参赛学生姓名：叶问天

中学：北京市第一〇一中学

省份：北京市

国家/地区：中国

指导老师姓名：杨洋

指导老师单位：北京市第一〇一中学

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On Institutional Intermediation under Dual Dependence

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On Institutional Intermediation under Dual Dependence

叶问天

Abstract

This paper studies an intermediary that depends simultaneously on participant compliance and permission from an external authority. Participants may bypass the intermediary, while the authority compares permission with alternative actions. A participant-side model identifies the easiest-to-implement activity, and an authority-side model derives the information requirement and the conditions under which implementation and authorization are jointly feasible. The two requirements can be feasible separately but incompatible when disclosure costs or authorization-induced activity displacement exceed the intermediary's participant-side resources. Two extensions broaden the analysis. When the authority also cares about substantive activity, authorization may push activity upward or downward depending on the net balance between information capacity and activity concern. When permission is denied, full disintermediation provides the relevant outside counterfactual: genuine restraint requires activity below the equilibrium that would arise when all participants operate outside. The paper concludes by relating these mechanisms to institutional design, optimizing institutional reform, and providing a contemporary institutional illustration.

Keywords: Institutional intermediation; Self-regulation; Participant incentives; External authorization; Information disclosure; Disintermediation.

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1 Introduction

1.1 Historical Motivation: The Leningrad Rock Club

On 7 March 1981, the Leningrad Rock Club (LRC) opened in the Soviet Union. At a time when rock music was institutionally restricted, the LRC gave rising bands access to legitimate public performance opportunities. Famous groups including Aquarium, Kino, and Televisor were associated with the Club. That access came with oversight from the authorities, including membership procedures and performance authorization or review (Kolesnik, 2023; Steinholt, 2004).

The interaction among bands, the LRC, and Soviet authorities was more complex than a simple command-and-control relationship. Bands received opportunities that were difficult to obtain individually, while the authorities gained a more legible setting in which to monitor activity. Accounts also describe bands bypassing or ignoring internal regulation. The LRC illustrates how an intermediary could simultaneously provide valued opportunities to participants and make their activity more observable to an authority.

The LRC thus provides an example of an institution positioned between participants seeking access to valued opportunities and an authority retaining the power to permit or restrict its operation. Policies that benefit participants may make permission more difficult, while policies that satisfy the authority may make participation less attractive.

The example motivates the following question: How can an intermediary benefit its participants while satisfying the authority that permits its continued existence?

1.2 Institutional Intermediation under Dual Dependence

Consider an intermediary that coordinates a group of participants while requiring permission from an external authority to operate. The intermediary faces two constraints. First, participants must prefer complying with the intermediary to bypassing or leaving it. Second, the authority must prefer permitting the intermediary to its available alternatives.

A policy that improves the intermediary's value to the authority may be more difficult to sustain among participants, while the policy easiest to implement internally may be unattractive to the authority. The conflict can arise through information requirements, substantive activity concerns, or both. The intermediary's ability to coordinate participants is therefore constrained by both participant incentives and external authorization.

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1.3 Research Question and Approach

The research question is: Under what conditions does an intermediary that must retain participant compliance and obtain external authorization face a conflict between these two requirements, and what institutional designs can mitigate or resolve that conflict?

To address this question, the paper develops a static theoretical model in which participant incentives and the authority's authorization decision are derived separately and then combined to characterize jointly feasible institutional policies. The analysis subsequently considers policy-sensitive authorization, full disintermediation, and institutional design implications.

1.4 Scope

The paper studies an already available intermediary. It does not explain why the intermediary forms or how it eventually disappears. Section 5.9 nevertheless considers full disintermediation as a counterfactual outcome following denial of permission; it does not model the process through which an intermediary forms, collapses, or evolves over time.

The historical discussion of the LRC motivates the problem but does not empirically estimate its parameters or trace its institutional evolution. The paper asks what can be learned from an intermediary subject to dual dependence on participant compliance and external permission.

Section 2 relates the argument to existing literature. Section 3 introduces the model. Section 4 constructs the participant problem and derives the easiest-to-implement activity. Section 5 develops authorization, joint incompatibility, policy-sensitive concern, and full disintermediation. Section 6 discusses institutional design and a contemporary illustration, and Section 7 concludes.

2 Literature Review

This paper relates to two main literatures: self-regulation and regulatory intermediation. These literatures explain different parts of the institutional problem considered here. The paper focuses on their interaction when the same policy must remain implementable among participants and acceptable to an external authority.

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2.1 Self-Regulation, Externalities, and Government Oversight

A large literature studies why governments may rely on self-regulatory organizations. Maxwell et al. (2000) show that firms may restrain behavior to pre-empt political intervention. DeMarzo et al. (2005) model a self-regulatory organization whose objective is member welfare; because the organization prefers relatively lax enforcement, government oversight can induce stronger enforcement. Grajzl and Murrell (2007) study the allocation of regulatory authority between governments and self-regulatory bodies, while Ma (2020) characterizes when self-regulation can be superior because private actors possess better information and can internalize industry externalities.

The present paper adds an explicit participant outside option. Participants can bypass the intermediary, so a policy must be both acceptable to the authority and sufficiently attractive to sustain compliance.

2.2 Regulatory Intermediaries and Delegated Information

Abbott et al. (2017) argue that regulation often involves a regulator-intermediary-target relationship and emphasize the expertise, information, and implementation that intermediaries can provide. Related work on delegation, such as Dessein (2002), explains why delegation can be preferable even when an authority and an intermediary have different interests.

This literature also suggests that an intermediary can be valuable because it performs functions that would be more difficult for an authority to carry out directly. In particular, the intermediary may organize participants, collect information, and make their activity easier to observe or verify. Delegation can therefore remain useful even when the preferences of the authority and intermediary are not perfectly aligned. In the present model, this informational role is separated from the participant-side problem. The authority may value the information provided through the intermediary, but producing or disclosing that information can make participation more costly. The same institutional arrangement can therefore improve the intermediary' s value to the authority while simultaneously weakening participant willingness to remain inside it.

The current paper takes the existence of the intermediary as given. It instead asks whether an established intermediary can simultaneously satisfy participant implementation and external authorization constraints.

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2.3 Disintermediation and the Relevant Authority Counterfactual

Private restraint is often valuable because it can reduce the need for intervention. Whether an intermediary provides genuine restraint depends on the relevant outside outcome. If participants continue operating after permission is denied, the appropriate comparison is not intermediation versus zero activity, but intermediation versus full disintermediation. If stronger restraint makes membership less attractive, the intermediary may require additional participant-side resources to sustain it.

This distinction is important for the later model, because a policy that looks restrictive within the institution may still generate more activity than full disintermediation. Whether the intermediary can provide genuine restraint therefore depends not only on its formal policy, but also on the incentives and frictions faced by participants outside the institution.

2.4 Contribution

Existing research explains many parts of this problem. Self-regulation can help control externalities; government oversight can influence private regulation; and intermediaries can provide monitoring and information valuable to an authority.

