the outcome, determines the state of the system by consulting records, and §1.2 established who holds them.

3.5 Credibility and the Distribution of Epistemic Standing

Fricker [2] establishes two forms of epistemic injustice. Testimonial injustice occurs where a hearer accords a speaker less credibility than the speaker's testimony warrants, on the ground of a prejudice attaching to the speaker's social identity. Hermeneutical injustice occurs where

a collective interpretive resource is impoverished in a manner that leaves some group unable to render an aspect of its experience intelligible. Dotson [6] extends the analysis to cases where a speaker's contribution fails through the persistence of a shared resource inadequate to receive it.

Wynne [16] established a case of a different kind and it bears directly on the limits of the present argument. Cumbrian sheep farmers subject to restrictions following radioactive deposition held detailed knowledge of local terrain, drainage and grazing on which the scientific advice they received had not drawn, the advice failed in ways their knowledge would have anticipated, and the standing accorded to their observation was lower than its accuracy warranted. The claim owned is that local observation sustained over long periods may carry epistemic standing that institutional assessment fails to receive.

The claim owned by this family is that epistemic exchange carries injustices distinct from the distribution of material goods, and that the correction of a credibility deficit is a requirement of justice.

The difficulty treated in Section 9 is related to these and differs from them in a respect that determines what corrective is available. A party lacking the instruments to establish the state of a system suffers a credibility deficit with respect to claims about that state, and the deficit is warranted. Its testimony is in fact less well supported, its assertions do rest on thinner evidence, and a hearer according it the credibility that instrument-holding parties receive would be crediting a claim beyond its warrant. The corrective developed for testimonial injustice consists in the correction of prejudice, and the correction of prejudice leaves a warranted deficit exactly where it stood.

3.6 The Class Surviving the Surveyed Treatments

Claim 3.1 (Residue of the surveyed treatments). The treatments surveyed locate the difficulty of a state-dependent rule in the priority of sovereign competence to the legal order, in the tendency of declared exceptions to persist, in the political constitution of expert bodies, or in a credibility deficit produced by prejudice or by an impoverished interpretive resource. Where the declaring authority is constrained by prior specification, the declaration is reviewable by a constituted body, the body deliberates without interest in the outcome, and no party suffers any deficit of credibility that a correction of prejudice would remedy, the determination may still be made on evidence held by the party the determination favours. No treatment surveyed addresses the allocation of the instruments by which the state is established.

The class is populated and Part IV examines two of its members. The remainder of the

paper is addressed to it.

Part II

The Structure of the Determination

4 The Components of a Determination of System State

This section decomposes the determination required by equation (1) into its components, identifies which of them the possession of instruments governs, and establishes that the constraint machinery surveyed in §3.2 operates on a component distinct from the one the instruments govern. The decomposition is what permits the argument of Part III to be stated precisely, since a claim about who determines the state is otherwise ambiguous between several distinct acts. The method is analytical.

4.1 The Determination Distinguished from a Decision

A decision selects among courses available to a party and is assessed for wisdom. A determination asserts that the world stands in a certain condition and is assessed for correctness.

The determination at issue asserts that a system occupies a region of its state space. The assertion is factual, it is defeasible, it is made on partial evidence under the conditions the companion paper establishes, and it admits reasonable disagreement among parties observing the same system with different instruments.

Three features follow. A determination may be mistaken in a sense in which a decision may not, so that a party contesting it contests a claim about how things stand. A determination made correctly may still be contested, since the evidence supporting it is partial. And a determination requires no exercise of preference, so that a party holding no interest in the outcome may make one, which is the presupposition on which the arrangements of §3.4 rest.

4.2 The Components

The determination decomposes into five components, performed in order and separable in principle.

Observation produces measurements of the system at intervals. The component consists in instruments, their placement, their calibration, and their operation over the period during which measurement continues.

Compilation produces a record from the measurements. The component consists in the retention of measurements, their assembly into a series, and the maintenance of the series against loss and against changes in instrumentation that would render its parts incomparable.

Estimation produces a claim about the present state of the system from the record. The component requires a model of the system sufficient to relate what the instruments measure to the quantity the rule refers to, since instruments measure positions, concentrations and

populations while the rule refers to a condition of the system as a whole.

Classification produces a claim about the relation between the estimated state and the boundary of the region in which the rule takes its restricted form. The component requires a specification of the boundary, and the specification is a further matter on which the record bears.

Declaration produces the legal or institutional act by which the rule takes its restricted form for the parties governed. The component consists in an authority stating that the preceding components have been performed and that their result places the system in the region.

4.3 The Components the Instruments Govern

The possession of instruments governs the first two components entirely and the third substantially.

Observation and compilation are constituted by the instruments and their operation. A party lacking instruments performs neither, and a party whose instruments were deployed recently holds a record whose brevity is a defect no present expenditure repairs, since the missing measurements concern past states of the system.

Estimation depends on the record in two ways. The estimate is computed from the record, and the model relating measurement to system state is ordinarily fitted to a record. A party holding a longer record accordingly holds both the input and the instrument of inference.

Classification depends on the record in one way and on a further matter in another. The boundary of the region is specified by a claim about the system's dynamics, and such claims are established from records of the system's past behaviour under varying conditions. A party holding the longest record is best positioned to assert where the boundary lies, and a party holding no record is positioned to assert nothing about it.

Declaration depends on the instruments in no way. The component is an institutional act, it may be performed by any party the arrangement designates, and its performance requires only that the designated party be presented with the result of the preceding components.

4.4 The Component the Constraint Machinery Reaches

The arrangements surveyed in §3.2 operate on declaration. Constitutional emergency provisions specify who may declare, on what conditions, for how long, and subject to what review, and the review examines whether the declared conditions obtained.

The examination requires that the reviewing body evaluate the preceding four components, and §4.3 establishes that all four rest on a record. A reviewing body holding no independent record evaluates the determination by examining the record presented to it, together with such account of the estimation and classification as the presenting party supplies. Its review is accordingly an audit of an account rendered by the party under review.

This is the precise form the difficulty takes, and it survives every improvement to the specification of declaration. A provision requiring that the declaring authority be

independent of the parties governed, that its declaration be reasoned, that it lapse after a fixed period, and that it be reviewable by a court, constrains declaration completely and leaves observation, compilation, estimation and classification where they were.

4.5 Exclusions from the Decomposition

Three matters lie outside the decomposition.

The decomposition asserts no temporal separation in practice. The components are separable in principle and are ordinarily performed by one party in a single continuous operation, and their separability is what permits the argument to identify where the difficulty lies.

The decomposition asserts nothing about the correctness of any determination. A party holding the instruments may determine the state correctly, and §2.3 restricts the account to competence.

