

Justice under Imperfect Implementation

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Abstract

Economic institutions can announce justified entitlements while failing to secure them. This article argues that institutional admissibility must depend on both substantive protections and their implementation. It defends a conditional case for effective adjudicative access, acknowledges the resulting conflict with unrestricted Pareto comparisons, and separates institutional reliability from permission to violate. A general stochastic bound shows that unavoidable delay and a positive probability of irreversible harm limit what correction can achieve, without requiring Markov transitions. A tractable model then distinguishes prevention from correction under capture. With general convex separable costs, greater capture increases prevention under the stated technology, while the direction of corrective effort depends on a curvature condition. Oversight and screening expand the design space but do not constitute a political equilibrium model of capture. An income example tests when a protected claim warrants constraint status and distinguishes universal protection from transfers to a fixed group. Numerical illustrations and an administrative appeals example clarify the limits of aggregate performance measures. The contribution is a conditional account of protection under imperfect implementation, supported by explicit bounds and comparative statics, rather than a complete theory of justice or a new theory of regulatory capture.

Keywords: institutional legitimacy; economic power; welfare economics; non-ideal theory; regulatory capture; inequality; enforcement; justice constraints

JEL classifications: A13, D63, D72, K40

1. Introduction

An economic institution can satisfy a distributive standard on paper while leaving those it protects unable to secure that standard in practice. A statutory entitlement may coexist with inaccessible procedures; a minimum-income guarantee may be defeated by administrative exclusion; a prohibition on economic abuse may leave complainants dependent on a regulator captured by the interests it regulates. In each case, assessing the announced rule separately from its implementation misidentifies the institution being assessed.

This article argues that implementation helps determine whether an institution secures a justified entitlement. The relevant protection depends on the incidence, duration, distribution, and possible entrenchment of violations. Prevention and effective remedies therefore enter the assessment of admissibility itself. A reliability standard can recognize institutional fallibility while preserving each affected person's claim to correction and redress.

The framework distinguishes substantive requirements, requirements governing exposure to their violation, and welfare comparison among compliant arrangements. Its priority claim is conditional: a requirement must first be justified as a condition of admissibility. Optimization cannot supply that

justification. Adjudicative access provides the central case; the income example tests the limits of extending the argument to a material threshold.

The intended contribution is to normative institutional analysis informed by welfare economics. Anderson's democratic equality and Valentini's distinctions among partial compliance, feasibility, and transition help specify the evaluative questions (Anderson 1999; Valentini 2012). Established work on rights and welfare identifies a conflict this framework must confront: protecting independently justified claims can restrict Pareto improvements (Sen 1970; Kaplow and Shavell 2001). The argument accepts that possibility rather than claiming that constrained optimization resolves it.

The formal analysis supplies two results with different scopes. A bound for general stochastic violation processes identifies unavoidable exposure before correction and after irreversible harm. A prevention–correction model then shows, under its particular technology and general convex separable costs, when worsening capture shifts resources toward prevention and when corrective effort rises or falls. Oversight and screening extend this design problem. The numerical exercises illustrate its mechanisms; they do not estimate a real institution's capture risk.

Neither hard constraints nor the claim that rights can limit welfare maximization is new. The proposed contribution is to connect a defended protection claim to explicit implementation requirements and to identify which remedial promises cannot satisfy them. The absorbing-state model makes that connection tractable; the general bounds state which conclusions survive beyond it.

Section 2 develops the normative argument and its Pareto cost. Section 3 states the assessment problem. Sections 4 to 6 analyze exposure, prevention, correction, and institutional safeguards. Section 7 applies the placement argument to income protection. Section 8 examines welfare sensitivity and penalty representations. Section 9 considers administrative evidence and model limitations. Proofs and numerical specifications appear in the appendices.

2. Entitlements institutional performance and normative priority

2.1 Three distinct assessments

Institutional evaluation involves three questions. The first concerns substantive justification: what may an institution require of persons, and what protections must it provide? An answer might identify a minimum material entitlement, equal access to adjudication, or protection against a specified form of arbitrary power. The second concerns institutional performance: what will a particular combination of rules, procedures, resources, and officials actually do? This includes the probability of noncompliance, the distribution of enforcement burdens, and the reliability of remedies. The third concerns comparative desirability: among the arrangements that satisfy the relevant requirements, which should be selected?

These questions are connected without being identical. The observed cost of securing an entitlement does not establish whether the entitlement is justified. Conversely, identifying a justified entitlement does not establish that an institution has secured it merely by announcing it. This distinction matters particularly for economic power: the significance of a contractual relationship depends partly on the institutional conditions supporting ownership, participation, exit, and enforcement. Hasan's account of poverty in Kant's theory of right locates the relevant injustice in the exclusion of the poor from the institutions of ownership necessary for free interaction, rather than in a reduction of welfare or an interpersonal relation

of domination (Hasan 2026). That argument supports attention to effective institutional participation, but it does not derive any particular numerical threshold used below.

2.2 Priority without a complete theory of justice

The framework adopts a conditional priority claim:

Once a requirement is justified as a condition of admissibility, welfare gains alone do not authorize departures from it.

Constraint status requires substantive justification. Some interests belong in a comparative objective; others may justify restrictions on institutional choice. The framework makes this placement explicit but cannot settle it by definition. Section 2.6 defends one application and Section 7 examines a case in which the justification may fail.

An interest is something a person has reason to want. A standing is a claim others have reason to recognize. Identifying a standing is relevant to constraint status, but does not establish its priority: many claims are defeasible. A separate argument must explain why the institution lacks authority to trade away this particular protection.

The framework treats an independently justified requirement as binding under specified conditions. It does not rank conflicting requirements or settle emergencies in which none of the available institutions satisfies them. This structure limits its scope. It cannot establish the priority of a requirement merely by calling that requirement conditional.

A substantive standard identifies what must be protected; an implementation standard specifies how reliably the institution must protect it. Their relationship requires justification. Announcing an entitlement does not show that it is secured, and a reliable procedure does not establish the justice of the rule it implements.

A placement argument must identify the claimant, the institutional duty, the conditions under which the duty holds, and the reasons why aggregate gains do not authorize its breach. These are questions to be defended rather than formal conditions that prove their own moral authority.

Two limitations follow.

The admissible set can be empty. That finding identifies a conflict between the requirements and the available alternatives; it supplies no instruction for emergency action or transition. Such a case requires an additional account of responsibility and permissible departures, rather than an unexplained relaxation of the standard.

The available alternatives can also depend on political power. Results conditional on current funding, appointment rules, or capture risk cannot establish that those conditions should remain fixed. Section 2.5 explains this limitation.

2.3 Why implementation requirements are not permissions to violate

A requirement limiting exposure to violations describes an institution's protective performance. It does not establish that each violation occurring under a compliant institution is permissible.

The distinction is between **institutional authorization** and **institutional fallibility**. A system may prohibit an act while acknowledging that preventing every instance is impossible. The affected person retains a claim to correction, compensation, or accountability even when the system satisfies an independently justified standard of reasonable protection. An exposure allowance is a statement about the reliability of protection, not a license to select victims. An institution that deliberately selects victims to exploit an aggregate allowance raises questions of equal standing and responsibility that the arithmetic of average exposure does not answer.

1. Categorical restrictions on conduct or institutional powers, justified independently of the expected-loss measure.
2. **Requirements governing the reliability of protection.** These are the exposure and permanent-violation constraints of Sections 3.3 and 4.
3. **Continuing claims arising when protection fails.** These are the remedial and accountability claims that survive even when the institution satisfies (1) and (2).

Meeting a reliability threshold leaves claims arising from actual failures intact. Whether those claims require a new hearing, correction, compensation, or accountability depends on the nature of the failure. An unsuccessful but fair adjudication does not itself establish an unremedied violation.

2.4 Prevention correction and compensation

Prevention reduces the probability that a violation begins. Correction ends an ongoing violation. Compensation addresses some consequences after the event. None is definitionally equivalent to the others.

Correction may stop an exclusion without restoring an opportunity that has passed. Compensation may offset material loss without removing a relationship of subordination. Prevention may protect a person while imposing intrusive monitoring on others. Institutional assessment must therefore identify what each instrument accomplishes and which independent constraints govern its use.

The model isolates prevention and correction. Ending exposure does not necessarily restore lost opportunities or discharge compensation and accountability duties. Those claims require additional constraints or outcome variables.

2.5 Avoiding a fixed-background defense of existing power

A non-ideal framework can become conservative if it treats the conditions sustaining injustice as unchangeable while scrutinizing only the costs of reform. Wenner and Gray argue that static non-ideal theory, which takes background structural injustice as a fixed point, can play an ideological role by helping to justify the status quo (Wenner and Gray 2026). The institutional choice set must therefore include relevant changes to prevention, access, and enforcement where these are feasible. Existing capture risk is not necessarily a natural constant.

Oversight and screening in Section 6 make capture partly responsive to institutional choice. They remain instruments of a planner facing given political conditions. Funding, appointments, lobbying, and post-service employment rules may change the environment itself. The model therefore identifies a conditional implementation frontier; it cannot establish that the frontier is politically inevitable.

2.6 A worked example adjudicative access as a constraint

Adjudicative access is the practical ability to contest an alleged denial before an authority able to review and, where warranted, correct it. The question is whether maintaining such a route may constrain welfare comparison. The following argument defends a limited institutional duty, rather than an unlimited right to hearings or a guarantee of favorable decisions.