This paper focuses on the interaction between these forces when they operate through the same institution. Participants can leave or bypass the intermediary, so its policies must remain attractive enough to sustain compliance. At the same time, the authority can deny permission, so those policies must also remain acceptable externally.

The paper's contribution is to characterize how participant exit and external authorization constrain institutional policy. The analysis separates direct disclosure costs from an authorization premium when information requirements displace activity . It also derives the participant-resource threshold for sustaining restraint relative to full disintermediation. The reform analysis then shows how common payments can keep activity fixed over a range of verification prices, and how investment can change discontinuously when larger upgrades offer better support savings per unit of investment.

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3 Main Model Overview

3.1 Institutional Environment

Consider an intermediary that coordinates $n \geq 2$ participants indexed by $i \in \{1, \ldots, n\}$, let:

$$e = (e_1, \ldots, e_n) \in \mathbb{R}^n_+$$

denote the vector of participant activities, where $e_i \geq 0$ denotes participant i's activity.

The intermediary is assumed to be already existing; as stated in section 1, the formation, organizational structure, and potential disappearance are outside the scope of this paper.

In the baseline model, the intermediary is treated as a policy designer rather than as an optimizing strategic player. The analysis characterizes policies capable of satisfying both participant implementation and external authorization and, where relevant, identifies the policy minimizing participant implementation burden. Section 6.6 adds an expenditure objective and studies the choice of activity, investment, and member support.

The intermediary prescribes a common activity level x for every participant; activity, depending on different contexts, can have varying meanings. Depending on the application, x may represent production volume, trading intensity, operating intensity, or another substantively regulated activity. Conditional on remaining in the intermediary, the prescription is enforceable; the strategic margin studied here is compliance versus unilateral exit. Section 4.2 shows that, under the quadratic benchmark, this prescription can be implemented through a binding activity ceiling. Under complete compliance

$$e_i = x \qquad \text{for every } i$$

The participant, however, need not comply with the intermediary and can instead operate outside at a selected activity level $t \geq 0$. A departing participant forfeits the access benefit and avoids the participation fee and disclosure cost. This will incur an outside activity friction[1] $C(t)$ that the participant will pay. A participant that remains, on the other hand, gain an institutional access benefit[2] $a \in [0, A]$, where

[1] Depending on context, can have different interpretations; such as transactional difficulty, legal obstacles, or other relevant costs.

[2] Access includes benefits available through the intermediary, such as a legitimate public venue or opportunities that are difficult to obtain individually. The scalar a expresses their value in participant payoff units.

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$0 \leq A < \infty$ is the maximum access that the intermediary can possibly provide to a participant. A compliant participant also pays a participation fee $k \geq 0$, and incurs a information disclosure cost[3] $h(\iota)$.

3.2 Participant Payoffs

Before introducing institutional access benefits, participation fees, and disclosure costs, let participant i have payoff:

$$u_i(e) = B(e_i) - bH\left(\sum_{j=1}^{n} e_j\right)$$

The function B represents the private benefit that the participant gains from activity level e. The function H denotes the shared exposure[4] from aggregate participant activity, and $b > 0$ represents the weight placed on shared exposure.

When the intermediary imposes a common activity level x on every participant, given all participants are compliant, the participant's payoff is

$$w(x) = B(x) - bH(nx)$$

If, however, participant i departs with the remaining $n-1$ participants compliant. Participant i have payoff

$$\Phi(t, x) = B(t) - bH\big(t + (n-1)x\big) - C(t)$$

This is a unilateral-departure problem: the remaining $n-1$ participants continue operating inside the intermediary at x. Shared exposure crosses institutional boundaries: leaving removes access benefits, fees, and disclosure obligations, but does not insulate a participant from exposure generated by insiders. The optimized departure payoff is thus

$$D(x) = \max_{t \geq 0} \Phi(t, x)$$

From which the implementation burden of the participant is defined as

$$T(x) = D(x) - w(x)$$

[3]This is the participant's cost of supplying information through the intermediary, including privacy, time, and reporting burdens. It is distinct from the participation fee k.

[4]Can have different interpretations under various contexts, this can include regulatory attention, surveillance, or public scrutiny.

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A smaller value of $T(x)$ indicates that compliance is relatively easier to maintain; a larger value means outside activity is more attractive relative to compliance. $T(x)$ may be negative, meaning that before fees and disclosure costs are introduced, compliance already dominates unilateral departure. Once fees, disclosure costs, and access benefits are added, compliance requires

$$w(x) + a - k - h(\iota) \geq D(x)$$

or, equivalently

$$a \geq k + h(\iota) + T(x)$$

This inequality represents the participant-side constraint. A participant compares the value of complying with the maximized, unilateral departure payoff. However, the intermediary need not make compliance strictly better than departure, indifference is assumed to be sufficient to sustain compliance.

3.3 Authority Payoffs

The authority is an external actor from which the intermediary must gain permission[5] to operate. Let F denote permission and $\mathcal{J}$ be a finite, non-empty set of alternative actions that the authority can choose relative to permission. The authority thus has action set:

$$\mathcal{Y}_G = \{F\} \cup \mathcal{J}$$

For each action $y \in \mathcal{Y}_G$, r_y denotes the non-informational payoff that the authority gains from the action. Let $\iota_y \in [0, 1]$ measure the informational effectiveness[6] of action y. Let $\kappa > 0$ denote the marginal value of informational effectiveness. Thus, the authority' s payoff from action y is:

$$V_G^y = r_y + \kappa \iota_y$$

The quantities r_F, r_j, ι_j, and κ are held fixed when the intermediary changes its policy.

[5]Permission means that the authority allows the intermediary to operate. As in the preceding discussion, it need not imply that the authority creates or directly manages the intermediary.

[6]Informational effectiveness measures the value of the information available to the authority under an action, including its usefulness for monitoring and oversight. The interval $[0, 1]$ is a normalization.

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The informational effectiveness of permission is denoted as $\iota_F = \iota$, for each alternative action $j \in \mathcal{J}$, define

$$d_j = r_j - r_F$$

Permission will weakly dominate alternative j when

$$r_F + \kappa\iota \geq r_j + \kappa\iota_j$$

or, equivalently

$$\iota \geq \iota_j + \frac{d_j}{\kappa}$$

Thus, define the minimum informational requirement

$$g = \max\left\{0, \max_{j \in \mathcal{J}} \left[\iota_j + \frac{d_j}{\kappa}\right]\right\}$$

Permission is acceptable, including when the authority is indifferent, whenever

$$\iota \geq g$$

g summarizes the authority' s options aside from permission, a larger g reflects more attractive alternatives.

3.4 Informational Technology and Policy Domain

The intermediary' s informational capacity depends on its activity level and informational technology[7], let

$$P : X \to [0, 1]$$

denote the maximum verifiable information that can be generated with activity level x, thus the technological constraint is

$$0 \leq \iota \leq P(x)$$

[7]Informational technology refers to the intermediary's ability to gather and verify information through its activity. The function P describes capacity under a fixed technology; supplying $\iota \leq P(x)$ remains a policy choice.