The decomposition treats the specification of the boundary as a matter on which the record bears and does not treat it as settled by the record alone. Where the boundary is specified by a rule, a treaty or a standard, its specification is an institutional act examined in Section 10, and the record bears on whether the specified value has been approached.

5 The Relation between Observational Capacity and Prior Use

This section establishes the relation on which Thesis 1.1 depends. It states what observational capacity consists in, establishes that the capacity is acquired in the course of use for systems of the kind specified at §2.3, states the countervailing cases in which the relation fails, and fixes the conditions under which the argument of Section 7 proceeds. The method is analytical, and the section states the relation as a conditional whose antecedent Part IV examines for two settings.

5.1 The Constituents of Observational Capacity

Observational capacity with respect to a system consists in three things, and the third is distinguished from the first two by the manner of its acquisition.

Instruments are the devices by which measurements are taken, together with their placement and their maintenance. Instruments are acquired by expenditure and their acquisition is available to any party willing to bear the cost.

Access is the standing by which instruments are placed where measurement is possible. Access to some systems is available from a distance and access to others requires proximity, presence, or the consent of a party controlling the site.

Duration is the period over which measurement has continued without interruption and without a change of instrumentation that renders the series incomparable. Duration is distinguished from the first two in that it cannot be acquired by present expenditure. A party deciding today to observe a system holds a record of zero length today, and no expenditure

produces the measurements it did not take.

The third constituent carries the argument. Sections 4 establishes that estimation and classification rest on a record, and a record's value for both purposes increases with its length, since a trend is established from a series and the specification of a boundary rests on observed behaviour under varying conditions.

5.2 The Acquisition of Capacity in the Course of Use

For the systems specified at §2.3, the three constituents are acquired in the course of using the system, and the acquisition is a by-product of operation in place of a separate undertaking.

A party operating within a system requires measurements of it for operational reasons. An operator of orbital assets tracks objects in order to avoid them, an extractive operation surveys the resource it draws on, a party discharging effluent monitors the receiving water under the terms of its permit. The instruments are deployed to serve the operation and the measurements accumulate as a consequence.

Access follows from operation in the same way. A party present within a system is positioned to measure it, and presence is what operation consists in. Where access requires the consent of a controlling party, the operating party ordinarily holds that consent already, since its operation required it.

Duration follows from the date at which operation began. A party that has operated within a system for a long period holds a record covering that period, and the record was accumulated at no cost beyond the operation itself. A party proposing to begin operation holds no record and cannot construct one retrospectively.

The relation is therefore of a particular form. Observational capacity is nondecreasing in the duration of prior use, and its most valuable constituent is a strictly increasing function of that duration.

5.3 The Benefit Conferred by a Determination of Approach

A determination that the system stands near its critical value contracts the permissions of every party, since it extends the burden of justification to courses that previously carried none. The contraction bears on parties according to the position of their use in time.

A party whose use is already realised retains what it holds. The contraction reaches courses the party has yet to adopt, and where its principal deployment is complete those courses are marginal to it.

A party whose use lies in prospect loses the whole of that prospect for the duration of the determination. The contraction reaches every course by which the party would enter, and the courses it reaches are the party's entire participation.

The benefit derived from a determination of approach is accordingly increasing in the share of a party's use already realised, taking its greatest value for a party whose deployment is complete and its least for a party that has yet to begin.

5.4 The Statement of the Relation

Claim 5.1 (Common ordering by prior use). For a system whose observation requires instruments deployed within it, whose access follows from operation within it, and whose state estimation rests on a record, both observational capacity and the benefit conferred by a determination of approach are increasing in the duration and extent of a party's prior use of the system. The two are accordingly ordered alike over the parties.

Claim 5.1 is a conditional. Its antecedent states three properties of a system, Section 7 draws the consequence formally, and Part IV examines whether the antecedent holds for two settings.

5.5 The Cases in Which the Relation Fails

The relation of Claim 5.1 fails in three classes of case, and the failures are neither rare nor marginal.

Where observation is performed from outside the system by instruments requiring no presence within it, access does not follow from operation. Satellite remote sensing of terrestrial systems is the standing instance, and a party holding no operational presence in a watershed may observe its condition from orbit.

Where a record is compiled and published by a party constituted for that purpose and made available without charge, duration does not follow from a party's own operation. Long civil observation programmes maintained as public undertakings supply records of great length to parties that contributed nothing to their accumulation.

Where observation is performed by parties with no operational interest, capacity is distributed by a process unrelated to use. Academic observatories, amateur networks and non-governmental monitoring all take this form, and their records are in some domains the principal ones available.

Each failure is a condition under which the argument of Section 7 does not obtain, and their existence establishes the shape of what a remedy would consist in. The three classes share a feature: in each, the observation is supported by a party that bears the cost without operating within the system. Such support is an achievement maintained by expenditure and by policy, it is withdrawn when either lapses, and Section 13 treats its maintenance as the condition on which a defensible arrangement rests.

6 The Distribution of Observational Capacity among the Parties

This section establishes the properties of the distribution that Claim 5.1 identifies. It states the sources of the distribution, establishes that the inequality in its most valuable constituent is permanent under continued operation, identifies the mechanism by which capacity converts into standing within the determination, and states what the distribution is not. The method is analytical, and the section prepares the construction verified in Section 7.

6.1 The Sources of the Distribution

Three sources produce the distribution of observational capacity across the parties to a system.

Expenditure produces instruments and their maintenance, and its effect is available to any party at any time. A party entering a system today acquires instruments of the current generation, and those instruments may exceed in quality the instruments an earlier party deployed.

Presence produces access, and its effect follows the geography of operation. A party present at a site measures conditions there, and a party absent from it measures them at a distance or through the consent of a party present.

Timing produces duration, and its effect follows the date at which operation began. A party that entered early holds a record covering the period since, and §5.1 established that this constituent stands outside the reach of present expenditure.

6.2 The Permanence of the Inequality in Duration

The inequality produced by the third source has a property the other two lack.

Let two parties enter a system at times $t_1 < t_2$ and operate continuously thereafter. At any later time T their records have lengths $T - t_1$ and $T - t_2$, and the difference between them equals $t_2 - t_1$ at every value of T . The gap is therefore fixed at the moment of the second party's entry and persists unchanged for as long as both parties operate.

Two consequences follow.

The inequality in duration admits no closure by the diligence of the later party. A party observing continuously from its entry accumulates record at the same rate as the party ahead of it, and equal rates leave a constant difference. The later party may exceed the earlier in instruments, in coverage and in the quality of each measurement, and it will hold the shorter series for as long as the comparison is made.