2.6.1 *The candidate standing*

A material interest and a claim to review are distinct. A legally final decision can deny a person a legal avenue of appeal while leaving a moral claim to review unresolved. The existence or absence of a statutory procedure therefore cannot, by itself, settle whether the person has the standing defended here.

Two arguments support treating a minimum effective route of contestation as a constraint.

First, an authority that imposes binding decisions on persons owes them a way to challenge relevant mistakes and arbitrary treatment. Without such a route, the affected person depends on the decision-maker's unreviewable discretion. Anderson's account of democratic equality motivates concern with this relation (Anderson 1999). The further premise defended here is that public institutions must remain answerable to those whose entitlements they determine; it does not follow from Anderson's theory without argument.

Second, a justified entitlement supplies reasons for institutional duties even when the administrator would prefer not to comply. A practical route of review makes those reasons actionable. An unreviewable entitlement can remain a legal entitlement, so review is not logically necessary to its existence. The claim is instead that an institution cannot adequately secure it where foreseeable error and arbitrary denial leave no effective way to demand compliance. Hasan's account of institutional participation motivates an analogy, but does not itself establish this adjudicative duty (Hasan 2026).

The strongest objection is that review consumes resources that could prevent more serious harms. Answerability alone therefore does not justify unlimited procedure. The defended requirement is a minimum effective route, sensitive to the stakes, error risk, urgency, and availability of independent review. It permits proportionate filing rules, reasoned screening of manifestly unfounded claims, and voluntary settlements, provided these do not make protection practically inaccessible.

Under these conditions, the state's duty to answer a challenge limits the trades officials may make on another person's behalf. The argument rejects compulsory removal of the minimum route merely because aggregate gains exceed its cost. It does not infer priority from incommensurability, deny all tradeoffs in institutional design, or identify a unique numerical reliability threshold.

2.6.2 *The implementation requirement*

The procedural requirement is that a person alleging an entitlement denial has a practically accessible route to independent, effective review under publicly defensible rules. It belongs among the categorical requirements represented by $H(z) = 1$. Reliability requirements separately constrain the incidence and duration of erroneous denial or obstruction. These requirements allow mistakes without authorizing deliberate exclusion.

Let R_i measure person i 's normalized expected time in the specified violation, as in Equation (9), and require $R_i \leq r_i$ as in Equation (10). For an access application the indicator must measure wrongful obstruction or denial without effective review; not every pending appeal is such a violation. The

numerical bound r_i requires its own justification. The model represents that bound once supplied; it does not derive it from the abstract value of answerability.

Two qualifications matter.

Person-specific protection rules out meeting an aggregate target by abandoning a known subgroup. Yet unconditional ex ante equality of risk can still conceal concentrated burdens after cases develop. Where such burdens matter, the standard must also apply to relevant groups or information histories. A bound on the initial expectation alone does not establish equal standing.

Failure to satisfy a justified claim can generate continuing duties even where the institution meets its reliability target. An adverse decision following adequate review need not generate those duties: the existence of an entitlement violation or procedural failure must be established independently.

2.6.3 What the placement forbids

A finite penalty and a hard constraint can select the same arrangement in a particular environment. Section 8.3 gives sufficient conditions. This equivalence does not make the two decision rules equivalent across environments. For example, let $t \in [0,1]$ measure an access shortfall, require $t = 0$, and let the unconstrained objective gain be a . Penalizing shortfall at M selects $t = 1$ whenever $a > M$. The constrained rule continues to select $t = 0$. This example demonstrates the possible divergence without assuming that every penalty below a reported multiplier necessarily causes violation.

The difference concerns which changes in circumstances may justify institutional departures. A constraint rules out a shortfall within its stated scope, even when the resource benefit grows. If compliance becomes impossible, the admissible set can be empty; the framework then requires the supplementary judgment described in Section 2.2. Constraint placement does not guarantee feasibility.

2.6.4 What the example does not establish

This argument supports a minimum route of review conditional on the duty of public answerability and on the scope just described. A critic who rejects that duty's priority can reject the placement without making a mathematical mistake. The framework helps identify that disagreement rather than resolve it by notation.

Three questions discipline the placement decision: does the institution owe the claimant a protection as a matter of equal standing; would its absence leave a justified entitlement inadequately secured; and why do the institution's duties restrict trades made for aggregate gain? These are considerations to be argued together. They are not a necessary and sufficient test for all rights, and noncommensurability alone would not establish constraint status.

Procedural answerability and measured reliability remain distinct. An accessible review procedure can operate too slowly to secure the underlying claim; a favorable average performance measure can coexist with inaccessible procedures. A full assessment must examine both. Section 7 shows why the same placement cannot simply be assumed for any numerical income target.

2.7 Priority and the Pareto objection

Kaplow and Shavell (2001) establish a conflict between non-welfarist assessment and the Pareto principle under their assumptions. Sen (1970) also demonstrates that a minimal formalization of individual liberty

can conflict with Pareto and unrestricted preferences. Neither result establishes this paper's access requirement. They show why its priority needs a defense that does not appeal solely to utility gains.

The present rule can reject a Pareto improvement across the unrestricted choice set. Suppose every person prefers an arrangement that removes independent review in exchange for higher resources, even after considering its procedural consequences. A binding access requirement may still exclude it. The defense must then rest on the institution's duty of answerability, including the difference between voluntary settlement of a particular dispute and officials' compulsory elimination of the route of review. This is a substantive commitment with a real efficiency cost.

Within the admissible set, an increasing welfare objective respects improvements in every person's modeled welfare. This restricted result does not restore unrestricted Pareto, and improvements in income need not improve all dimensions of utility. The framework also does not produce a complete ranking of inadmissible arrangements. Its contribution beyond priority alone is to specify what implementation must deliver, show when remedial substitution fails, and identify unmet claims that survive aggregate compliance.

3. A framework for institutional assessment

3.1 Institutions as implemented arrangements

Let $N = \{1, \dots, n\}$ denote a fixed population. An institutional arrangement is a pair

$$z = (x, e) \in Z, \quad (1)$$

where x describes substantive economic rules and e describes their implementation. Implementation includes prevention, access to remedies, corrective capacity, oversight, and safeguards against capture. The pair is the object of assessment; neither component is assessed in isolation, for the reason given in Section 2.1.

For person i , arrangement z produces a stochastic sequence of strictly positive outcomes $c_{it}(z, \omega)$. Let $H(z) = 1$ indicate satisfaction of categorical requirements that are not represented as expected losses. Other requirements are expressed as

$$G_j(z) \geq b_j, \quad j = 1, \dots, J. \quad (2)$$

The admissible set is

$$\mathcal{J}(b) = \{z \in Z: H(z) = 1, G_j(z) \geq b_j \ \forall j\}. \quad (3)$$

The functions G_j may measure minimum outcomes, access, individual exposure, or protection against permanent exclusion. Their substantive interpretation precedes optimization. The framework does not assume that Z or $\mathcal{J}(b)$ is convex; convexity is imposed only for results that require it.

3.2 Welfare comparisons

For deterministic incomes $c_i > 0$, define

$$\phi_\gamma(c) = \begin{cases} \frac{c^{1-\gamma}}{1-\gamma}, & \gamma \neq 1, \\ \log c, & \gamma = 1, \end{cases} \quad \gamma \geq 0, \quad (4)$$

and

$$W_\gamma(c) = \frac{1}{n} \sum_{i=1}^n \phi_\gamma(c_i). \quad (5)$$

The equally distributed equivalent income is

$$\xi_\gamma(c) = \begin{cases} \left(\frac{1}{n} \sum_i c_i^{1-\gamma} \right)^{1/(1-\gamma)}, & \gamma \neq 1, \\ \exp \left(\frac{1}{n} \sum_i \log c_i \right), & \gamma = 1. \end{cases} \quad (6)$$

EDE income is the equal income for everyone that would yield the same measured welfare as the actual distribution.

This is the standard welfare-based approach to inequality measurement developed by Atkinson (1970). Its normative parameters should be stated rather than concealed within a summary index.

For stochastic implementation, one possible extension is

$$W_\gamma(z) = \frac{1-\delta}{n} \sum_{i=1}^n \mathbb{E}_z \left[\sum_{t=0}^{\infty} \delta^t \phi_\gamma(c_{it}) \right], \quad 0 < \delta < 1. \quad (7)$$

Outcomes are assumed bounded within a strictly positive interval, ensuring convergence. The normalization makes a constant deterministic allocation evaluate as in Equation (5). Equation (7) is an explicit modeling choice: it uses the same curvature parameter for interpersonal distributional sensitivity and sensitivity to individual outcome risk. Those judgments need not coincide; applications requiring their separation should employ a richer welfare specification rather than interpret γ as a universal ethical parameter.

The institutional problem is

$$\max_{z \in J(b)} W_\gamma(z). \quad (8)$$

Enforcement costs must enter the resource constraints or the outcome mapping. They cannot be omitted from those components and subsequently described as already reflected in welfare.

3.3 Person-specific protection

An aggregate exposure limit can conceal persistent burdens on a minority. Let I_{it} indicate whether person i experiences the specified violation at time t . Define

$$R_i(z) = (1 - \delta) \mathbb{E}_z \left[\sum_{t=0}^{\infty} \delta^t I_{it} \right]. \quad (9)$$

Normalized exposure is the expected share of discounted time spent in violation; zero means no exposure and one means continuous violation.