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The model assumes that P is continuous and strictly increasing on the policy domain

$$X = [0, x^D]$$

where x^D is the frictionless symmetric decentralized benchmark derived in Section 4. It is a reference point for the policy domain, not necessarily the activity that occurs after permission is denied; Section 5.9 derives that separate full-disintermediation outcome.

The disclosure cost $h(\iota)$ is assumed to be nonnegative, continuous, and nondecreasing, with

$$h(0) = 0$$

The assumption that P is increasing represents the idea that with more activity, holding informational technology fixed, the intermediary will have a greater capacity to generate information. Activity itself generates observable events or records, such as performances or logged transactions, from which verifiable information can be produced. This is a substantive assumption behind the upward-displacement mechanism: a higher information requirement can force activity upward when technology is fixed. It need not hold when information can be produced independently of activity. The assumption that h is nondecreasing captures the idea that supplying more information cannot decrease the disclosure burden of individuals.

For a given authority requirement g, the set of activities that can generate sufficient information is defined as

$$K(g) = \{x \in X : P(x) \geq g\}$$

Authorization is attainable if and only if

$$g \leq P(x^D)$$

For attainable g, define the minimum activity level capable of generating required information

$$q(g) = \begin{cases} 0, & 0 \leq g \leq P(0), \\ P^{-1}(g), & P(0) < g \leq P(x^D). \end{cases}$$

the upper half is necessary since $P^{-1}(g)$ may not exist when $g < P(0)$.

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4 Participant Model

4.1 Quadratic Benchmark

For closed-form solutions, a quadratic benchmark is used. Assume:

$$B(e) = \alpha e - \frac{c}{2}e^2$$

$$H(E) = \frac{1}{2}E^2, \qquad E = \sum_{j=1}^{n} e_j$$

and

$$C(t) = \frac{\sigma}{2}t^2$$

where

$$\alpha, b, c, \sigma > 0.$$

Participant i' s private payoff thus becomes:

$$u_i(e) = \alpha e_i - \frac{c}{2}e_i^2 - \frac{b}{2}\left(\sum_{j=1}^{n} e_j\right)^2$$

Under a common $e_i = x$ for all i, define institutional participant payoff:

$$w(x) = \alpha x - \frac{c + bn^2}{2}x^2$$

4.2 Collective and Decentralized Benchmark

The collective participant benchmark is the common activity x that maximizes the payoff for every i:

$$x^I \in \arg\max_{x \geq 0} w(x)$$

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The unique result is

$$x^I = \frac{\alpha}{c + bn^2}$$

The frictionless symmetric decentralized benchmark is derived by allowing participants to optimize activity individually and subsequently imposing symmetry. Outside friction C is not included in this benchmark. The resulting activity level is

$$x^D = \frac{\alpha}{c + bn}$$

Since $n \geq 2$ and $b > 0$

$$0 < x^I < x^D$$

The gap between x^I and x^D emerges from the exposure externality that a participant generates when they optimize individually. They account for the exposure cost on their own activity but do not fully internalize the effect of aggregate activity imposed on all participants. Thus, the collective benchmark is more restrained than the decentralized benchmark. The paper concerns and will henceforth proceed with the policy domain

$$X = [0, x^D]$$

It does not imply, however, that activity above x^D is not achievable.

On this domain, the prescribed allocation can be implemented by an enforceable activity ceiling $e_i \leq x$. Holding institutional access, fees, and disclosure fixed, and with every other participant at x, the best response without the ceiling is

$$BR_i(x) = \frac{\alpha - b(n-1)x}{c + b}, \qquad x \in X,$$

whose numerator is positive throughout X. Moreover,

$$BR_i(x) \geq x \quad \Longleftrightarrow \quad x \leq \frac{\alpha}{c + bn} = x^D.$$

Strict concavity therefore makes $e_i = x$ optimal subject to the ceiling throughout the policy domain. This explains both how the common allocation can be sustained among remaining participants and why x^D is the relevant upper bound for a binding ceiling. The unilateral-departure comparison continues to hold the other participants' activities fixed at x.

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4.3 Optimized Departure

Suppose one participant chooses to deviate while the rest continues with activity level x, the departing participant chooses outside activity $t \geq 0$, and receives a payoff:

$$\Phi(t, x) = \alpha t - \frac{c}{2}t^2 - \frac{b}{2}\left[t + (n-1)x\right]^2 - \frac{\sigma}{2}t^2$$

Let

$$Q = c + b + \sigma > 0$$

The optimized departure payoff is

$$D(x) = \max_{t \geq 0} \Phi(t, x)$$

The optimal outside activity is

$$t(x) = \frac{\alpha - b(n-1)x}{Q}$$

Within policy domain X, outside activity is positive and decreasing as institutional activity increases

$$t(x) > 0, \qquad t'(x) = -\frac{b(n-1)}{Q} < 0$$

This negative derivative indicates that increase in institutional activity will cause optimal outside activity to decrease, as the deviator still bears the shared exposure generated by group activity.

Substitution gives the optimized outside activity payoff

$$D(x) = \frac{[\alpha - b(n-1)x]^2}{2Q} - \frac{b(n-1)^2}{2}x^2$$

4.4 The Easiest-to-Implement Activity

Define the easiest-to-implement activity

$$\chi \in \arg\min_{x \in X} T(x)$$

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Proposition 1. Under the quadratic benchmark and the policy domain $X = [0, x^D]$. $T(x)$ is strictly convex and has a unique minimizer χ that satisfies:

$$x^I < \chi < x^D$$

The implementation burden has closed-form representation

$$T(x) = T(\chi) + \frac{M}{2}(x - \chi)^2$$

where

$$M = c + b(2n - 1) + \frac{b^2(n-1)^2}{Q} > 0$$

The implementation burden minimizing activity is

$$\chi = \frac{\alpha\left[1 + \frac{b(n-1)}{Q}\right]}{M}$$

and the minimized burden is

$$T(\chi) = -\frac{\alpha^2\sigma}{2QM} < 0$$

The detailed proof can be found in Appendix A.

The easiest-to-implement activity lies strictly between the collective and decentralized benchmarks. At x^I, the compliant payoff is locally maximized, while a marginal increase in activity lowers the payoff of departure. At x^D, by contrast, activity becomes high enough that compliance and departure value are both declining, section 5.7 shows that the former declines faster when $x > \chi$.

The result also shows the significance of shared exposure and outside friction. If $b = 0$, the shared-exposure cost disappears, and the two benchmarks no longer generate the strict ordering. If $\sigma = 0$, outside friction disappears and the upper inequality collapses to $\chi = x^D$.

Exposure across institutional boundaries is specifically responsible for the gap $\chi > x^I$. If only the departing participant's exposure to insiders were removed, replacing $H(t + (n-1)x)$ by $H(t)$ while keeping the compliant payoff unchanged, departure value would no longer depend on x. Minimizing $D - w(x)$ would then select exactly x^I. In the baseline model, higher institutional activity instead lowers departure value, allowing the easiest-to-implement activity to exceed the collective benchmark.