The relative inequality declines while the absolute inequality persists. As T grows, the ratio of the two record lengths approaches unity, so a system observed for a very long time by both parties yields records whose lengths are comparable in proportion. Whether the absolute gap or the ratio governs depends on what the record is used for, and §6.3 states the condition under which the absolute gap governs.

6.3 The Conversion of Capacity into Standing

Observational capacity converts into standing within the determination through the components identified at §4.3.

The conversion operates through the estimate. A party presenting an estimate presents the record supporting it, and a party contesting the estimate contests it with a record of its own. Where the contesting party's record is shorter, its contest is assessed by a body comparing two series, and the shorter series supports fewer inferences about trend and none at all about the behaviour of the system before it began.

The conversion operates more strongly through the boundary. A claim about where the critical value lies rests on observed behaviour under varying conditions, and the range of conditions a record covers is a function of its length. A party holding a record covering one regime of the system asserts nothing about the value at which the system leaves that regime, and §6.2 establishes that this party may be the one holding the better instruments.

The absolute gap accordingly governs where the question concerns behaviour in a period covered by one record and absent from the other, which is the question a boundary claim raises. The ratio governs where the question concerns the precision of an estimate of a present quantity.

6.4 The Distribution Distinguished from Adjacent Distributions

Three descriptions of the distribution are declined.

The distribution is not a distribution of wealth, though it correlates with one. A wealthy party entering a system today acquires instruments and acquires no duration, and §6.2 establishes that the second deficiency persists. Section 11 examines a setting in which the correlation with wealth is nevertheless strong, and identifies the mechanism as the maintenance of programmes over time in place of expenditure at any moment.

The distribution is not produced by any party's design. It follows from the order in which parties entered a system together with the by-product character of operational measurement, and §2.6 declines any claim that determinations are made in bad faith.

The distribution is not a distribution of credibility in the sense treated at §3.5. The parties holding shorter records receive less credence on questions about the system's past, and the lesser credence is warranted. What the distribution produces is a warranted asymmetry, and Section 9 establishes what follows for a party seeking to contest a determination from within it.

6.5 Exclusions from the Account of the Distribution

Two matters lie outside this section.

The section establishes properties of a distribution and supplies no measurement of any actual one. Part IV examines two settings and characterises the distribution in each qualitatively, and no quantity stated here is estimated from data.

The section treats continuous operation and treats interruption only implicitly. A party whose observation lapses holds a record with a gap, the gap bears on inferences spanning it, and a full treatment would state how a gapped record compares with a shorter continuous

one. The comparison is left open.

Part III

The Consequences of the Distribution

7 The Convergence of Determining Competence with the Interest Served

This section establishes Thesis 1.1. It states the construction, establishes the convergence in Proposition 7.1, establishes its robustness to expenditure, and establishes in Proposition 7.2 the condition under which the convergence is defeated. The second proposition carries the paper's constructive content, since it converts a negative result about the distribution into a quantity that an arrangement may secure. The method is formal, and both propositions are verified over the ranges declared.

7.1 The Construction

Let N parties operate within a system opened at time zero and observed to the present time T . Party i entered at t_i and has since operated and observed continuously.

Write $D_i = T - t_i$ for the duration of party i 's use and of its record. Write X_i for its expenditure on instruments, drawn independently of t_i , so that a late entrant may hold the better instruments. Write H for the period a party requires to complete its intended deployment, and

$$s_i = \min\left(1, \frac{D_i}{H}\right) \quad (2)$$

for the share of that deployment already realised.

Observational capacity combines a term expenditure purchases and a term it cannot:

$$C_i = (1 - w) \frac{D_i^{\text{eff}}}{D_{\max}} + w \frac{X_i}{X_{\max}}, \quad (3)$$

where $w \in [0, 1]$ weights purchasable instrument quality and D_i^{eff} denotes the effective record length available to party i .

The benefit conferred on party i by a determination that the system stands near its critical value is $B_i = s_i$, following §5.3, since the contraction reaches courses a party has yet to adopt and reaches nothing it has already realised.

A public record of length L , compiled by a party bearing the cost without operating within the system, gives every party a record of at least that length, so that $D_i^{\text{eff}} = \max(D_i, L)$.

7.2 The Convergence and Its Robustness

Proposition 7.1 (Concordance of capacity with benefit). With $L = 0$ and $w = 0$, the ordering of the parties by C_i and the ordering by B_i are perfectly concordant: no pair of parties is

ranked oppositely by the two measures. For $w > 0$ the fraction of pairs so ranked rises slowly, remaining below one tenth for $w \leq 0.3$.

The verification draws $N = 40$ parties with entry times uniform on $[0, T]$ for $T = 60$, expenditure uniform and independent of entry, and $H = 25$, over four hundred draws. The discordant fraction at $w = 0$ is zero in every draw. At $w = 0.1, 0.2$ and 0.3 it takes mean values 0.023, 0.051 and 0.089, and at $w = 0.5$ it reaches 0.203.

Two features of the result deserve record.

The concordance at $w = 0$ is exact and follows from the construction, since both measures are nondecreasing functions of D_i . The formal content of the proposition lies in the second clause, which establishes that the concordance degrades slowly under the one form of remedy a party may purchase. A late entrant outspending every incumbent on instruments displaces itself a short distance in the ordering, because expenditure enters C_i through one term and duration enters through the other.

The rank correlation between the two measures stands at 0.891 at $w = 0$, below unity, and the shortfall is produced by ties in B_i . Parties whose deployment is complete are tied at the maximum benefit, and the tie is a feature of the situation in place of an artefact: a determination of approach is equally favourable to every party that has finished deploying, however long each has been present.

7.3 The Condition Defeating the Convergence

Proposition 7.2 (Public-record threshold). The rank correlation between capacity and benefit falls monotonically in the length L of a public record available to every party, and reaches a floor of approximately zero once L attains $D_{\max}$. At that point every party holds an equally long record, capacity is governed by expenditure alone, and expenditure is independent of the position of a party's use in time.

The verification computes the correlation over the same draws. At $w = 0.2$ it takes the values 0.864, 0.823, 0.565, 0.220 and -0.009 for L equal to 0, 15, 30, 45 and 60. At $w = 0.4$ it takes the values 0.740, 0.662, 0.378, 0.103 and -0.009 . Figure 1 displays the curves.

Two readings of the proposition are available and both are intended.

Read as a diagnosis, it establishes that the convergence is a property of the observational regime in place of a property of the parties. Where observation is left to those who operate, the party best equipped to determine the state is the party the determination favours. Where observation is maintained as a public undertaking of sufficient duration, the relation dissolves.

Read as a requirement, it fixes what an arrangement must secure, and the quantity is stated in years. A public record shorter than the longest private one leaves the convergence in place to a degree that falls with its length. The requirement is exacting: the record must be as long as the longest record any operating party holds, and §5.1 established that length is the constituent no expenditure supplies at the moment it is wanted.