A person-specific implementation requirement is

$$R_i(z) \leq r_i \quad \text{for every } i. \quad (10)$$

An additional requirement may constrain permanent exclusion:

$$B_i(z) = \Pr_z(\text{person } i \text{ enters a permanent-violation state}) \leq \rho_i. \quad (11)$$

Neither an average of the R_i nor a single welfare number replaces these requirements. Group-specific constraints may also be required where individual risks are difficult to estimate or institutional procedures systematically disadvantage identifiable classes. The discount factor in Equation (9) is normatively consequential: it determines how later exposure is weighted relative to immediate exposure, and it is not merely a device for making a series converge.

4. Correction and capture

4.1 States and timing

Consider a person whose violation is active at time zero. There are three states:

- A : an active violation that remains correctable.
- C : successful correction.
- B : capture that makes the violation permanent within the model.

States C and B are absorbing. At the beginning of each period, an active or permanently captured violation generates one unit of exposure. Transitions occur at the end of the period.

Conditional on state A :

- Capture occurs with probability $q \in [0,1]$.
- Conditional on no capture, correction occurs with probability $\kappa \in [0,1]$.
- Otherwise the violation remains active.

The transition matrix, with states ordered A, C, B , is

$$P = \begin{pmatrix} (1-q)(1-\kappa) & (1-q)\kappa & q \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}. \quad (12)$$

Here capture is an absorbing failure of corrective authority. This is a deliberately restrictive representation, not a claim that actual regulatory capture is always irreversible. Carpenter and Moss emphasize the importance of diagnosing capture carefully and examining possibilities for prevention and control (Carpenter and Moss 2014).

4.2 Discounted exposure

Let F denote expected discounted periods of violation conditional on starting in A . A permanently captured violation has value $1/(1 - \delta)$. Hence

$$F = 1 + \delta \left[(1 - q)(1 - \kappa)F + \frac{q}{1 - \delta} \right]. \quad (13)$$

Define

$$a = 1 - \delta + \delta q, \quad D = a + \delta(1 - q)\kappa. \quad (14)$$

Solving Equation (13) gives

$$F = \frac{a}{(1 - \delta)D}. \quad (15)$$

The normalized conditional exposure is therefore

$$h(\kappa, q) = (1 - \delta)F = \frac{a}{D}. \quad (16)$$

If the violation initially occurs with probability p , and otherwise never begins, total normalized exposure is

$$R(p, \kappa, q) = p h(\kappa, q). \quad (17)$$

The function h isolates duration after a violation begins; multiplying by p also accounts for the chance that it begins.

The restriction to a single initial onset isolates the duration of a violation. Institutions facing repeated new violations require an additional incidence process.

Proposition 1. Exposure, capture, and the limits of correction.

For $0 < \delta < 1$, $0 \leq q < 1$, and $0 \leq \kappa \leq 1$:

$$\frac{\partial h}{\partial \kappa} = -\frac{a \delta (1 - q)}{D^2} < 0, \quad (18)$$

$$\frac{\partial^2 h}{\partial \kappa^2} = \frac{2a \delta^2 (1 - q)^2}{D^3} > 0, \quad (19)$$

and

$$\frac{\partial h}{\partial q} = \frac{\delta \kappa}{D^2} \geq 0, \quad (20)$$

with strict inequality in Equation (20) when $\kappa > 0$.

Moreover,

$$a \leq h(\kappa, q) \leq 1, \quad (21)$$

and the lower bound is attained at $\kappa = 1$.

Consequently, for fixed p , a requirement $R \leq r$ is achievable by correction alone if and only if

$$r \geq p(1 - \delta + \delta q). \quad (22)$$

Proof: Appendix A.

The lower bound has two components. The initial violation occurs before any end-of-period correction. Capture may then prevent correction altogether. A promise of rapid remedies therefore cannot make an arbitrarily high initial incidence compatible with an arbitrarily demanding exposure standard.

When $p > r$, the minimum corrective probability satisfying the exposure requirement is

$$\kappa_{\text{req}} = \frac{a(p - r)}{r\delta(1 - q)}, \quad (23)$$

provided this quantity does not exceed one. If $p \leq r$, the exposure standard alone requires no correction in this model. That conclusion describes the limitation of the exposure standard, not the absence of a separate duty to provide a remedy.

4.3 Permanent violation is a different object

If $q + (1 - q)\kappa > 0$, the probability of eventual capture conditional on an initial violation is

$$\varepsilon(\kappa, q) = \frac{q}{q + (1 - q)\kappa}. \quad (24)$$

The unconditional probability of permanent violation is

$$B(p, \kappa, q) = p\varepsilon(\kappa, q). \quad (25)$$

At $\kappa = 1$,

$$B = pq. \quad (26)$$

If $q = \kappa = 0$, an initial violation persists forever without entering the formally defined capture state. A permanent-persistence measure must count that case separately rather than assign it zero merely because capture never occurs.

Discounted exposure and permanent violation are not equivalent. If $q > 0$, then

$$\lim_{\delta \uparrow 1} h(\kappa, q) = \frac{q}{q + (1 - q)\kappa}. \quad (27)$$

For a fixed discount factor below one, however, equal values of R can coexist with different probabilities of permanent violation. The framework must therefore report the measure relevant to the claim being protected.

4.4 Assessing a rule by incidence alone can mislead

Suppose p is determined by an economic rule and κ by its enforcement arrangement. For fixed q , the set of incidence rates compatible with an exposure cap r , allowing any $\kappa \leq 1$, is

$$p \leq \min \left\{ 1, \frac{r}{a} \right\}. \quad (28)$$

If no correction is available, the condition is instead $p \leq r$.

Thus, assessing a rule by incidence alone can exclude arrangements satisfying an authorized duration-sensitive standard. But assessing the rule under an assumption of perfect enforcement can admit an arrangement whose actual implementation fails that standard. The object of assessment must be the implemented pair.

This conclusion does not permit replacing an incidence requirement with an exposure requirement. If justice independently requires $p \leq \bar{p}$, Equation (28) cannot override it.

4.5 An exposure bound beyond Markov transitions

Proposition 1A. Suppose an initial violation occurs with probability p . Conditional on onset, exposure is certain for periods 0 to $d - 1$, where the integer $d \geq 1$ is the earliest possible remedy date. Suppose an event B , with conditional probability b , makes exposure persist in every period $t \geq d$. All exposure indicators are nonnegative. No stationarity, independence, or Markov property is required. Then normalized discounted exposure satisfies

$$R \geq p [1 - \delta^d + \delta^d b]. \quad (28a)$$

The bound is sharp within this class of processes: set exposure to one before d , and equal to the indicator of B thereafter. If every available corrective policy has $b \geq \underline{b}$, then an exposure requirement $r < p[1 - \delta^d + \delta^d \underline{b}]$ cannot be met by correction alone. Prevention, an earlier remedy date, or a technology reducing the irreversibility risk is necessary. The threshold is sufficient only when an institution can attain the sharp construction; a lower bound alone does not establish feasibility above it.

Proof. Conditional on onset, the normalized discounted sum over $t < d$ is $1 - \delta^d$. On B the remaining sum is at least δ^d , so its conditional expectation is at least $\delta^d b$. Multiply by p . The stated construction attains equality. In the baseline model, $d = 1$ and $b = q$ for the first-period capture event, giving Equation (22) when correction is perfect.

Irreversibility and remedy timing do the work. If harm can always be reversed before the first measured exposure, or no uniform positive bound on irreversible harm exists, the corresponding component of the bound disappears. The proposition does not establish that capture is necessarily permanent in real institutions.

5. Prevention and corrective capacity

5.1 A least-cost implementation problem

Consider a baseline incidence $p_0 \in (0,1]$. Prevention reduces incidence to $p \in [0, p_0]$; corrective investment raises $\kappa \in [0,1]$. Capture risk q is fixed for this subproblem.

Let the resource budget needed to maintain the installed capacities be

$$C(p, \kappa) = \frac{\alpha}{2} (p_0 - p)^2 + \frac{\beta}{2} \kappa^2, \quad \alpha, \beta > 0. \quad (29)$$

The institution minimizes the cost of meeting $R \leq r$, with $0 < r < p_0$.

Define

$$\eta(q) = \frac{\delta(1-q)}{1-\delta+\delta q}. \quad (30)$$

Because

$$R = \frac{p}{1+\eta\kappa}, \quad (31)$$

the exposure constraint is equivalent to

$$p \leq r(1+\eta\kappa). \quad (32)$$

The apparent nonlinear exposure requirement therefore becomes an affine constraint when capture risk is fixed. The cost problem is strictly convex:

$$\min_{0 \leq p \leq p_0, 0 \leq \kappa \leq 1} C(p, \kappa) \quad \text{subject to Equation (32)}. \quad (33)$$

This is a resource frontier, not yet a complete welfare optimum. If prevention and correction produce different non-resource effects, those effects must be included in the wider assessment.

Proposition 2. The prevention–correction allocation.

Let

$$\hat{\kappa} = \frac{\alpha r \eta (p_0 - r)}{\beta + \alpha r^2 \eta^2}. \quad (34)$$

The unique least-cost solution is

$$\kappa^* = \min\{1, \hat{\kappa}\}, \quad p^* = r(1+\eta\kappa^*). \quad (35)$$

The exposure constraint binds. On the interior branch $\hat{\kappa} < 1$,

$$p_0 - p^* = \frac{\beta (p_0 - r)}{\beta + \alpha r^2 \eta^2}. \quad (36)$$

Since $\eta'(q) < 0$, greater capture risk strictly increases prevention on the interior branch. The same direction holds on the branch $\kappa^* = 1$.