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4.5 Implementation with Access, Fees, and Disclosure

Recalling from section 3, a compliant participant receives

$$w(x) + a - k - h(\iota)$$

while departure yields $D(x)$. Thus, implementation requires

$$w(x) + a - k - h(\iota) \geq D(x)$$

or, equivalently

$$a \geq k + h(\iota) + T(x)$$

The minimum physical access required by a policy pair[8] (x, ι) is thus

$$[k + h(\iota) + T(x)]_+, \qquad [z]_+ = \max\{z, 0\}$$

The quantity $T(x)$ isolates the individual optimization problem before institutional resources and costs are considered. Participation fees and disclosure costs shift the requirement of compliance up, while access benefits provide compensation to make compliance individually optimal. Sufficient access capacity therefore allows the intermediary to sustain policies with a higher implementation burden.

The participant-side analysis is complete. The following section studies how informational requirements from the authority can restrict the set of activities that sustain compliance.

5 Authorization and Dual Dependence

5.1 The Authority' s decision problem

The authority permits the intermediary when permission weakly dominates every alternative j. As shown in section 3, that will require

$$\iota \geq g$$

[8]The pair (x, ι) specifies common activity and supplied information. Access a is then chosen to satisfy the participant incentive constraint; the positive part is needed because access cannot be negative.

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where

$$g = \max\left\{0, \max_{j\in\mathcal{J}}\left[\iota_j + \frac{d_j}{\kappa}\right]\right\}$$

The authority does not directly consider compliance within the intermediary; it evaluates permission by its non-informational payoff and the informational value supplied by the intermediary. Thus, the intermediary must satisfy the authorization constraint, separate from the participant incentive constraint.

5.2 Information Capacity and Authorized Activities

The intermediary' s informational capacity under activity x is

$$0 \le \iota \le P(x)$$

Recall from section 3, authorization is attainable if and only if

$$g \le P(x^D)$$

for attainable g, the authorized activity set is

$$K(g) = \{x \in X : P(x) \ge g\}$$

with the lowest authorized activity being

$$q(g) = \begin{cases} 0, & 0 \le g \le P(0), \\ P^{-1}(g), & P(0) < g \le P(x^D). \end{cases}$$

The function $q(g)$ transforms information requirement into activity requirement. If $g \le P(\chi)$, then the easiest-to-implement activity still satisfies the authorization requirement; if $g > P(\chi)$, then the intermediary must increase activity to at least $q(g) > \chi$, since the easiest-to-implement activity is no longer authorized.

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5.3 Joint Policy Feasibility

A policy (x, ι, a) is defined as jointly feasible if it is technologically attainable, provides sufficient information, and can sustain participant compliance

$$x \in X, \qquad 0 \le \iota \le P(x), \qquad 0 \le a \le A,$$
$$\iota \ge g, \qquad a \ge k + h(\iota) + T(x).$$

Define, for attainable g, the minimum authorized implementation burden

$$v(g) = \min_{x \in K(g)} T(x)$$

and let $x^a(g) \in \arg\min_{x \in K(g)} T(x)$ denote the minimizing activity, and define the authorization premium as

$$\pi(g) = v(g) - T(\chi)$$

5.4 Authorization-Induced Activity Displacement

Proposition 2. Under the quadratic benchmark, for attainable g,

$$x^a(g) = \max\{\chi, q(g)\}$$

and

$$v(g) = T(\chi) + \frac{M}{2}[q(g) - \chi]_+^2$$

Therefore

$$\pi(g) = \frac{M}{2}[q(g) - \chi]_+^2$$

Particularly

$$\pi(g) > 0 \quad \Longleftrightarrow \quad g > P(\chi)$$

This follows from the completed-square representation of $T(x)$, it can be found in Appendix B.

The authorization premium only arises when the authority' s informational requirement exceeds the information that the intermediary can generate at the easiest-to-

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implement activity χ. Below that threshold, the intermediary can satisfy authority requirements without increasing activity.

5.5 Separate Feasibility and Joint Incompatibility

Without authorization, disclosure may be set to zero and activity level to χ. Define the raw participant requirement R_0 and its nonnegative physical access requirement A_0

$$R_0 = k + T(\chi), \qquad A_0 = [R_0]_+$$

For attainable g, define the corresponding raw requirement $R(g)$ and minimum physical access $A_{\min}(g)$

$$R(g) = k + h(g) + v(g), \qquad A_{\min}(g) = [R(g)]_+$$

When $g > P(x^D)$, let $A_{\min}(g) = +\infty$.

Theorem 1. Participant implementation is feasible in isolation, or without regard to authorization if and only if

$$A \geq A_0$$

Authorization, on the other hand, is feasible in isolation if and only if

$$g \leq P(x^D)$$

A jointly feasible policy exists if and only if

$$g \leq P(x^D) \quad \text{and} \quad A \geq A_{\min}(g)$$

Consequently, the two requirements will be separately achievable but jointly infeasible when

$$0 \leq g \leq P(x^D), \qquad A_0 \leq A < A_{\min}(g)$$

The proof is moved to Appendix B

When $A_0 \leq A < A_{\min}(g)$, while g is attainable, the institution can support both participant implementation and authorization separately, but no policy satisfies both requirements simultaneously. Noteworthy, joint incompatibility does not by itself

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mean that the institution will disappear, because partial participation, renegotiation, policy revision, and other factors are not considered in the current model.

5.6 Direct Disclosure and Activity Displacement

Authorization increases the raw implementation requirement by

$$h(g) + \pi(g) = R(g) - R_0$$

On the left-hand side, the first term is the direct disclosure increment, while the second term is the additional implementation burden.

When participant implementation is feasible in isolation, define the available incentive headroom

$$s = A - R_0 \geq 0$$

For attainable g, joint feasibility is equivalent to having

$$h(g) + \pi(g) \leq s$$

To isolate authorization effects, define

$$A_d(g) = [k + h(g) + T(\chi)]_+$$

which ignores the authorization premium.

Corollary 1 For attainable g, the authorization premium, induced by increases in activity, is decisive for incompatibility when

$$A_d(g) \leq A < A_{\min}(g)$$

or equivalently

$$h(g) \leq s < h(g) + \pi(g)$$

This interval is non-empty if and only if

$$g > P(\chi) \quad \text{and} \quad R(g) > 0$$

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Corollary 2 For attainable g, when the easiest-to-implement activity is not excluded

$$g \le P(\chi)$$

then

$$x^a(g) = \chi, \qquad \pi(g) = 0, \qquad A_{\min}(g) = [k + h(g) + T(\chi)]_+$$

Joint incompatibility emerges when

$$A_0 \le A < [k + h(g) + T(\chi)]_+,$$
$$\text{equivalently} \quad 0 \le s < h(g).$$

These separate two mechanisms. Direct disclosure makes compliance more expensive when activity level is fixed, while the authorization premium is induced by a change in activity level itself, which is only present when the authorization forces the intermediary to move above the easiest-to-implement policy χ. Both can result in joint incompatibility, yet through different channels.