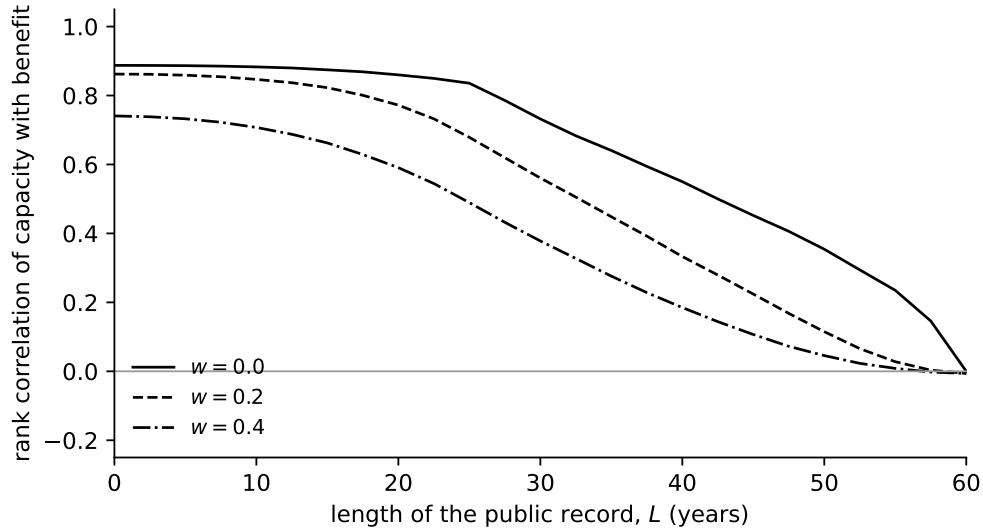


Figure 1: Rank correlation between observational capacity and the benefit conferred by a determination of approach, against the length L of a public record available to every party, at three weights w on purchasable instrument quality. The correlation reaches its floor once the public record attains the length of the longest private one.

7.4 The Consequence for the Timing of Provision

Proposition 7.2 carries a consequence about when a public observational programme must be established, and the consequence is unwelcome.

A programme established at the moment a governance arrangement is adopted supplies a record of zero length at that moment. Its record attains the length of the longest private record only after a period equal to the age of that record, and during the whole of that period the convergence obtains to a degree that declines slowly.

An arrangement adopting a state-dependent rule therefore operates under the convergence for a period fixed by the history of the system's use before the arrangement existed. The period is longest exactly where use began earliest, which is where the state-dependent rule is most likely to be needed.

7.5 Exclusions from the Result

Three matters lie outside the propositions.

The construction is an existence argument concerning the structure of the two orderings. It establishes that the concordance follows from the stated properties and supports no estimate of w , of L , or of the discordant fraction in any actual system.

The result concerns competence and concerns correctness in no respect, following the restriction at §2.3. A party favoured by a determination it is best equipped to make may make it correctly, and the result establishes that the arrangement supplies no party positioned to check.

The result treats the public record as available to every party equally. A record published under conditions restricting its use, or in a form requiring expertise concentrated among

the same parties, supplies less than the construction assumes, and Section 13 records the qualification.

8 Termination and the Evidential Origin of Persistence

This section examines the condition under which a determination ceases to bind. It establishes that the record required to establish departure from a critical region exceeds the record that established approach to it, that the excess is a consequence of the system's dynamics in place of a consequence of any party's conduct, and that the persistence of determinations therefore admits an explanation independent of the sovereign interest that the classical account invokes. The method is formal for Proposition 8.1 and analytical for its consequences.

8.1 The Condition Required for Termination

A rule of the form of equation (1) relaxes when the system leaves the region in which the rule takes its restricted form. The condition for relaxation is stated in the same terms as the condition for extension, and the companion paper offers this symmetry as a constraint distinguishing the arrangement from the classical exception.

The symmetry holds at the level of the statement. Both conditions concern the position of X_t relative to a boundary, both are factual, and both are established by the components decomposed at §4.2. A party asserting that the system has left the region asserts a claim of the same form as the party that asserted it had entered.

The symmetry fails at the level of the evidence, and the failure is the subject of this section.

8.2 The Record Required near a Threshold

A system fluctuating about a stable state returns toward that state at a rate that falls toward zero as the system approaches a threshold at which the state loses stability. The consequence for observation is that successive measurements decorrelate slowly, so that a record of given length contains fewer independent observations of a slow system than of a fast one.

Model the fluctuation by

$$dx = -\lambda(x - \mu)dt + \sigma dW, \quad (4)$$

in which λ is the restoring rate. A determination distinguishing one value of μ from another rests on the sample mean of a record of length T .

Proposition 8.1 (Record length required near a threshold). For the process of equation (4), the variance of the sample mean over a record of length T scales as T^{-1} at fixed λ and as λ^{-2} at fixed T . The record length required to attain a fixed precision accordingly scales as λ^{-2} , so that a system whose restoring rate has halved requires a record four times as long to support a determination of equal confidence.

The verification simulates equation (4) over four record lengths at fixed λ and over four restoring rates at fixed T . The fitted exponent in T is -1.004 against an expected -1 , and the

fitted exponent in λ is -1.943 against an expected -2 . The third clause is checked directly: at restoring rates 0.8, 0.4, 0.2 and 0.1, records of length 200, 800, 3200 and 12800 attain the same precision, with achieved variances within four per cent of the target in each case.

8.3 The Asymmetry between Approach and Departure

Proposition 8.1 bears asymmetrically on the two determinations, and the asymmetry follows from where each is made.

A determination of approach is made while the system is still leaving the ordinary regime. The restoring rate has fallen and has not yet reached its smallest value, and the record supporting the determination was accumulated over a period during which the rate was higher than it is at the moment of determination.

A determination of departure is made from within the critical region. The restoring rate is at its smallest there, the record supporting the determination must be accumulated under that condition, and Proposition 8.1 fixes the multiple by which it must exceed the record that supported the approach.

The consequence is that the evidential burden for terminating a determination exceeds the burden for making one, and the excess grows as the system's condition becomes more severe. An arrangement whose termination condition is stated in the same terms as its trigger therefore imposes a heavier requirement for relaxation than for extension, and it does so without any provision to that effect.

8.4 Persistence Explained without Appeal to Interest

The classical account explains the persistence of exceptional arrangements by the alignment of the declaring authority's interest with their continuation, and Agamben's analysis rests on the identity between the authority competent to declare and the authority competent to determine that the declaration continues.