Corrective effort need not be monotonic in capture risk. Before imposing the upper bound on κ ,

$$\frac{d\hat{\kappa}}{d\eta} = \frac{\alpha r (p_0 - r) (\beta - \alpha r^2 \eta^2)}{(\beta + \alpha r^2 \eta^2)^2}. \quad (37)$$

Proof: Appendix A.

The result distinguishes two responses to capture. When corrective effectiveness remains substantial, an institution may increase corrective effort to offset deterioration. When effectiveness becomes sufficiently poor, prevention dominates at the margin and corrective effort falls. Equation (37) locates the turning point: $\hat{\kappa}$ rises with capture risk as long as $\eta(q) > \sqrt{\beta/\alpha}/r$ and falls once $\eta(q)$ drops below that level. It

would therefore be mistaken to infer from capture alone that an institution should always spend more, or always spend less, on remedies.

5.2 General convex costs

Proposition 2A. Keep Equation (32), but replace the quadratic cost with $P(u) + K(\kappa)$, where $u = p_0 - p$ is prevention. Let P and K be twice continuously differentiable and convex, with $P'(u) > 0$ at the solution and $K''(\kappa) > 0$. On a differentiable branch with a binding exposure constraint and interior prevention and correction, define $L = K'' + r^2\eta^2P'' > 0$. Then

$$du/d\eta = -r[\kappa K'' + r\eta P']/L < 0, \quad (37a)$$

$$d\kappa/d\eta = r[P' - r\eta\kappa P'']/L. \quad (37b)$$

Primes denote marginal changes; double primes describe curvature, or how those marginal changes themselves vary.

Thus prevention rises as capture q rises, since $\eta'(q) < 0$. Corrective effort rises with q exactly when $r\eta\kappa P'' > P'$, falls when the inequality reverses, and has zero derivative at equality. Quadratic costs yield Equation (37). General convexity does not guarantee a turning point or its uniqueness. The sign result for prevention depends on the retained technology and separability; it is not a theorem for arbitrary hazard and cost functions.

Proof. Binding compliance gives $u = p_0 - r - r\eta\kappa$. The interior first-order condition is $K'(\kappa) = r\eta P'(u)$. Differentiate that condition and substitute $du/d\eta = -r\kappa - r\eta(d\kappa/d\eta)$. Rearrangement gives (37b), and substitution gives (37a). Strict convexity of the reduced objective supplies the positive denominator. At boundaries these derivatives need not apply.

5.3 Numerical illustration

Table 1 uses

$$p_0 = 0.30, \quad r = 0.10, \quad \alpha = 100, \quad \beta = 2, \quad \delta = 0.95.$$

These values are chosen for illustration. The turning point of corrective effort is at $\eta = \sqrt{\beta/\alpha}/r \approx 1.414$, which for these parameters corresponds to $q \approx 0.383$. The first five rows lie below it; the last two rows lie above it.

Table 1. Least-cost prevention and correction under an exposure cap

Capture risk q	Initial incidence p^*	Correction κ^*	Resource cost C^*	Exposure R	Permanent-violation probability B
0.00	0.2989	0.1047	0.0110	0.1000	0.0000
0.01	0.2984	0.1255	0.0159	0.1000	0.0222
0.05	0.2954	0.2111	0.0456	0.1000	0.0590
0.10	0.2891	0.3207	0.1088	0.1000	0.0744
0.20	0.2667	0.5266	0.3326	0.1000	0.0859
0.40	0.1935	0.7056	1.0646	0.1000	0.0940
0.60	0.1316	0.5160	1.6837	0.1000	0.0979

The exposure standard is met in every row. Yet the probability of a permanent violation varies substantially. An institution can therefore maintain one performance statistic while deteriorating along another morally relevant dimension. The last two rows illustrate Equation (37): corrective effort falls from 0.706 to 0.516 even as prevention continues to rise.

The table also shows the limitations of a permissive exposure standard. At low capture risk, prevention is expensive relative to the assumed cost of correction, and the least-cost institution leaves initial incidence close to its baseline. If the initial violation is independently objectionable, an incidence constraint must be added. The cost-minimizing response to an incomplete standard is not evidence that the standard is adequate.

5.4 Incorporating implementation into welfare choice

The resource frontier can enter the general problem without treating protection as an optional welfare bonus. Let $C^*(x; r, q)$ be the least implementation cost for rule x , conditional on a specified protection standard. If this cost is borne equally, net resources might be represented as

$$y_i(x) = c_i(x) - C^*(x; r, q). \quad (38)$$

That incidence assumption must be defended. Equal per-capita cost is not equivalent to equal burden, and taxes financing enforcement may themselves alter behavior or distribution.

Actual violations must also remain in the outcome mapping. For example, if an active violation reduces person i 's outcome by ℓ_i , with $y_i > \ell_i > 0$, the single-onset model implies

$$W_Y = \frac{1}{n} \sum_i [(1 - R_i) \phi_Y(y_i) + R_i \phi_Y(y_i - \ell_i)]. \quad (39)$$

Equation (39) follows because R_i is normalized expected time in violation. Correlation among persons' violations does not affect this additive expectation, although it can matter for other welfare criteria and institutional risks.

The exposure requirement and welfare effect perform different functions. The requirement limits which arrangements may be selected; welfare evaluates consequences within that set. Including the consequence of a violation in welfare does not authorize breaching the constraint.

6. Endogenous capture oversight and screening

6.1 From primitive capture risk to a choice

Sections 4 and 5 treated capture risk q as a parameter. That is adequate for isolating the mechanics of exposure, but it is not adequate for institutional assessment, because the central normative concern of this article is that capture is *itself* an institutional outcome: something prevention, oversight, and screening can affect, and something whose level is partly chosen rather than suffered. A framework that treats q as fixed can characterize conditional results but cannot ask the design question the paper's motivation raises: given that corrective authority may be captured, what should an institution do about it?

This section endogenizes capture as the outcome of two institutional margins. The first is oversight: the institution can monitor enforcement officials and remove those who have been captured before the

violation they would have let persist becomes permanent. The second is screening: the institution can exclude, ex ante, officials whose capture-proneness is high. Both margins consume resources, and both are feasible objects of institutional choice. Neither eliminates capture. That is assumed rather than derived: oversight is imperfect, screening is noisy, and some capture occurs before either can operate. The model captures this by bounding the two intensities strictly below one (Section 6.2).

The resulting model preserves the three-state structure of Section 4.1 (active violation A , correction C , permanent capture B) but replaces the constant q with an effective capture hazard $q(m, s)$ that depends on oversight intensity m and screening intensity s . The exposure bound of Proposition 1 survives with $q \rightarrow q(m, s)$, and the design problem of Section 5 acquires two further margins. Primed equation numbers in this section denote the endogenous-capture analogues of the correspondingly numbered equations in Sections 4 and 5.

The capture literature already endogenizes influence and institutional responses. Tirole (1986) studies collusion in hierarchies, while Laffont and Tirole (1991) develop an agency account of regulatory capture. Dal Bó (2006) reviews strategic and empirical approaches. Public enforcement theory also addresses detection, sanctions, and agency problems (Polinsky and Shavell 2000). The present model does not improve their account of incentives: it takes the response technologies as given and omits bribe bargaining, participation, and incentive-compatibility constraints. Its narrower purpose is to show how a separately justified exposure requirement changes allocation across assumed protective technologies.

6.2 The enforcement authority

Officials have capture-proneness types $\theta \in \{\theta_L, \theta_H\}$, with $0 \leq \theta_L < \theta_H < 1$ and low-type prior $\pi \in (0, 1)$. Conditional on an unresolved violation, a type- θ official faces capture with per-period probability θ before oversight. A fresh official is assigned independently from the retained pool each period. This assumption yields a constant Markov hazard; persistent assignment would generally require tracking type composition among unresolved cases.

Two institutional instruments are available.

Screening excludes a fraction s of high-type officials and no low-type officials, with $0 \leq s \leq \bar{s} < 1$, at cost $\chi(s)$. This is an assumed technology with imperfect sensitivity and perfect specificity, not a derived incentive-compatible screening mechanism. An external signal is assumed to permit this exclusion even though the institution cannot distinguish the types among those retained. Assume $\chi(0) = 0$, $\chi' \geq 0$, and $\chi'' \geq 0$.

Oversight detects and neutralizes an attempted capture with probability $m \in [0, \bar{m}]$, where $\bar{m} < 1$, at cost $\psi(m)$. When capture is neutralized, the case proceeds to the same within-period correction opportunity as any other case not permanently captured. If still unresolved, it receives a fresh official next period. Assume $\psi(0) = 0$, $\psi' \geq 0$, and $\psi'' \geq 0$.

The costs C , ψ , and χ are resource budgets for maintaining capacities, charged on a common normalized scale across institutional states. They are not expected expenditures incurred only while a particular case remains active. Modeling costs conditional on case duration would change the objective. The upper bounds on oversight and screening encode technological limits.

The timing within a period is:

1. A violation is active. The responsible official is of type θ , drawn from the retained pool.

2. With probability θ an attempted capture occurs. Oversight neutralizes it with probability m before it becomes permanent. Thus permanent capture occurs with probability $\theta(1 - m)$. A case whose capture is neutralized remains eligible for correction in the current period.
3. Conditional on no permanent capture, correction occurs with probability κ , independent of type and of oversight.