Corollary 3. Information Requirements and Technology

In the baseline model, $\pi(g)$ and $A_{\min}(g)$ are nondecreasing in attainable g, with $\pi(g)$ strictly increasing once $g > P(\chi)$. If P is continuously differentiable with $P'(x) > 0$, then for $P(\chi) < g < P(x^D)$,

$$q'(g) = \frac{1}{P'(q(g))} > 0, \qquad \pi'(g) = \frac{M[q(g) - \chi]}{P'(q(g))} > 0.$$

Thus, once authorization displaces the easiest-to-implement activity, stricter information requirements increase the implementation premium. The physical access requirement need only increase weakly, since its positive part can remain zero.

Now hold participant payoffs, disclosure costs, and the authority requirement fixed. If a technology $\widetilde{P}$ satisfies the same assumptions as P and $\widetilde{P}(x) \ge P(x)$ for every $x \in X$, then for any g attainable under P,

$$\widetilde{K}(g) \supseteq K(g), \qquad \widetilde{v}(g) \le v(g),$$
$$\widetilde{\pi}(g) \le \pi(g), \qquad \widetilde{A}_{\min}(g) \le A_{\min}(g).$$

Tildes denote quantities evaluated under the improved technology. Better information capacity expands the authorized set and weakly reduces the access needed for joint feasibility. The proof is given in Appendix B.5.

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5.7 Participant Response to Authorization

At fixed access and disclosure, the participant' s compliance advantage is

$$w(x) + a - k - h(\iota) - D(x) = a - k - h(\iota) - T(x)$$

Its derivative with respect to activity is

$$-T'(x) = -M(x - \chi)$$

For $x > \chi$, the compliance advantage decreases. Since

$$D'(x) < 0$$

and

$$T'(x) = D'(x) - w'(x) > 0$$

when $x > \chi$, it implies

$$w'(x) < D'(x) < 0$$

Thus the compliant payoff falls faster than departure payoff once activity exceed χ.

This provides economic meaning to the authorization premium. The authority' s requirement for information may push the intermediary to increase activity beyond the activity level that minimizes the implementation burden. Thus participants may find compliance less attractive relative to departure, the intermediary must then compensate with additional access benefits or existing headroom.

5.8 Policy-Sensitive Authorization

The preceding model assumes that the authority values the information supplied by the intermediary without assigning a policy-dependent cost to the actual activity. This section relaxes this assumption and models how increasing activity can raise concerns[9] for the authority. The intermediary may thus face both upward and downward pressure on activity

[9]These concerns may reflect regulatory attention, public scrutiny, or other costs that the authority associates with permitted activity. They enter the authority's authorization decision; the shared exposure H in section 3.2 enters participant payoffs.

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Recall the policy domain

$$X = [0, x^D]$$

and the implementation burden

$$T(x) = T(\chi) + \frac{M}{2}(x - \chi)^2.$$

Let

$$L : X \to \mathbb{R}_+$$

be continuous and nondecreasing, where $L(x)$ measures the authority' s concern associated with permitting activity level x. Let $\rho \geq 0$ denote the weight placed on this concern relative to information.

Authorization is assumed to require

$$\iota \geq g + \rho L(x),$$

while technological capacity requires

$$0 \leq \iota \leq P(x).$$

Hence activity x can be authorized if and only if

$$P(x) - \rho L(x) \geq g.$$

Define

$$P_\rho(x) = P(x) - \rho L(x),$$

The expression $P_\rho(x)$ summarizes the two effects of activity on authorization: higher activity may expand information capacity through $P(x)$ while simultaneously making permission less desirable through $L(x)$. Authorization depends on the net contribution of these effects.

Thus the authorized policy set is

$$K_\rho(g) = \{x \in X : P_\rho(x) \geq g\}.$$

Therefore, activity now has two opposing effects on authorization, higher activity can increase the information that the intermediary is capable of producing but also simultaneously make permission less desirable to the authority.

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The projection characterization below requires $K_\rho(g)$ to be a nonempty interval. Continuity alone does not ensure this shape; concavity of P together with convexity of L is a sufficient condition.

Proposition 3. Policy-Sensitive Authorization

Suppose $K_\rho(g)$ is a nonempty interval, under the quadratics, the authorized activity with lowest implementation burden is

$$x^a_\rho(g) = \mathrm{proj}_{K_\rho(g)}(\chi),$$

and the associated authorization premium is

$$\pi_\rho(g) = T\big(x^a_\rho(g)\big) - T(\chi) = \frac{M}{2}\,\mathrm{dist}\big(\chi, K_\rho(g)\big)^2.$$

The proof and sufficient conditions for $K_\rho(g)$ to be an interval are provided in Appendix C.1.

The proposition generates three regimes. The case that is absent from the baseline model is when $\sup K_\rho(g) < \chi$, authorization will force activity downward. When this condition holds, the easiest to implement policy will involve too much rather than too little activity.

The baseline authorization result is thus nested as a special case. Setting $\rho = 0$ gives

$$K_0(g) = K(g) = [q(g), x^D], \qquad g \le P(x^D),$$

and thus

$$x^a_0(g) = \max\{\chi, q(g)\}, \qquad \pi_0(g) = \frac{M}{2}[q(g) - \chi]^2_+.$$

Once required disclosure varies with activity level, the easiest-to-implement activity need not minimize the total resources needed for joint feasibility. The relevant access benefit frontier is

$$A_{\min,\rho}(g) = \left[k + \min_{x \in K_\rho(g)} \big\{T(x) + h\big(g + \rho L(x)\big)\big\}\right]_+,$$

with $A_{\min,\rho}(g) = +\infty$ when $K_\rho(g)$ is empty. The derivation is available in Appendix C.2.

The broader implication is authorization, when activity is concerned, does not always impose an upward pressure. When the authority values both visibility and restraint, the intermediary can be pushed away from χ in either direction.

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5.9 Disintermediation and the Restraint-Capacity Threshold

The relevant outside option need not be zero activity. If permission is denied, participants may continue operating individually.

Substantive restraint thus needs to be evaluated against the activity that would occur under full disintermediation.

A distinction worth mentioning is that disintermediation is different from unilateral deviation. $D(x)$ remains unchanged and still represents value of departure for a participant. Full disintermediation is a separate scenario in which every participant operates outside the intermediary and bears an outside friction C.

Let x^O denote the symmetric equilibrium outside activity. Under the quadratic benchmark

$$x^O = \frac{\alpha}{c + bn + \sigma}.$$

The distinction is outside friction. This differs from the decentralized benchmark

$$x^D = \frac{\alpha}{c + bn},$$

because the latter does not include outside friction.

Proposition 4. The Outside Benchmark

For $\sigma > 0$,

$$x^O < \chi,$$

and

$$T(x^O) - T(\chi) = \frac{\sigma^2 (x^O)^2}{2M} > 0.$$

The proof is available in Appendix C.3.