Proposition 8.1 supplies an explanation of persistence that stands independent of interest. A determination binding a system in its critical region persists because the evidence sufficient to end it is harder to produce than the evidence that began it, and the difficulty is fixed by the system's dynamics. An authority holding no interest whatever in the continuation of a determination, applying a termination condition in good faith and with every diligence, will terminate late.

Two consequences follow.

The first bears on the constraint proposed in the companion paper. That constraint held that a condition keyed to a state variable supplies an internal termination condition that the classical exception lacks. Proposition 8.1 establishes that the internal condition is systematically harder to satisfy than the condition that triggered the arrangement, so the constraint operates more weakly than its statement suggests.

The second bears on diagnosis. Where an arrangement of this kind persists, the persistence is evidence of the system's dynamics before it is evidence of anyone's interest, and an inference

from persistence to capture is unavailable without further argument.

8.5 The Compounding of the Two Results

The results of Section 7 and of this section compound, and the compounding is the paper's central claim about the position a late-entering party occupies.

A party whose use lies in prospect is disadvantaged by a determination of approach, holds the shortest record among the parties, and is accordingly least equipped to contest that determination. The same party is most advantaged by a determination of departure, and Proposition 8.1 establishes that such a determination requires the longest record of any determination the arrangement admits. The party with the greatest interest in establishing departure is therefore the party least able to establish it, and the excess it must overcome grows with the severity of the condition the arrangement was adopted to address.

8.6 Exclusions from the Result

Three matters lie outside Proposition 8.1.

The proposition concerns a single scalar fluctuating about a stable state and supplies no treatment of systems whose state is multidimensional or whose approach proceeds by a mechanism other than the loss of stability of an equilibrium. The companion paper establishes that transitions of two further kinds occur, and neither is treated here.

The proposition concerns the precision of an estimate and supplies no account of how a boundary is specified. Where the boundary is fixed by a standard in place of by inference from a record, the determination of departure requires an estimate of position relative to a stated value, and the proposition governs the precision of that estimate alone.

The proposition establishes a scaling and supplies no estimate of λ for any actual system. The multiples it yields are illustrative, and §13.2 records that no setting examined in Part IV is quantified.

9 Contestation by a Party Disadvantaged by the Determination

This section examines the position of a party that a determination disadvantages and that seeks to contest it. It sets out the forms an objection may take, establishes that the evidential form fails through the asymmetry established in Part II, establishes that the corrective developed for testimonial injustice is unavailable because the deficit at issue is warranted, and identifies the forms of objection the asymmetry leaves standing. The last is the section's constructive content. The method is analytical.

9.1 The Forms Available to an Objecting Party

A party disadvantaged by a determination that the system stands near its critical value may object in three forms.

An evidential objection asserts that the determination is mistaken: the system does not occupy the region claimed, or the boundary does not lie where the determining party places it.

A procedural objection asserts that the determination was made irregularly: the components of §4.2 were performed by a party the arrangement does not authorise, or without the disclosure the arrangement requires, or without an opportunity for the objecting party to be heard.

A consequential objection asserts that the determination is correct and that what the arrangement attaches to it is wrong: the contraction of permissions falls unequally, or falls on parties for reasons unconnected with their contribution to the condition determined.

9.2 The Failure of the Evidential Objection

An evidential objection contests a claim about the state of the system, and a claim about the state of the system is supported by a record.

A party contesting on this ground must produce a record supporting a different estimate, or must show that the record produced supports no estimate of the confidence claimed. The first requires a record of its own, and Part II establishes that the objecting party holds the shorter one. The second requires expertise in the analysis of series and access to the series analysed, and it succeeds where the determining party has overreached its evidence and fails where the determining party has not.

The position of a late-entering party is accordingly this. Its objection, where the determining party has proceeded carefully, has no evidential foundation available to it, and the absence follows from the timing of its entry in place of from any defect in its diligence. Section 6 establishes that the deficiency persists for as long as both parties operate.

A body receiving such an objection compares the record supporting the determination with the record supporting the objection, and reaches the conclusion the comparison warrants. The proceeding is regular, the body is impartial, and the outcome is fixed before the proceeding begins.

9.3 The Reception of the Procedural Objection

A procedural objection contests the manner in which the determination was made and requires no counter-record. The objection is accordingly available to a party of any observational capacity, and it is the form the arrangements surveyed in §3.2 are designed to receive.

Its reception is limited by the result of §4.4. Where the arrangement authorises the determining party to perform the components, requires disclosure of the record, and provides a hearing, an objection asserting that these requirements were unmet fails whenever they were met. The requirements are satisfiable, they are ordinarily satisfied, and their satisfaction leaves the determination standing on a record the objecting party has no means to controvert.

The procedural objection therefore succeeds against irregularity and leaves regular determinations untouched, which is what a procedural objection is for. The difficulty is that

the paper's result concerns regular determinations.

9.4 The Warranted Deficit and the Corrective It Excludes

Section 3 recorded the analysis of testimonial injustice and stated the respect in which the present difficulty differs. The respect is now statable in its consequences.

A party contesting a determination with a shorter record receives less credence, and the lesser credence is warranted. Its estimate does rest on thinner evidence, its claim about the boundary does rest on observation of a narrower range of conditions, and a body according its assertions the weight accorded to assertions supported by the longer record would be crediting claims beyond their warrant.

The corrective developed for testimonial injustice consists in the identification and correction of a prejudice operating in the hearer. Where a hearer discounts a speaker on the ground of the speaker's social identity, correcting the prejudice restores the credence the testimony warranted throughout. Where a hearer discounts a party on the ground that its record is shorter, there is no prejudice to identify, and a correction would introduce an error in place of removing one.

The claim requires a bound, and Wynne's [16] case supplies it. A party may hold observation sustained over long periods which the institutional record has failed to receive, and the standing accorded to such observation may be lower than its accuracy warrants. The deficit is then unwarranted, no argument of this section applies to it, and the corrective developed for testimonial injustice is available in the ordinary way. What §9.4 establishes concerns a party that genuinely holds the shorter record, and it establishes nothing about a party whose record is held and unreceived.

The difficulty treated here is accordingly distributive in its origin and epistemic only in its appearance. It arises from the allocation of instruments and records, it presents as a difference in the standing of assertions, and a remedy addressed to the presentation leaves the origin untouched. Section 7 establishes what a remedy addressed to the origin would consist in and states the quantity in years.

9.5 The Objections the Asymmetry Leaves Available

Three forms of objection survive the asymmetry, and a disadvantaged party's position is determined by which of them the arrangement admits.

A difficulty of the same form arises in the companion papers by other routes, since the product of a course satisfying their criterion is an absence and a withheld possibility presents the configuration a possibility no scheme addressed also presents. In each the object at issue cannot be verified from the field by the party that would need to verify it, and the companion paper constituting the problem class states the common form.