Correction is independent of official type and of oversight conditional on avoiding permanent capture. This assumption fixes the timing needed for Equation (12'). If neutralizing capture instead forced the case to wait until the next period, the current-period correction probability would differ and the effective-hazard substitution would no longer reproduce the stated transition matrix.

6.3 The effective capture hazard

Let

$$\bar{\theta}(s) = \frac{(1 - s)\pi_H\theta_H + \pi_L\theta_L}{(1 - s)\pi_H + \pi_L}$$

denote the expected capture-proneness of a retained official after screening intensity s . The denominator is the retained mass; the numerator is the retained capture-proneness mass. Screening reduces $\bar{\theta}$ because it removes high types disproportionately, but it cannot eliminate the high-type hazard entirely, and it is costly. Conditional on retention, the per-period probability that an active violation becomes permanently captured is

$$q(m, s) = \bar{\theta}(s) (1 - m). \quad (12')$$

The effective hazard falls with oversight and screening. At zero investment it equals the prior mean capture-proneness. The hypothetical endpoint $s = 1$ would leave only low types and give $q = \theta_L(1 - m)$, but that endpoint is outside the assumed feasible set $s \leq \bar{s} < 1$. The attainable lower hazard is $q(\bar{m}, \bar{s})$.

Two properties of (12') matter for what follows.

First, with $m \leq \bar{m} < 1$ and $s \leq \bar{s} < 1$, $q(m, s) \geq \bar{\theta}(\bar{s})(1 - \bar{m}) > 0$ whenever $\theta_H > 0$ and $\pi_H > 0$. Capture cannot be eliminated within the feasible range; the lower bound on exposure derived in Proposition 1' therefore remains strictly positive, and the no-substitution result survives. Even if capture could be eliminated, the timing component $(1 - \delta)p$ of the bound would remain, because the initial violation occurs before any correction. This is the formal content of the claim in Section 2.5 that existing capture risk is not a natural constant but is also not eliminable by fiat.

Second, q is now a *choice variable* in the institution's problem. The exposure function $h(\kappa, q)$ of Section 4.2 becomes $h(\kappa, q(m, s))$, and the design problem acquires the margins m and s in addition to p and κ .

6.4 Exposure with endogenous capture

The Bellman equation (13) and its solution (15) and (16) carry over with $q \rightarrow q(m, s)$. Write

$$a(m, s) = 1 - \delta + \delta q(m, s), \quad D(m, s) = a(m, s) + \delta (1 - q(m, s)) \kappa. \quad (14')$$

Then the normalized conditional exposure is

$$h(\kappa, m, s) = \frac{a(m, s)}{D(m, s)}, \quad (16')$$

and the total normalized exposure from initial incidence p is $R = p h(\kappa, m, s)$.

Proposition 1'. Exposure bound under endogenous capture. For $0 < \delta < 1$, $0 \leq \kappa \leq 1$, $m \in [0, \bar{m}]$, $s \in [0, \bar{s}]$, and $\theta_H \in (0, 1)$:

$$a(m, s) \leq h(\kappa, m, s) \leq 1, \quad (21')$$

with the lower bound attained at $\kappa = 1$, and

$$\frac{\partial h}{\partial \kappa} < 0, \quad \frac{\partial^2 h}{\partial \kappa^2} > 0, \quad \frac{\partial h}{\partial q} \geq 0. \quad (18'-20')$$

By the chain rule through (12'),

$$\frac{\partial h}{\partial m} = \frac{\partial h}{\partial q} \frac{\partial q}{\partial m} \leq 0, \quad \frac{\partial h}{\partial s} = \frac{\partial h}{\partial q} \frac{\partial q}{\partial s} \leq 0, \quad (20'a)$$

where $\partial h / \partial m < 0$ whenever $\kappa > 0$, and $\partial h / \partial s < 0$ whenever $\kappa > 0$ and $m < 1$. Consequently, for fixed p , a requirement $R \leq r$ is achievable by correction alone if and only if

$$r \geq p a(m, s). \quad (22')$$

The proof is the same as Appendix A.1 with $q \rightarrow q(m, s)$, together with $\partial q / \partial m = -\bar{\theta}(s) < 0$ and $\partial q / \partial s = \bar{\theta}'(s)(1 - m)$, where $\bar{\theta}'(s) < 0$ because $\theta_H > \theta_L$ and $\pi_H > 0$ (Appendix A.3'). ■

The substantive reading of (22') is that oversight and screening *lower the floor* on achievable exposure by lowering the capture hazard, but they do not remove the floor: $a(m, s) \geq a(\bar{m}, \bar{s}) > 1 - \delta > 0$ throughout the feasible range. This is the formal version of the claim that capture is an institutional variable and not an institutional constant, but also not an institutional free lunch.

The eventual-capture probability (24) becomes

$$\varepsilon(\kappa, m, s) = \frac{q(m, s)}{q(m, s) + (1 - q(m, s))\kappa}, \quad (24')$$

and the unconditional permanent-violation probability is $B = p \varepsilon(\kappa, m, s)$. The limit as $\delta \uparrow 1$ of h equals ε , as before; the distinction between discounted exposure and permanent-violation probability survives endogenization.

6.5 The design problem with four margins

The least-cost problem of Section 5.1 becomes a four-variable problem in (p, κ, m, s) :

$$\min_{(p, \kappa, m, s) \in \mathcal{X}} C(p, \kappa) + \psi(m) + \chi(s) \quad \text{s.t.} \quad p h(\kappa, m, s) \leq r, \quad (33')$$

where $\mathcal{X} = [0, p_0] \times [0, 1] \times [0, \bar{m}] \times [0, \bar{s}]$. The cost function $C(p, \kappa) = \frac{\alpha}{2}(p_0 - p)^2 + \frac{\beta}{2}\kappa^2$ is as in (29). Unlike the fixed- q problem, (33') is not generally convex, so the first-order conditions below characterize

interior solutions but do not by themselves guarantee a global optimum; Section 6.6 and Appendix B.4 use multi-start numerical optimization.

Proposition 2'. Allocation across four margins. Suppose $0 < r < p_0$. Then:

1. A solution to (33') exists, and the exposure constraint binds at every solution, with $p^* < p_0$.
2. At an interior solution, with multiplier $\lambda = \alpha(p_0 - p^*)/h > 0$, the marginal resource cost of each margin per unit of exposure reduction is equalized:

$$\frac{\beta\kappa^*}{-p^*h_\kappa} = \frac{\psi'(m^*)}{-p^*h_m} = \frac{\chi'(s^*)}{-p^*h_s} = \lambda. \quad (34')$$

Equation (34') says that, at an interior optimum, the last unit of spending on each instrument achieves the same reduction in exposure.

3. The minimized cost is nondecreasing in the underlying capture-proneness θ_H .
4. The maintained assumptions do not provide a common monotone response across all instruments. The numerical examples demonstrate sign reversals for incidence, correction, and screening. They do not establish that oversight must rise, or that every instrument can exhibit both signs in every admissible cost family.

Existence and monotonicity of minimized cost are analytical results. Equation (34') is an interior necessary condition. Reallocation of individual instruments requires additional assumptions or a separate numerical analysis. In particular, the examples below show how improved oversight can offset higher capture-proneness and reduce corrective investment.

6.6 Numerical illustration

Table 1' extends Table 1 to the endogenized model. Parameters are as in Section 5.3, with $\theta_L = 0.01$, $\pi = 0.5$, $\chi(s) = 2s^2$, $\bar{m} = \bar{s} = 0.9$, and θ_H varying across rows. Oversight costs are $\psi(m) = \psi_0 m^2$ with $\psi_0 = 0.5$ (baseline), 5 (expensive oversight), and 0.05 (cheap oversight). The values are illustrative; Section 9.1 specifies what evidence would be required to identify them.

Table 1'. Least-cost prevention, correction, oversight, and screening under an exposure cap

Oversight cost ψ_0	θ_H	p^*	κ^*	m^*	s^*	B	Cost
0.50	0.10	0.2953	0.2153	0.054	0.005	0.0599	0.0490
0.50	0.20	0.2908	0.2960	0.149	0.015	0.0720	0.1034
0.50	0.40	0.2849	0.3741	0.384	0.029	0.0785	0.2268
0.50	0.60	0.2845	0.3784	0.579	0.031	0.0788	0.3246
0.50	0.80	0.2865	0.3545	0.711	0.026	0.0771	0.3890
5.00	0.10	0.2950	0.2211	0.006	0.006	0.0611	0.0504
5.00	0.20	0.2887	0.3259	0.017	0.019	0.0748	0.1146
5.00	0.40	0.2703	0.5031	0.054	0.067	0.0850	0.3211
5.00	0.60	0.2489	0.6170	0.099	0.133	0.0890	0.5960
5.00	0.80	0.2287	0.6773	0.139	0.203	0.0913	0.8918
0.05	0.10	0.2970	0.1721	0.419	0.002	0.0478	0.0388

Oversight cost ψ_0	θ_H	p^*	κ^*	m^*	s^*	B	Cost
0.05	0.20	0.2974	0.1614	0.743	0.002	0.0436	0.0540
0.05	0.40	0.2978	0.1476	0.900	0.002	0.0369	0.0625
0.05	0.60	0.2971	0.1689	0.900	0.003	0.0466	0.0695
0.05	0.80	0.2963	0.1904	0.900	0.004	0.0537	0.0775

Note. Exposure $R = 0.1000$ in every row. $m^* = 0.900$ is the upper bound $\bar{m}$. Screening s^* is small throughout under the assumed cost $\chi(s) = 2s^2$.