Thus, the easiest to implement activity will result in more activity than would occur after full disintermediation. An intermediary is therefore not automatically a restraint mechanism merely because it coordinates activity and addresses the exposure externality. To produce restraint relative to disintermediation, the intermediary must implement

$$x < x^O.$$

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Suppose the authority compares disintermediation with permission according to

$$\iota - \gamma + \rho\big[L(x^O) - L(x)\big] \geq 0,$$

where L is now strictly increasing and γ is the fixed, finite informational and non-activity advantage of denial, measured in information units.

Intermediation may thus be valuable for two reasons: either it can provide information, or it can provide sufficient restraint to undesirable activity when $x < x^O$.

To isolate participant-side capacity to sustain genuine restraint, evaluate the least costly disclosure level $\iota = 0$, for which $h(0) = 0$, and define the participant-side restraint-capacity

$$A^R = k + T(x^O).$$

This is a participant-side threshold evaluated at zero disclosure; it is not the full joint-feasibility threshold. Actual feasibility also requires technological feasibility and authority acceptance.

Theorem 2. Restraint-Capacity Threshold

Assume $A \geq A_0$, retaining the assumptions on P and h from section 3. If

$$A < A^R,$$

participant-side resources are insufficient to support restraint relative to full disintermediation. Greater authority concern therefore cannot create joint feasibility once it fails.

If instead

$$A > A^R,$$

the intermediary can sustain some policy with

$$x_R < x^O, \qquad k + T(x_R) < A, \qquad \iota = 0.$$

It therefore has the participant-side capacity to implement genuine restraint relative to full disintermediation. Joint feasibility holds for sufficiently large ρ. At $A = A^R$, strict restraint is not supportable and eventual joint feasibility is not determined by these assumptions.

For fixed $A \geq A_0$, the values of $\rho \geq 0$ for which joint feasibility fails form an interval, possibly empty.

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This creates the possibility of non-monotonic joint feasibility. At low activity concern, permission may be supported by information capacity. At intermediate concern, however, information intense policies may generate too much activity while restraint intense policies may sacrifice too much information. At high concern, the value of restraint becomes high enough to make information generating activity less important.

Hence joint feasibility can follow the sequence of

$$\text{jointly feasible} \longrightarrow \text{jointly infeasible} \longrightarrow \text{jointly feasible.}$$

The capabilities of the intermediary and its participants are fixed throughout this comparison. What changes is the authority' s weight ρ: information-rich policies lose value as activity concern rises, while sufficiently restrictive policies eventually gain value because their restraint becomes more important.

The formal proof is available in Appendix C.4.

The main implication is that the intermediary' s role can change with the authority' s priorities. It may obtain permission because it informs when activity concern is low, but because it restrains when concern is high. Whether the intermediary can make this transition depends on its available participant-side resources.

6 Institutional Design Implications and Contemporary Illustration

Section 5 identifies the conditions in which authorization and implementation can be separately feasible but jointly incompatible. Recalling, joint feasibility requires

$$g \leq P(x^D) \quad \text{and} \quad A \geq A_{\min}(g)$$

Institutional design can therefore address this problem through two broad strategies: reducing the information requirement or participant burden and increasing the intermediary' s capacity to provide information or access.

6.1 Diagnose the causes of incompatibility.

Recall the raw access requirement with information g

$$R(g) = k + h(g) + v(g)$$

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where

$$v(g) = T(\chi) + \pi(g)$$

thus

$$R(g) = k + h(g) + T(\chi) + \pi(g)$$

The term $h(g)$ represents the direct cost of information disclosure. The term $\pi(g)$ represents the additional implementation burden, or the additional difference in value between deviation and compliance, occurring when the informational requirement forces a level of activity above χ.

The first step before any changes is imposed is to diagnose where the incompatibility emerges from. If incompatibility is caused mainly by $h(g)$, then the intermediary should lower the costs of disclosure or improve gathering efficiency. If it is mainly caused by $\pi(g)$, then the intermediary should aim to expand their information capacity, so that the same level of information can be met with a lower activity level.

This is significant as the same observable result, access shortfall, can emerge from various distinct reasons. A participant may demand compensation because information is too costly to disclose, because the authorized activity is too high, or because of both.

6.2 Improve Information Productivity

The intermediary can improve its ability to produce information, or its information capacity, by keeping better records, better monitoring systems, or more reliable reporting procedures. The target is

$$P(\chi) \geq g$$

When this condition holds, the intermediary will be able to satisfy the authority' s requirement with the easiest-to-implement activity, thus eliminating the additional implementation burden caused by raised activity. If instead $P(\chi) < g \leq P(x^D)$, authorization will create the premium

$$\pi(g) = \frac{M}{2}[q(g) - \chi]^2 > 0$$

Improving information productivity is thus valuable because it allows the intermediary to produce more reliable information without imposing a higher activity level

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upon the participants. The effect, however, does not reduce the current authorization premium when $P(\chi) \geq g$ already holds. It will provide some additional reliability to counter changing future requirements, but does not further reduce the current implementation burden.

Corollary 3 formalizes this comparison: holding participant primitives and disclosure costs fixed, a pointwise increase in information capacity weakly lowers both the authorization premium and the minimum access requirement.

Importantly, this does not address the direct disclosure costs, which as discussed in section 5, can also result in incompatibility.

6.3 Reduce Direct Disclosure Costs

The intermediary can reduce $h(g)$ by establishing confidentiality, aggregate reporting, delayed disclosure, or standardizing information collection procedures.

This aspect will be especially relevant when the authorized activity is already close, or equal, to the easiest-to-implement activity, but the demanded information is deemed too much by participants, making the main obstacle not high activity but rather high cost of disclosure.

However, some privacy reforms may cause a decline in informational capacity, which might in turn incur an authorization premium which will potentially offset the benefits of reducing information disclosure costs.

6.4 Reduce the Authority' s Information Requirement

The authority' s requirement is

$$g = \max\left\{0, \max_{j \in \mathcal{J}} \left[\iota_j + \frac{d_j}{\kappa}\right]\right\}$$

The intermediary or a policy maker can reduce g by changing the authority' s payoff comparison so that less information is required, such as making permission more attractive compared to other alternatives that the authority has. Improving the credibility of existing information can instead increase the informational effectiveness supplied at a given activity.

Reducing g can have two effects. If the requirement is above $P(\chi)$, a reduction in g can help reduce the authorization premium when the requirement is attainable. If the requirement is already equal or lower than $P(\chi)$, the reduction would not impact the premium, but it can still reduce $h(g)$ by requiring less information.

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6.5 Increase Participant Resources

The intermediary can also increase the access benefit, expand its maximum access capacity, reduce the participation fee, or provide other additional benefits to members. These measures, collectively, relax the participant incentive constraint

$$a \geq k + h(\iota) + T(x), \qquad 0 \leq a \leq A$$

Additional participant resources are effective when authorization is attainable but participants find it too costly to comply with. The intermediary can, thus, finance the resource gap with additional benefits. Sections 5.8–5.9 give participant resources an additional role. Greater access capacity may allow the intermediary to sustain more restrictive policies without inducing exit. When $A > A^R$, it has participant-side capacity to implement some activity below the full-disintermediation benchmark, although authority acceptance and disclosure feasibility must still be satisfied separately.