An objection to the specification of the boundary survives where the boundary is fixed by a standard, a treaty or an administrative act. A specification of that kind is an institutional decision, its adoption is contestable on the grounds on which institutional decisions are

contestable, and a party holding no record whatever may contest it. Where the boundary is inferred from a record, the objection reverts to the evidential form and fails as §9.2 establishes.

An objection demanding disclosure of the record survives in every case, since it asserts a claim about access in place of a claim about the system. This is the one form of objection the asymmetry leaves wholly intact, and its availability is the reason §13.3 states disclosure as a condition of a defensible arrangement.

A consequential objection survives entirely, since it concedes the determination and contests what the arrangement attaches to it. The evidential asymmetry operates on claims about the state of the system and operates on nothing else, so a party unable to contest the state may contest the allocation of the contraction with its full standing.

The third form indicates where a disadvantaged party's argument is to be made. The contest that party can win concerns the consequence and never the trigger, and the companion paper's separation of those two is what makes the position available. An arrangement collapsing the two, by attaching a single non-derogable consequence to the determination, forecloses the only contest the party is equipped to conduct.

9.6 Exclusions from the Account of Contestation

Three matters lie outside this section.

The section treats a party contesting in good faith and treats obstruction in no respect. A party contesting a determination in order to delay a contraction it accepts as warranted raises a further question the account does not reach.

The section treats objections raised within an arrangement and treats refusal to participate in no respect. A party rejecting the arrangement altogether stands outside the analysis, and the conditions under which such rejection is warranted are a question of political legitimacy the paper does not enter.

The section assumes that the record supporting a determination is disclosed. Where it is withheld, the evidential objection fails for a second and independent reason, and §13.3 treats disclosure accordingly.

Part IV

Two Settings

10 The Determination of Orbital State

This section examines the first of the two settings identified at §2.5. It states the system and the boundary at issue, identifies the parties holding each constituent of observational capacity, tests the antecedent of Claim 5.1 against the setting, and records the respect in which the antecedent requires refinement. The refinement is the section's principal finding, since it establishes that the convergence obtains through a mechanism other than the one Claim 5.1 states. The treatment is qualitative and estimates no quantity.

10.1 The System and the Boundary

A congested orbital shell carries objects whose collisions generate fragments, and Kessler and Cour-Palais [11] established that above a population density determined by the collision rate and the rate of natural decay the generation of fragments becomes self-sustaining. The shell then carries a critical value in the sense the companion paper requires, and the determination that the shell has approached it is the determination this paper treats.

Two features of the setting bear on what a determination involves.

Natural decay operates on a timescale set by altitude, and at the altitudes carrying the densest traffic the timescale runs to centuries. A determination of approach accordingly concerns a condition from which recovery is unavailable within any period the parties can act over, and §8.3 establishes the consequence for termination.

The boundary is specified in part by inference and in part by institutional act. Mitigation guidelines adopted through the Committee on the Peaceful Uses of Outer Space [15] state practices in place of a critical density, so a party contesting a determination of approach contests an inference from a record in the manner §9.2 describes, and the objection to the boundary specification that §9.5 preserves is available only where a stated value exists to contest.

10.2 The Parties Holding the Constituents

Observational capacity in this setting is held with marked concentration.

The most extensive catalogue is maintained by the United States through its surveillance network, which tracks a population reported in the tens of thousands of objects, and the second most extensive is maintained by Russia. Other parties maintain networks of smaller extent, including a European tracking arrangement and observation systems developed within Asian cooperative programmes, and commercial providers have entered the field.

Reported assessments of European capability indicate that for operationally significant determinations European parties rely on the more detailed data held by the United States military, and analyses of ground-based tracking note that the geographic distribution of sensors leaves coverage gaps. Both features bear on the argument: the first establishes that even parties holding substantial instruments occupy a dependent position on the determinations that matter, and the second establishes that the record is partial in a manner varying by region.

10.3 The Antecedent Tested against the Setting

Claim 5.1 states an antecedent in three parts, and the orbital setting satisfies two of them and requires a refinement of the third.

The duration clause is satisfied strongly. Tracking of orbital objects began with the opening of the system, the parties that launched first began observing first, and §6.2 establishes that the resulting gap persists. A party beginning to track today begins a record covering none of the period over which the population accumulated.

The estimation clause is satisfied. A determination of approach rests on a population estimate and on a model relating the tracked catalogue to the untracked population of smaller fragments, and both rest on a record.

The access clause requires refinement, and the refinement is the finding of this section. Orbital tracking is performed principally from the ground, so access to the system does not follow from operating within it. A party holding no orbital assets may in principle build radars and telescopes and observe the shell.

The convergence nevertheless obtains, through a mechanism the refined statement identifies. The capacity to build and sustain a tracking network and the capacity to place assets in orbit are produced by the same national programme and are acquired together, and the date at which each began is the same date. Observational capacity and prior use are accordingly correlated through a common cause in place of through the direct relation Claim 5.1 states, and the ordering the convergence requires is produced either way.

10.4 The Consequence for a Late-Entering Party

A state beginning orbital operations now occupies the position §8.5 describes.

A determination that a shell has approached its critical value contracts its prospective deployment and leaves the deployments of established operators in place. The party holds the shortest record of the shell and the fewest sensors, so an evidential objection is unavailable to it in the form §9.2 requires. The determination of departure that would restore its prospect requires the longest record of any determination the arrangement admits, and Proposition 8.1 establishes the multiple.

The forms of objection §9.5 preserves are correspondingly narrow here. The boundary is stated as practice in place of as a value, so the institutional objection has a limited object. A demand for disclosure of tracking data is available and is the strongest instrument the party holds. The consequential objection is available in full, and it is the objection the equitable-access arguments raised within the allocation of orbital and spectrum resources have historically taken.

10.5 Exclusions from the Treatment of the Setting

Three matters lie outside this section.

The section characterises a distribution qualitatively from reported assessments and estimates no quantity. Figures for catalogue size and for capability are drawn from secondary and institutional sources of varying independence, they change rapidly, and no conclusion here rests on the value of any of them.

The section treats observational capacity and treats the legal regime governing orbital activity only where the two intersect. The provisions of the Outer Space Treaty [14] concerning jurisdiction over registered objects bear on what may be done about debris and bear on the present argument only through the disclosure question.

The section treats states and treats commercial operators as holders of instruments without

examining the arrangements by which their data enter a determination. Those arrangements are consequential and their examination requires the institutional analysis the paper declines.