The exposure target is met throughout, while permanent-violation probabilities differ. Minimized cost rises with θ_H in all three panels, consistent with Proposition 2'. Oversight also rises in these illustrations, up to its bound; this is a numerical pattern, not a proved general comparative static. With expensive oversight, prevention, correction, and screening rise across the displayed rows. With baseline oversight costs, correction and screening rise and then fall. With cheap oversight, correction initially falls and then rises once oversight reaches its bound. These calculations exhibit possible allocations under the specified technologies and costs; they do not certify the global solution of an arbitrary nonconvex problem.

7. Income floors targeted claims and inequality

7.1 A two-group economy

Consider two equally sized groups, L and H . Let

$$Y(\tau) = 100(1 - 0.5\tau^2), \quad 0 \leq \tau \leq 0.6, \quad (40)$$

and

$$c_L(\tau) = 2(0.3 + \tau)Y(\tau), \quad c_H(\tau) = 2(0.7 - \tau)Y(\tau). \quad (41)$$

Here Y is mean income, and τ changes the groups' income shares while reducing total resources.

The group labels are fixed. Group L is initially poorer, but ceases to be the poorer group after $\tau = 0.2$. This distinction becomes decisive when defining a floor.

A universal minimum requires

$$\min\{c_L(\tau), c_H(\tau)\} \geq f. \quad (42)$$

A group-targeted claim requires

$$c_L(\tau) \geq f. \quad (43)$$

Equation (43) is not a universal floor. It may represent a separately justified remedial claim, but its justification cannot be supplied merely by continuing to call L the disadvantaged group.

7.2 Feasibility and the identity of the protected person

The incomes are equal at $\tau = 0.2$, where $c_L = c_H = 98$. On $[0, 0.2]$, c_L is increasing and is the minimum. On $[0.2, 0.6]$, c_H is decreasing and is the minimum. The highest feasible universal floor is therefore 98.

A targeted floor of 120, by contrast, is feasible at approximately $\tau = 0.335864$. At that allocation, $c_H \approx 68.7195$. A model that reports this policy as satisfying a minimum income of 120 has changed the protected claim. It has not merely selected a more redistributive implementation of the same requirement.

The placement argument also limits the interpretation of this example. A universal material minimum may support effective participation and answerability, but these considerations do not identify the numerical level f or give any transfer to a fixed group priority over everyone else. A targeted floor above equality needs an additional remedial justification, such as an independently established outstanding claim; the group's initially lower income is insufficient.

If no such justification succeeds, the targeted floor should not be imposed as an admissibility condition. The same economy can instead be compared using the stated welfare criterion, or with a separately defended soft weight on material deprivation. For logarithmic welfare without that constraint, the optimum is Equation (44); for mean income it is $\tau = 0$. If a justified universal floor is retained, it is slack or binding according to its level and is infeasible above 98. These alternatives make a substantive difference: the inequality reversal alone cannot validate the targeted claim.

7.3 Welfare and shadow prices

Let τ_f denote the smallest transfer satisfying the targeted floor. For $\gamma = 0$, mean income is maximized at $\tau = 0$. For $\gamma = 1$, unconstrained EDE income is maximized at approximately

$$\tau_1^* = 0.159796, \quad \xi_1^* = 98.403599. \quad (44)$$

At this optimum, $c_L \approx 90.7851$ and $c_H \approx 106.6614$. Consequently, a targeted floor below approximately 90.7851 is slack for logarithmic welfare, even though the minimum transfer needed to satisfy it may be positive.

Define

$$V_\gamma(f) = \max_{\tau: c_L(\tau) \geq f} \xi_\gamma(c(\tau)). \quad (45)$$

Where differentiable, its EDE shadow price is

$$\lambda_\gamma^{\text{EDE}}(f) = -\frac{dV_\gamma}{df}. \quad (46)$$

Table 2. Targeted floors, constrained welfare, and EDE shadow prices

Targeted floor f	Minimum compliant τ_f	$V_0(f)$	λ_0^{EDE}	$V_1(f)$	λ_1^{EDE}
60	0.0000	100.0000	0.0000	98.4036	0.0000
80	0.1021	99.4788	0.0535	98.4036	0.0000
90	0.1555	98.7909	0.0848	98.4036	0.0000
95	0.1831	98.3238	0.1023	98.2676	0.0651

Targeted floor f	Minimum compliant τ_f	$V_0(f)$	λ_0^{EDE}	$V_1(f)$	λ_1^{EDE}
98	0.2000	98.0000	0.1136	98.0000	0.1136
100	0.2114	97.7648	0.1216	97.7393	0.1473
120	0.3359	94.3598	0.2300	90.8094	0.5863

The transfer column reports minimum compliance, not the optimum under every welfare criterion. Floors above 98 have only the targeted interpretation in this table.

For universal floors between 60 and 98, the constrained welfare values coincide with those of the targeted problem for the two criteria displayed. Their feasible sets nevertheless differ, and the equivalence ends at the universal feasibility boundary.

7.4 A substantive inequality result

Define the Atkinson index as

$$A_\gamma(c) = 1 - \frac{\xi_\gamma(c)}{\mu(c)}. \quad (47)$$

A general derivative identity is

$$\frac{dA_\gamma}{df} = \frac{\xi_\gamma}{\mu} \left[\frac{\mu'}{\mu} - \frac{\xi_\gamma'}{\xi_\gamma} \right]. \quad (48)$$

Equation (48) alone does not explain how a floor changes the income distribution. The two-group structure permits a stronger conclusion.

Proposition 3. Equalization, targeted overshooting, and inequality.

For the economy in Equations (40) and (41), and any finite $\gamma > 0$:

- $A_\gamma(\tau)$ strictly decreases for $0 \leq \tau < 0.2$.
- $A_\gamma(\tau)$ strictly increases for $0.2 < \tau \leq 0.6$.
- On a differentiable binding branch below $\tau = 0.2$, tightening a universal or group- L floor strictly reduces inequality.
- On a differentiable binding targeted branch above $\tau = 0.2$, tightening the group- L floor strictly increases inequality.

These signs do not depend on the common output factor $Y(\tau)$, provided it remains positive and the relevant floor increases with τ .

Proof: Appendix A.

The result follows from the distinction between absolute income and mean-normalized distribution. A common reduction in output affects welfare levels but cancels from the Atkinson index. The shares move toward equality before $\tau = 0.2$ and away from it afterward.

A policy can therefore reduce inequality while lowering EDE welfare. Conversely, a policy increasing the income of an initially disadvantaged group can increase inequality once that group is no longer

disadvantaged. Neither conclusion establishes whether the policy is justified; both clarify what justification would have to address.

8. Welfare sensitivity and the interpretation of shadow prices

8.1 Robust and parameter-dependent rankings

For ordered incomes $c_{(1)} \leq \dots \leq c_{(n)}$, define the generalized Lorenz curve at population shares k/n by

$$GL_c(k/n) = \frac{1}{n} \sum_{i=1}^k c_{(i)}, \quad (49)$$

with linear interpolation.

Generalized Lorenz dominance provides a sufficient condition for agreement across increasing concave welfare criteria and therefore across the Atkinson family considered here (Shorrocks 1983).

Crossing curves do not guarantee reversals within the isoelastic family. They establish that generalized Lorenz dominance cannot settle the comparison. Reversals within a restricted family must be demonstrated.

For example, consider $A = (20, 35, 50, 75, 160)$ and $B = (30, 42, 55, 70, 113)$.

Table 3. EDE income under alternative inequality-aversion parameters

γ	Policy A	Policy B	Preferred policy
0.0	68.000	62.000	A
0.5	60.120	58.893	A
1.0	53.046	55.948	B
2.0	42.317	50.782	B
5.0	28.959	41.334	B

A numerical equality occurs at approximately $\gamma = 0.638929$, $\xi_\gamma(A) = \xi_\gamma(B) \approx 58.0551$. This example demonstrates parameter sensitivity. It does not identify the morally correct value of γ .

8.2 Shadow prices measure conditional opportunity costs

Suppose, on a convex subproblem, the institution solves

$$V(b) = \max_{z \in Z} W(z) \quad \text{subject to} \quad G_j(z) \geq b_j. \quad (50)$$

Under continuity, concavity, compactness, and Slater feasibility, optimal multipliers $\lambda_j \geq 0$ exist. At differentiability points,

$$\frac{\partial V}{\partial b_j} = -\lambda_j. \quad (51)$$

A shadow price measures welfare forgone when a requirement is tightened slightly; it does not measure the requirement's moral importance.

This is a standard sensitivity result, not a new moral theorem. Lagrange duality explains what tightening a requirement costs relative to the specified objective and feasible set; it does not establish whether the requirement has authority (Boyd and Vandenberghe 2004).

A zero multiplier does not imply that a requirement is unimportant. It may be slack because existing arrangements already satisfy it. A large multiplier does not prove that the requirement should be abandoned. It may identify the need for different technologies, financing arrangements, or institutional powers.

8.3 Normalization and finite penalties

Multipliers depend on units. Rescaling a constraint rescales its multiplier. Transforming the objective can preserve the optimum while changing reported welfare costs.

For deterministic Atkinson welfare, corresponding multipliers satisfy

$$\lambda^{\text{obj}} = \xi_Y^{-\nu} \lambda^{\text{EDE}}. \quad (52)$$

For logarithmic welfare, $\lambda^{\text{obj}} = \lambda^{\text{EDE}}/\xi_1$.