Admittedly, there are several clear limits to this approach. First, if $g > P(x^D)$, then the authority' s information requirement is by itself unattainable, providing more resources does not mitigate the gap. Second, this can only be done to a certain extent as it also incurs a cost on the institution, although it is not modeled in the main model.

6.6 Joint Reform Design

Following from the previous sections, with known member types and fixed fees, reforms can be a combination of participant support and purchased verification. Let L^O denote authority concern under full disintermediation. Authorization requires $r(x) = [\gamma + \rho\{L(x) - L^O\}]_+$; investment $z \geq 0$ gives capacity $P_z(x) = 1 - e^{-(p+z)x}$, with baseline productivity $p > 0$. For $x > 0$ and $r(x) < 1$, the least investment meeting $P_z(x) \geq r(x)$ is

$$z(x) = \left[\frac{-\log\{1 - r(x)\}}{x} - p\right]_+ .$$

Only activities with finite required investment are compared; $r(x) \geq 1$ is infeasible. Set $z(0) = 0$ if $r(0) = 0$, and $+\infty$ otherwise. Impose $L(x) \leq L^O$ when restraint is required.

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The remaining shortfall of Member i and support expenditures within the intermediary are

$$S_i(x) = k_i - A_i + h_i(r(x)) + T_i(x),$$
$$F_U(x) = n\lambda[\max_i S_i(x)]_+, \qquad F_T(x) = \lambda \sum_i [S_i(x)]_+.$$

Common support (U) pays everyone the largest positive shortfall; targeting (T) meets individual positive shortfalls. Benefits are externally funded at unit cost $\lambda > 0$, conditional on membership, without offsetting fees. At verification price $c_z > 0$, total expenditure is $J_j(x; c_z) = F_j(x) + c_z z(x)$.

Proposition 5. Payment Rules and Reform Responses

Let the shortfalls be convex on an interval containing feasible activities and differentiable at an interior feasible x_K, where two members share the positive maximum with slopes $s_- < 0 < s_+$. If $0 < z(x_K) < \infty$ and z is differentiable there, x_K uniquely minimizes common-support total expenditure for all sufficiently small positive prices. If $z'(x_K) \neq 0$, targeting strictly lowers optimized expenditure at all but possibly one of these prices.

Proof. Convex tangent bounds for the two binding members give

$$F_U(x) - F_U(x_K) \geq m|x - x_K|, \qquad m := n\lambda \min\{-s_-, s_+\} > 0.$$

Differentiability gives $\ell_z > |z'(x_K)|$ and $\epsilon > 0$ such that investment savings within distance ϵ are at most $\ell_z|x - x_K|$. Outside, savings cannot exceed $z(x_K)$, while extra support costs at least $m\epsilon$. Hence every alternative costs more if

$$0 < c_z < \min\left\{\frac{m}{\ell_z}, \frac{m\epsilon}{z(x_K)}\right\}.$$

Targeting is already strictly cheaper at x_K if any shortfall is below the maximum. Otherwise all tie positively, the two rules cost the same there, and

$$J_T'(x_K; c_z) = \lambda \sum_i S_i'(x_K) + c_z z'(x_K).$$

With $z'(x_K) \neq 0$, this activity derivative vanishes at at most one price. At every other price, a nearby activity strictly lowers targeted expenditure.

A smooth interior support minimum with $z' \neq 0$ has total slope $c_z z' \neq 0$; the common-payment corner therefore changes the reform response.

A conditional investment-jump. For either rule, write $F = F_j$. The following additional conditions apply only to this result. On a compact feasible interval $[x_{\mathrm{b}}, \bar{x}]$, costs are finite and continuous, z strictly increases, and F, z have twice continuously

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differentiable right-hand extensions at x_{b}, with $F'(x_{\mathrm{b}}) < 0 < z'(x_{\mathrm{b}})$. Each feasible package outside the interval has an inside alternative with weakly lower F and z, and at least one strict inequality.

Define support saving per unit of additional investment, extending the ratio at the baseline by its limit:

$$\mathcal{G}(x) = \frac{F(x_{\mathrm{b}}) - F(x)}{z(x) - z(x_{\mathrm{b}})}, \qquad \mathcal{G}(x_{\mathrm{b}}) = -\frac{F'(x_{\mathrm{b}})}{z'(x_{\mathrm{b}})}.$$

Its right-hand derivative is

$$\mathcal{G}'_{+}(x_{\mathrm{b}}) = \left.\frac{F'z'' - F''z'}{2(z')^2}\right|_{x=x_{\mathrm{b}}}.$$

If this is positive, the saving ratio initially improves. Its maximum $c_{\mathrm{ad}} := \max_{x \in [x_{\mathrm{b}}, \bar{x}]} \mathcal{G}(x)$ therefore has a smallest maximizer $x_{\mathrm{ad}} > x_{\mathrm{b}}$. Above this price the baseline is optimal; at it the baseline and x_{ad} tie; below it every optimum invests at least $z(x_{\mathrm{ad}})$. This is adoption from zero investment or upgrading from a positive baseline.

Proof. Continuity gives an attained maximum above the endpoint value, and

$$J(x; c_z) - J(x_{\mathrm{b}}; c_z) = [z(x) - z(x_{\mathrm{b}})][c_z - \mathcal{G}(x)].$$

At c_{ad}, every intermediate activity $x_{\mathrm{b}} < x < x_{\mathrm{ad}}$ costs more than both the baseline and x_{ad}. Raising the price favours the baseline, which uses less investment; lowering it favours x_{ad}, which uses more. Intermediate investment levels are therefore never optimal, even without setup costs.

For prices between the marginal saving ratio and the adoption threshold, a sufficiently small upgrade raises total expenditure, while a larger package reduces it. If F and z are both convex instead, tangent bounds give $\mathcal{G}(x) \le \mathcal{G}(x_{\mathrm{b}})$, the marginal ratio is the global price ceiling for an upgrade.

6.7 Contemporary Institutional Illustration: California's Irrigated Lands Program

California's Irrigated Lands Regulatory Program provides a contemporary setting for applying the model. Growers can obtain coverage through a third-party coalition or individually. Coalition coverage shares monitoring and reporting costs, while individual coverage generally requires more time and expenditure. In the Eastern San Joaquin River watershed, growers, the East San Joaquin Water Quality Coalition, and the Central Valley Water Board correspond to the model's participants,

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intermediary, and authority. The coalition must remain attractive to growers while meeting the Board's requirements (Central Valley Water Board, 2025).

To apply the model, let x represent nitrogen-generating agricultural activity, so lower activity means greater restraint. A grower's alternative is individual regulatory coverage. This alternative determines the departure burden $T_i(x)$. If all growers instead obtained individual coverage, the resulting environmental concern would determine the separate benchmark L^O. The model therefore distinguishes retaining one grower from assessing whether the coalition improves outcomes relative to full disintermediation.