11 The Determination of Ecological State and the Density of Monitoring

This section examines the second setting identified at §2.5. It states what an ecological determination requires, characterises the distribution of the records on which such determinations rest, tests the antecedent of Claim 5.1, and establishes that the convergence takes an inverted form here. The inversion is the section's principal finding, since it identifies a case in which the party disadvantaged by the distribution is the party in whose territory the system lies. The treatment is qualitative.

11.1 The Determination Required and the Records Supporting It

A determination that an ecological system has approached a condition from which its present configuration is unrecoverable rests on a record of population, composition, extent, or a related quantity, observed over a period long enough for a trend to be established against natural variability.

The requirement is demanding in a specific respect. Ecological variability operates over periods of years and decades, so a record establishing a trend against that variability must run for a comparable period, and §6.2 establishes that such length cannot be acquired at the moment it is wanted.

11.2 The Characterisation of the Distribution

The distribution of ecological records is uneven in a manner that has been documented for several decades and that persists.

Studies of the principal aggregating repositories report that occurrence records are concentrated in a small number of countries, that the concentration has been marked since such repositories were first assessed [12], and that observation density per unit area is several times higher in high-income countries than in others. Assessments of coverage report that only a small fraction of the terrestrial surface has been surveyed at a density adequate for the purposes such records are put to.

Two qualifications belong with these figures. The concentration has declined over the past two decades as data mobilisation programmes have operated, and analyses of national trajectories report increasing coverage in regions that began from low values. And coverage has been found to be stronger for species over which a nation holds greater stewardship [13], which operates against the concentration in the cases where it holds.

11.3 The Antecedent Tested against the Setting

Claim 5.1 states that observational capacity follows from use of the system, and the ecological setting satisfies the antecedent weakly and satisfies a related condition strongly.

Use of an ecological system does generate records where a permit requires monitoring, and an operator discharging effluent or extracting a resource ordinarily holds a record of the receiving system. The relation Claim 5.1 states therefore holds within a single site.

Across sites the relation is dominated by another. The records supporting a determination about an ecosystem are ordinarily produced by research institutions, government agencies and long-running survey programmes, and their existence follows from the sustained expenditure of the party in whose territory the system lies, or from the sustained expenditure of a party funding observation elsewhere. The constituent that governs, following §5.1, is duration, and duration in this setting follows from the maintenance of a programme over decades in place of from any party's operational presence.

The distribution therefore correlates with wealth, and §6.4 declined to describe the distribution as a distribution of wealth. The description remains declined and the mechanism is now statable: what wealth purchases here is the maintenance of a programme over time, and a party acquiring wealth today acquires the programme and acquires none of the record it would have produced.

11.4 The Inversion of the Convergence

The convergence established in Section 7 takes an inverted form in this setting, and the inversion is the finding that distinguishes the two settings of Part IV.

In the orbital setting, the party holding the longest record is a party operating within the system, and the party disadvantaged by a determination is a party seeking to enter.

In the ecological setting, the party holding the longest record is frequently a party external to the system: a research programme, an international body, or a state funding observation beyond its own territory. The party in whose territory the system lies may hold a shorter record than the external party, and it is the party whose prospective use a determination of approach contracts.

The consequence is that the disadvantaged party is the host. A determination that an ecosystem within a state's territory has approached a critical condition contracts that state's prospective development, and the state may hold no record adequate to contest the determination on evidential grounds. The forms of objection §9.5 preserves are accordingly the ones raised in this setting: contestation of the boundary where a threshold is stated by an international instrument, demands for disclosure and for participation in monitoring, and consequential objections concerning who bears the cost of a contraction.

The inversion establishes that the convergence of Section 7 is not a claim about incumbency in operation. It is a claim about the relation between the holder of a record and the bearer of a contraction, and the two settings instantiate that relation with different parties in each position.

11.5 Exclusions from the Treatment of the Setting

Three matters lie outside this section.

The section reports figures from published assessments and from secondary summaries of them. The figures are used to characterise a distribution qualitatively, they are contested in detail, and no conclusion here depends on the value of any of them.

The section treats records held by institutions and treats knowledge held by resident populations in no respect. Observation sustained over long periods by parties resident within a system exists in many of the settings at issue, its relation to the records that enter a determination is a substantial question, and the analysis of §3.5 bears on it directly. The question is left open and §13.3 records it.

The section treats the distribution as it stands and treats the programmes addressing it only in passing. Data mobilisation and capacity-building programmes operate on exactly the quantity Proposition 7.2 identifies, and an assessment of their effect against that proposition would require the empirical work the paper does not undertake.

Part V

Declinations and Limits

12 Positions Declined and the Arguments for Declining Them

This section argues the four declinations announced at §2.6. Each is stated at the strength its proponents would give it, the ground for declining it is derived from a result established earlier, and the cost of the declination is stated. The arguments are placed here because each depends on results established in Parts II and III.

12.1 The Declination of an Account Resting on Bad Faith

The position declined holds that determinations of criticality are made by parties seeking the advantage such determinations confer, and that the difficulty is accordingly one of capture.

The ground for declining it is derived from Proposition 7.1. The concordance of the two orderings follows from the structure of the distribution and holds over every draw of the construction, with no term representing any party's intention. A determination made by a party indifferent to its own advantage, on the best evidence available, with every diligence, is made by the party the determination favours, and the favouring is a property of who holds the record.

An account resting on bad faith would establish something weaker in two respects. It would fail where parties act well, which is the case the paper is addressed to, and it would license the inference that an arrangement staffed by disinterested parties is thereby repaired. Section 7 establishes that it is not.

The cost is that the account supplies no ground for objecting to any particular determination. A party wishing to resist a determination on the ground of the determining party's interest must establish that interest independently, and the present argument assists it in no way.

12.2 The Declination of a General Relation between Observation and Use

The position declined holds that observation of a system generally requires participation in it, so that the difficulty identified here attends governance of every system whose state must be determined.

The ground for declining it is derived from §5.5, which states three classes of case in which the relation fails, and from §10.3, which establishes that the relation fails in its direct form even in the setting the argument was built around. The orbital case satisfies the convergence through a common cause in place of through the direct relation, and a thesis asserting the direct relation generally would be refuted by the very setting Part IV examines first.

The cost is that the argument's scope is fixed by an antecedent requiring examination in each case. Claim 5.1 is a conditional, its antecedent holds in some settings and fails in others, and the paper establishes nothing about how large the first class is.

12.3 The Declination of a Proposed Allocation of Competence

The position declined holds that a paper identifying a defect in the allocation of a competence should propose an allocation that lacks the defect.

The ground for declining it is derived from Proposition 7.2 together with §7.4. The convergence is defeated by a public record of sufficient duration and by nothing else the paper has identified, and duration is the constituent that no allocation of competence supplies. An arrangement conferring the competence on any party whatever leaves that party determining the state from the records available, and §4.4 establishes that a body holding no independent record audits an account rendered by the party under review.