It is therefore misleading to compare raw multipliers across studies without identifying their objective and constraint units.

Under convex regularity, a sufficiently large finite penalty can reproduce a constrained optimum. Let λ^* be an optimal multiplier vector and choose coefficients $M_j > \lambda_j^*$. Then maximizing

$$W(z) - \sum_j M_j [b_j - G_j(z)]_+ \quad (53)$$

produces only constrained optima.

The penalty coefficients reproduce constrained solutions under the assumptions of the convex subproblem. Their sufficiency need not survive changes in technologies, resources, or alternative arrangements. A coefficient below a multiplier is not, without additional conditions, a general necessary-and-sufficient test for violation. Section 2.6.3 gives a direct example of divergence between a fixed penalty and a constraint. The computational equivalence alone supplies no justification for the constraint or a moral exchange rate.

Nor does a finite penalty define an institution's legal sanction. Behavioral incentives, information, and enforceability require a separate analysis.

9. Empirical interpretation and limitations

9.1 What evidence would be required

An application of the correction model requires separate evidence about: initial incidence p ; correction probability conditional on an unresolved violation; access to the corrective process; failures that make

correction unavailable; resources devoted to prevention, remedy, oversight, and screening; and the distribution of the resulting burdens.

Observed case-closure rates do not automatically identify correction. Closure may reflect withdrawal, procedural exclusion, or abandonment. Low complaint counts may indicate either successful prevention or barriers to access. The same caution applies to oversight: an increase in the number of captured officials removed does not establish that oversight is effective, because removal may be selective or may reflect changes in the composition of cases rather than improvements in monitoring.

The capture parameters are especially demanding. Neither the prior π nor the type-specific capture-proneness θ_L, θ_H can be identified merely by observing that an institution produces outcomes favorable to powerful actors. A causal account must distinguish influence over corrective authority from lawful policy choices, resource shortages, ordinary error, and changes in underlying conditions. The endogenized model of Section 6 introduces a further identification problem: oversight m and screening s affect the effective capture hazard $q(m, s)$ jointly, so an observed reduction in permanent violations is consistent with different allocations across the two margins. Identification requires either direct evidence on oversight intensity or an instrument that shifts one margin without shifting the other.

Administrative appeals provide an empirical anchor for the distinction between throughput and protection. The Office of Medicare Hearings and Appeals reports average processing times of 1,430.1 days in fiscal year 2020, 71.0 in 2024, and 74.0 in 2025 (OMHA 2026). These figures demonstrate substantial variation in administrative duration; they do not measure the duration of wrongful denial or establish capture. Medicare appeals also concern diverse claimants and payment disputes, so they cannot be mapped directly to the representative protected person.

Even a reliable mean duration is insufficient to calculate discounted exposure. If T is time to successful correction, with exposure until then and no subsequent recurrence, conditional exposure is $E[1 - \delta^T]$, taking $\delta^T = 0$ when correction never occurs. Because $1 - \delta^T$ is concave in finite T , substituting the mean duration gives an upper bound under those assumptions, not an exact estimate. A completed-case mean additionally omits unresolved cases and cannot supply that population mean. Identification requires a cohort of independently validated violations, correction dates, censored follow-up, information about access barriers, and an account of competing exit routes.

The administrative statistics therefore motivate the measurement problem rather than calibrate p , κ , or q . Estimating a quantitative capture-dependent floor would require evidence distinguishing irreversible obstruction from delay and ordinary adverse adjudication. None of the illustrative parameters in Tables 1 and 1' is estimated from these figures.

9.2 Identification of economic power

Wage or price responses can inform institutional assessment without identifying the normative object directly. A wage markdown, for instance, depends on the relationship between compensation and marginal revenue product; a regression estimating wage changes alone does not identify that ratio. More generally, an empirical proxy should not silently replace the protected concept. Market concentration is not identical to dependence; access to an application procedure is not identical to access to the underlying opportunity; compensation is not identical to restoration of standing.

The legal constitution of markets matters here. Britton-Purdy and coauthors place power, equality, and democracy at the center of legal analysis (Britton-Purdy et al. 2020). The present indicators represent

specified institutional concerns; they do not exhaust economic power, equal standing, or the legitimacy of coercion. Other assessments may need qualitative evidence alongside these measures.

9.3 Model boundaries

The model has several boundaries. Violations arise only initially, although Proposition 1A permits richer stochastic paths after onset. Permanent capture is absorbing; recovery would require a different persistence measure. Oversight and screening are chosen by a protective planner, not generated by a political equilibrium. Correction ends exposure without necessarily restoring opportunities or settling redress. The endogenous-capture example assumes independent reassignment, an externally available screening signal, and a corrective probability independent of oversight and type. Capacity costs are separable budgets; costs conditional on active caseload would alter the design problem. Proposition 2A relaxes quadratic costs but retains the particular affine implementation technology. Finally, two representative income groups omit within-group burdens, and all protection thresholds require independent normative justification.

10. Conclusion

The legitimacy of an economic institution cannot generally be assessed by separating its announced standards from the machinery that implements them. A substantive entitlement, a tolerable implementation risk, and a welfare ranking are different evaluative objects. Making their relationship explicit allows institutional analysis to preserve normative priority without assuming perfect compliance.

Unavoidable delay and a positive chance of irreversible harm limit what remedies can achieve. Proposition 1A establishes that conclusion without a Markov assumption. The tractable capture model then identifies a particular implementation frontier. Proposition 2A shows that its shift toward prevention survives general convex separable costs, while corrective effort has a sign determined by a curvature condition. Oversight and screening change the frontier but remain conditional on the political environment.

The adjudicative-access argument defends a minimum effective route of contestation under a duty of public answerability. It acknowledges that this priority can exclude Pareto improvements across the full choice set. Its additional content is to distinguish procedural duties, measurable reliability, and continuing claims when protection fails. The income application shows why constraint status cannot be inferred from a policy label or a desirable distributional effect.

Welfare analysis remains valuable within this structure. It identifies consequences, distributional sensitivity, and the opportunity costs of protection. Its appropriate role is neither to erase the distinction between permissible and impermissible arrangements nor to render implementation costs invisible. It is to make institutional choices more explicit about what they protect, how reliably they protect it, whose burdens remain, and what alternatives are being forgone.

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article's arguments, verification, and final content rests with the author. The tool is available through OpenAI at <https://openai.com/codex/>.

Appendix A. Mathematical proofs

A.1 Proposition 1

Write $a = 1 - \delta + \delta q > 0$ and $D = a + \delta(1 - q)\kappa > 0$. The Bellman equation yields

$$F[1 - \delta(1 - q)(1 - \kappa)] = 1 + \frac{\delta q}{1 - \delta}.$$

Since $1 - \delta(1 - q)(1 - \kappa) = D$ and the right-hand side equals $a/(1 - \delta)$, Equation (15) follows.

Differentiating $h = a/D$ with respect to κ gives Equations (18) and (19). For q , $a_q = \delta$ and $D_q = \delta(1 - \kappa)$. Hence

$$h_q = \frac{\delta D - a\delta(1 - \kappa)}{D^2} = \frac{\delta\kappa[a + \delta(1 - q)]}{D^2} = \frac{\delta\kappa}{D^2},$$

because $a + \delta(1 - q) = 1$.

At $\kappa = 0$, $h = 1$. At $\kappa = 1$, $D = 1$, so $h = a$. Monotonicity establishes Equation (21), and multiplying by p proves Equation (22).

For $p > r$, solving $pa/[a + \delta(1 - q)\kappa] \leq r$ gives Equation (23). ■

A.2 Eventual capture

Conditional on starting in state A , let ε be the eventual capture probability. Then

$$\varepsilon = q + (1 - q)(1 - \kappa)\varepsilon.$$

If $q + (1 - q)\kappa > 0$,

$$\varepsilon = \frac{q}{q + (1 - q)\kappa}.$$

Multiplication by initial incidence gives Equation (25). Taking $\delta \uparrow 1$ in Equation (16) proves Equation (27) for $q > 0$. ■

A.3 Proposition 2

If $p_0 > r$, the zero-cost point $(p_0, 0)$ is infeasible. At any optimum, the exposure constraint binds. Otherwise prevention could be reduced or corrective effort lowered while preserving feasibility.

For a fixed κ , the least costly feasible incidence is $p = \min\{p_0, r(1 + \eta\kappa)\}$. Define $\kappa_0 = (p_0 - r)/(r\eta)$. For $\kappa \leq \kappa_0$, substitution gives

$$C(\kappa) = \frac{\alpha}{2}(p_0 - r - r\eta\kappa)^2 + \frac{\beta}{2}\kappa^2.$$

Differentiation yields

$$C'(\kappa) = -\alpha r \eta (p_0 - r - r \eta \kappa) + \beta \kappa.$$

The unique unconstrained minimizer is Equation (34). Moreover,

$$\frac{\hat{\kappa}}{\kappa_0} = \frac{\alpha r^2 \eta^2}{\beta + \alpha r^2 \eta^2} < 1.$$

Thus the unconstrained minimizer lies before the point at which prevention would be eliminated. If $\hat{\kappa} > 1$, the constrained optimum is $\kappa = 1$, and then $\kappa_0 > 1$, ensuring $p^* < p_0$. This proves Equation (35).