A proposal would therefore relocate the competence and leave the difficulty in place, and its adoption would furnish an appearance of repair. Section 13 states conditions in place of a proposal, and the difference is that a condition is assessable against an arrangement while a proposal invites adoption.

The cost is that a party designing an arrangement receives from this paper a set of conditions and no design.

12.4 The Declination of a Scheme for Equalising Observational Capacity

The position declined holds that the paper, having identified the public record as the quantity that defeats the convergence, should propose the programme that would supply it.

The ground for declining it has two parts. The first is that such a programme is an institutional design, and the companion paper's argument against specifying machinery applies here: a specification supplies the party administering it with a determinate account of what compliance consists in, and the predictable result is a programme complete in every specified feature whose records are unsuited to the determinations at issue. The second is derived from §11.3. The capacity in question is expensive, its distribution follows the maintenance of programmes over decades, and no governance arrangement establishes the distribution of resources on which such maintenance rests.

The cost is stated plainly. The paper identifies a quantity, establishes that securing it dissolves the difficulty, establishes that it must be secured long before the arrangement requiring it is adopted, and proposes no means of securing it.

13 The Limits of the Account and the Conditions a Defensible Arrangement Would Secure

This section states the limits of the account in two classes, derives from the results of Parts II and III the conditions an arrangement adopting a state-dependent rule would have to secure, records the objections the paper leaves unanswered, and fixes the relation to the remaining papers of the series. The conditions of §13.3 are the section's constructive content, and each is derived from a stated result in place of being proposed.

13.1 Limits Internal to the Argument

Four limits attach to the argument itself.

The construction of Section 7 represents observational capacity by a weighted sum of a duration term and an expenditure term, and the representation is a simplification of a relation that is unlikely to be additive. A capacity requiring both a long record and current instruments would be represented better by a form penalising the absence of either, and the concordance would be stronger under such a form than under the one used.

Proposition 8.1 treats a single scalar fluctuating about a stable state, and the companion paper establishes that transitions occur by two further mechanisms for which no equilibrium loses stability. The scaling established here governs the first mechanism and governs neither of the others.

The argument treats the record as the object whose distribution matters and treats the capacity to analyse a record as available to any party holding one. Where the analysis requires expertise concentrated among the same parties that hold the records, the difficulty is aggravated and the argument understates it.

The argument treats parties as unitary. A state, an operator and a regulator within one jurisdiction hold different records and different interests, and an account resolving parties into their components would establish something more precise and possibly something different.

13.2 Limits of the Two Settings

Both settings of Part IV are characterised qualitatively from published assessments and from secondary summaries.

The orbital figures concern catalogue sizes and capability comparisons drawn from institutional and secondary sources of varying independence, they change rapidly, and §10.5 records that no conclusion rests on any of them. The ecological figures concern the concentration of records in aggregating repositories, the concentration is documented over several decades and is contested in detail, and the trend over the past two decades runs against

it.

Neither setting is used to test Claim 5.1 empirically. Each is used to establish that the antecedent is satisfiable and to identify the mechanism by which it is satisfied, and §10.3 and §11.4 establish that the mechanisms differ.

13.3 The Conditions a Defensible Arrangement Would Secure

Five conditions follow from the results established, and each is stated with the result it follows from.

Disclosure of the record supporting a determination follows from §9.5. A demand for disclosure asserts a claim about access in place of a claim about the system, and it is the one objection the evidential asymmetry leaves wholly intact. An arrangement withholding the record removes the only instrument a record-poor party holds without qualification.

A public record whose duration approaches that of the longest record held by any operating party follows from Proposition 7.2, which establishes that the concordance falls monotonically in that duration and reaches its floor at parity.

Establishment of such a record in advance of the arrangement requiring it follows from §7.4. A programme begun when the arrangement is adopted supplies a record of zero length at that moment and attains parity only after a period equal to the age of the longest private record. The condition is therefore temporal before it is institutional: the observation must begin long before the rule that will need it.

Specification of the boundary as a stated value by institutional act, in place of by inference from a record, follows from §9.5 together with §10.1. Where the boundary is stated, a party holding no record may contest its adoption on the grounds on which institutional decisions are contestable. Where it is inferred, the contest reverts to the evidential form and the record-poor party has no standing in it.

Termination provisions operating on a fixed period, in addition to any condition keyed to the state, follow from Proposition 8.1 and §8.3. A determination whose relaxation requires establishing departure from a region imposes an evidential burden exceeding the one that produced it, and the excess grows with the severity of the condition. A provision requiring re-determination after a stated period places the burden of establishing continuation on the party asserting it, which is the reverse of the allocation the evidential structure produces unaided.

The five conditions are assessable against an existing arrangement, and §12.3 states why the paper offers conditions in place of a design.

13.4 Objections the Account Leaves Unanswered

Three objections bear on the account and none is answered.

The first concerns observation sustained by resident populations. Such observation exists in many of the settings at issue, it may run far longer than any institutional record, and its exclusion from the records that enter a determination is a difficulty of a different kind from the one this paper treats. Wynne [16] establishes a case of the kind, and §9.4 states the bound

the case imposes on the argument of that section. The analysis of §3.5 bears on it directly and in the opposite direction, since a credibility deficit attaching to such observation may be unwarranted and therefore may admit exactly the corrective that §9.4 finds unavailable here. The question is substantial and is left open.

The second concerns the relation between the conditions of §13.3 and the incentive to comply with them. Each condition imposes a cost on the party best placed to resist it, and the paper establishes that this party holds the strongest position within the arrangement. An account of why such conditions would be adopted requires an argument the paper does not supply.

The third concerns the possibility that the convergence is benign. A party holding the longest record may determine the state more accurately than any other party would, and an arrangement vesting the determination elsewhere may produce worse determinations. The paper establishes that no party is positioned to check, and it establishes nothing about whether checking would improve the result.

13.5 The Relation to the Remaining Papers of the Series

The companion paper establishes the criterion, establishes its failure to compose, and establishes that the repair requires a rule of the form of equation (1). The present paper establishes who is positioned to operate such a rule and what an arrangement adopting it would have to secure.

Two matters raised here belong to papers not yet written. The relation between the records that enter a determination and the observation held by parties whose knowledge takes another form is the first, and §13.4 states it. The unifying treatment of the governance operations under which restraint, prevention and deliberate non-occupation are placed within a single vocabulary is the second, and the position of the present results within that treatment is fixed by the finding of §11.4: the convergence concerns the relation between the holder of a record and the bearer of a contraction, and the parties occupying those positions differ by setting.

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