On the interior branch, substitution yields Equation (36). Finally,

$$\eta'(q) = -\frac{\delta}{(1 - \delta + \delta q)^2} < 0.$$

Equation (36) therefore implies increasing prevention as capture rises. On the boundary branch, prevention is $p_0 - r(1 + \eta)$, which also increases as η falls. Differentiating Equation (34) establishes Equation (37). The turning point is where $\beta = \alpha r^2 \eta^2$. ■

A.3' Propositions 1' and 2'

Derivatives of the effective hazard. Write $u = (1 - s)\pi_H$, so that $\bar{\theta} = (u\theta_H + \pi_L\theta_L)/(u + \pi_L)$. Then $d\bar{\theta}/du = \pi_L(\theta_H - \theta_L)/(u + \pi_L)^2 > 0$ and $du/ds = -\pi_H$, so

$$\bar{\theta}'(s) = -\frac{\pi_H\pi_L(\theta_H - \theta_L)}{[(1 - s)\pi_H + \pi_L]^2} < 0.$$

Also $\partial\bar{\theta}/\partial\theta_H = (1 - s)\pi_H/[(1 - s)\pi_H + \pi_L] \geq 0$. Hence $\partial q/\partial m = -\bar{\theta}(s) \leq 0$, $\partial q/\partial s = \bar{\theta}'(s)(1 - m) \leq 0$, and $\partial q/\partial\theta_H \geq 0$.

Proposition 1'. Equations (21') and (18'–20') follow from Appendix A.1 with q replaced by $q(m, s) \in [0, 1]$, since $q \leq \theta_H < 1$. Equation (20'a) is the chain rule. Strictness: $\partial h/\partial q = \delta\kappa/D^2 > 0$ iff $\kappa > 0$; $\partial q/\partial m < 0$ since $\bar{\theta}(s) > 0$ when $\theta_H > 0$ and $\pi_H > 0$; $\partial q/\partial s < 0$ iff $m < 1$. Because $q \geq \bar{\theta}(\bar{s})(1 - \bar{m}) > 0$ on the feasible range, $a(m, s) \geq a(\bar{m}, \bar{s}) > 1 - \delta$.

Proposition 2'. (1) The feasible set contains $p = 0$ for any (κ, m, s) , because then $R = 0 \leq r$. The objective is continuous on the compact box, so a minimizer exists. Suppose the constraint is slack at a minimizer. If $p < p_0$, raising p strictly lowers cost and preserves feasibility for a small increase. If $p = p_0$, slackness requires $h < r/p_0 < 1$, so $\kappa > 0$ (since $h = 1$ at $\kappa = 0$); lowering κ strictly lowers cost and preserves feasibility by continuity. Either case contradicts optimality, so the constraint binds. If $p^* = p_0$, the multiplier from the p -condition would be zero, which with the κ -condition forces $\kappa^* = 0$ and $h = 1$, contradicting feasibility since $r < p_0$; hence $p^* < p_0$.

- (2) Form the Lagrangian $\mathcal{L} = C(p, \kappa) + \psi(m) + \chi(s) + \lambda [p h(\kappa, m, s) - r]$. At an interior solution the first-order conditions are $-\alpha(p_0 - p) + \lambda h = 0$, $\beta\kappa + \lambda p h_\kappa = 0$, $\psi'(m) + \lambda p h_m = 0$, and $\chi'(s) + \lambda p h_s = 0$. Since $\partial(ph)/\partial p = h > 0$, the constraint qualification holds. Solving each for λ gives $\lambda = \alpha(p_0 - p)/h > 0$ and Equation (34').

- (3) For every (p, κ, m, s) , q is nondecreasing in θ_H and h is nondecreasing in q , so $p h$ is nondecreasing in θ_H . The feasible set therefore weakly shrinks as θ_H rises, and the minimized cost cannot fall.
- (4) The first-order system involves cost curvatures and cross-effects of exposure, so it supplies no immediate common monotonicity conclusion for all instruments. The specified examples establish changing signs for incidence, correction, and screening. They do not prove sign ambiguity for oversight itself. No stronger claim is required here.

A.4 Proposition 3

Let $u = 0.3 + \tau$. Mean income is $Y(\tau)$, and normalized group incomes are $2u$ and $2(1 - u)$.

Homogeneity of EDE income implies

$$\frac{\xi_\gamma(c_L, c_H)}{\mu} = \xi_\gamma(2u, 2(1 - u)).$$

The output term cancels.

For $\gamma > 0$, ϕ_γ is strictly concave. Along the normalized fixed-sum distribution,

$$\frac{d}{du} \left[\frac{\phi_\gamma(2u) + \phi_\gamma(2(1 - u))}{2} \right] = (2u)^{-\gamma} - [2(1 - u)]^{-\gamma}.$$

This derivative is positive for $u < 1/2$, zero at equality, and negative for $u > 1/2$. Because the inverse utility function is increasing, normalized EDE income has the same directional changes. The Atkinson index therefore decreases before $\tau = 0.2$ and increases afterward.

On a binding branch where the protected income increases with τ , the implicit-function theorem gives $d\tau/df > 0$. Composition establishes the floor comparative statics.

For the specified economy,

$$c_L'(\tau) = 200(1 - 0.3\tau - 1.5\tau^2) > 0$$

throughout $[0, 0.6]$, while

$$c_H'(\tau) = 200(-1 - 0.7\tau + 1.5\tau^2) < 0$$

there. The universal minimum is therefore maximized at equality. ■

A.5 Shadow-price sensitivity

Assume Z is nonempty, compact, and convex; W and each G_j are continuous and concave; and Slater's condition holds at the reference requirement b . Categorical restrictions are either absent from this subproblem or already incorporated into a convex domain.

The Lagrangian is

$$\mathcal{L}(z, \lambda; b) = W(z) + \sum_j \lambda_j [G_j(z) - b_j].$$

Strong duality gives an optimal $\lambda^* \geq 0$ satisfying

$$W(z) + \sum_j \lambda_j^* [G_j(z) - b_j] \leq V(b) \quad \forall z \in Z.$$

For any perturbation $\tilde{b}$ and any arrangement feasible for that perturbation,

$$W(z) \leq V(b) - \lambda^* \cdot (\tilde{b} - b).$$

Taking the maximum shows that $-\lambda^*$ is a supergradient of V . At differentiability points, Equation (51) follows. ■

A.6 Exact penalties

Let $v_j(z) = [b_j - G_j(z)]_+$. From dual optimality,

$$W(z) \leq V(b) - \sum_j \lambda_j^* [G_j(z) - b_j] \leq V(b) + \sum_j \lambda_j^* v_j(z).$$

Therefore,

$$W(z) - \sum_j M_j v_j(z) \leq V(b) - \sum_j (M_j - \lambda_j^*) v_j(z).$$

If every $M_j > \lambda_j^*$, an infeasible point yields a value strictly below $V(b)$, whereas a constrained optimum attains $V(b)$. Every penalized maximizer is consequently a constrained optimum. No converse or equality-case claim is needed. ■

A.7 Objective normalization

For deterministic outcomes, $W_\gamma = \phi_\gamma(\xi_\gamma)$. Along a differentiable optimized value path,

$$\frac{dW_\gamma}{df} = \phi_\gamma'(\xi_\gamma) \frac{d\xi_\gamma}{df} = \xi_\gamma^{-\gamma} \frac{d\xi_\gamma}{df}.$$

Taking negatives proves Equation (52).

For the Atkinson index,

$$\frac{d}{df} \left(1 - \frac{\xi_\gamma}{\mu} \right) = \frac{\xi_\gamma}{\mu} \left[\frac{\mu'}{\mu} - \frac{\xi_\gamma'}{\xi_\gamma} \right],$$

proving Equation (48). At $\gamma = 0$, the index is identically zero. ■

Appendix B. Numerical specification and reproducibility

B.1 Prevention and correction

Table 1 is calculated directly from Equations (30), (34), and (35), using

$$(p_0, r, \alpha, \beta, \delta) = (0.30, 0.10, 100, 2, 0.95).$$

Permanent-violation probability is calculated using Equation (25). All displayed solutions are interior in corrective capacity.

B.2 Income floors

For each targeted floor f , the minimum compliant transfer solves

$$2(0.3 + \tau) 100 (1 - 0.5\tau^2) = f.$$

For $\gamma = 0$, the constrained optimum is this minimum transfer. For $\gamma = 1$, it is the larger of this transfer and the unconstrained logarithmic optimum.

On a binding branch,

$$\lambda_\gamma^{\text{EDE}} = -\frac{d\xi_\gamma/d\tau}{dc_L/d\tau}.$$

For $\gamma = 1$,

$$\frac{d\xi_1}{d\tau} = \frac{\xi_1}{2} \left(\frac{c_L'}{c_L} + \frac{c_H'}{c_H} \right).$$

Slack floors have zero shadow price.

B.3 Welfare sensitivity

Table 3 applies Equation (6) to the two specified income vectors. The reported equality parameter is obtained by solving $\xi_\gamma(A) - \xi_\gamma(B) = 0$ within $(0.1, 1)$.

B.4 Endogenous capture

The accompanying `reproduce_tables.py` uses only the Python standard library. Conditional on oversight and screening, it solves prevention and correction analytically using Proposition 2. It then searches over oversight and screening using bounded coordinate minimization from nine starting points, refining a grid on each coordinate. Agreement across starts is checked, but is not a certificate of global optimality. Tables 1 to 3 and Table 1' are reproduced at full precision before rounding. The script also reports the logarithmic optimum and the isoelastic crossing. The numerical results are illustrative, not empirical estimates.

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