For a proposed activity x, verification investment z, and additional member support $\beta_i \geq 0$, joint feasibility requires

$$r(x) \leq P_z(x), \qquad A_i + \beta_i \geq k_i + h_i(r(x)) + T_i(x) \quad \text{for every } i.$$

The first condition tests whether monitoring supplies enough information for authorization. The second tests whether existing benefits and proposed support cover each grower's participation shortfall. A feasible reform must also fit the available budget, with expenditure

$$\lambda \sum_i \beta_i + c_z z.$$

Applying these conditions requires evidence on coalition fees and benefits, reporting costs, individual coverage, monitoring effectiveness, and environmental outcomes under both arrangements.

The June 2026 amendments concerning the Modesto Management Zone combine reporting requirements, grower outreach, and staged nitrate-reduction milestones (Central Valley Water Board, 2026a). These measures illustrate the different reform channels: monitoring can improve information capacity, assistance can reduce participation burdens, and management requirements can change activity. The model directs attention to their interaction. Stronger reporting may help satisfy the Board while increasing growers' costs; additional support may retain growers without resolving an information gap. The practical task is to identify which constraint fails, compare reforms that address it, and check whether both conditions hold after activity adjusts. This is an analytical application, rather than an estimate of the program's effects.

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7 Conclusions

The paper studies an intermediary that depends simultaneously on participant compliance and external authorization. These requirements can each be feasible in isolation while no single institutional policy satisfies both.

The participant-side analysis identifies the easiest-to-implement activity χ, which lies between the collective and frictionless decentralized benchmarks in the quadratic model. Informational requirements can displace activity above χ and generate an authorization premium, while direct disclosure costs create a separate participant burden.

Allowing the authority to care directly about substantive activity broadens the baseline result: authorization may displace activity upward or downward. Denial of permission need not eliminate activity. Relative to full disintermediation, the easiest institutional policy may itself generate more activity, so genuine restraint requires sufficient participant-side resources as well as authority acceptance.

An intermediary may therefore be valuable to an authority for different reasons under different conditions: because it makes activity more informative, or because it can restrain activity relative to the outside alternative. Its ability to perform either role remains constrained by the willingness of participants to remain inside.

Joint reform design shows how payment rules can affect expenditure and the optimal response to verification prices. Under stated assumptions, common support allows the same activity level to stay optimal for a range of prices, while targeted support can produce strict savings after reoptimization. It also shows how optimal verification investment can jump as its price falls. These results concern an already existing intermediary; formation, partial exit, and bargaining are not within the range of analysis.

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A Participant Derivations and Proof of Proposition 1

A.1 Benchmark Derivations

Under section 4.1's assumptions, strict concavity gives the benchmarks in section 4.2:

$$\begin{aligned} w''(x) &= -(c + bn^2) < 0, \\ \frac{\partial^2 u_i}{\partial e_i^2} &= -(c + b) < 0, \\ w'(x^I) &= 0, \\ \alpha - (c + bn)x^D &= 0. \end{aligned}$$

For unilateral departure on $X = [0, x^D]$,

$$\begin{aligned} \Phi_{tt}(t, x) &= -Q < 0, \\ \Phi_t(0, x) &\geq \frac{\alpha(c + b)}{c + bn} > 0. \end{aligned}$$

Thus the optimizer in section 4.3 is interior throughout X.

A.2 Proof of Proposition 1

The envelope theorem and differentiation give

$$\begin{aligned} D'(x) &= -b(n - 1)[t(x) + (n - 1)x] < 0, \\ T''(x) &= c + b(2n - 1) + \frac{b^2(n - 1)^2}{Q} \\ &= M > 0. \end{aligned}$$

Since $w'(x^I) = 0$ and $t(x^D) = (c + b)x^D/Q < x^D$,

$$\begin{aligned} T'(x^I) &= D'(x^I) < 0, \\ T'(x^D) &= b(n - 1)[x^D - t(x^D)] > 0. \end{aligned}$$

Strict convexity gives the unique minimizer $\chi \in (x^I, x^D)$. Substitution into $D(x) - w(x)$ gives

$$T'(x) = Mx - \alpha \left(1 + \frac{b(n - 1)}{Q}\right).$$

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Solving $T'(\chi) = 0$ and completing the square yields the expressions in section 4.4:

$$T(x) = T(\chi) + \frac{M}{2}(x - \chi)^2,$$
$$T(\chi) = -\frac{\alpha^2 \sigma}{2QM} < 0.$$

B Proofs for Authorization Results

B.1 Proof of Proposition 2

For attainable g, minimizing the completed square on $K(g) = [q(g), x^D]$ gives

$$x^a(g) = \max\{\chi, q(g)\},$$
$$\pi(g) = \frac{M}{2}[q(g) - \chi]_+^2.$$

Strict monotonicity of P makes $q(g) > \chi$ equivalent to $g > P(\chi)$.

B.2 Proof of Theorem 1

Monotonicity of h and the minimum of T give

$$k + h(\iota) + T(x) \geq R_0,$$
$$k + h(\iota) + T(x) \geq R(g) \quad \text{under authorization.}$$

The bounds are attained at $(\chi, 0)$ and $(x^a(g), g)$, respectively. The latter exists exactly when $g \leq P(x^D)$. Since $A \geq 0$, taking positive parts gives Theorem 1.

B.3 Proof of Corollary 1

For attainable g, the positive-part definitions give

$$A_d(g) \leq A < A_{\min}(g)$$
$$\iff \quad h(g) \leq s < h(g) + \pi(g).$$

Since $A_d(g) \geq A_0$, implementation is separately feasible. The interval is nonempty exactly when $\pi(g) > 0$ and $R(g) > 0$.

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B.4 Proof of Corollary 2

For attainable $g \le P(\chi)$, Proposition 2 gives $\pi(g) = 0$. Theorem 1 then gives

$$\begin{aligned} & A_0 \le A < A_{\min}(g) \\ \iff \quad & 0 \le s < h(g). \end{aligned}$$

B.5 Proof of Corollary 3

As g rises within the attainable range, $q(g)$ is nondecreasing, so Proposition 2 makes $\pi(g)$ nondecreasing and strictly increasing above $P(\chi)$. Since h is also nondecreasing, the same weak monotonicity holds for $A_{\min}(g) = [k+h(g)+T(\chi)+\pi(g)]_+$. Under the stated differentiability assumptions, differentiating $P(q(g)) = g$ and the premium formula gives

$$\begin{aligned} P'(q(g))q'(g) &= 1, \\ \pi'(g) &= M[q(g) - \chi]q'(g), \end{aligned}$$

for $P(\chi) < g < P(x^D)$, proving the derivative claims. If $\widetilde{P} \ge P$, every originally authorized activity remains authorized. Minimizing the unchanged T over this larger set gives $\widetilde{v}(g) \le v(g)$; subtracting $T(\chi)$, or adding $k+h(g)$ and taking positive parts, gives the remaining inequalities.

C Proofs for Sections 5.8 and 5.9

C.1 Proof of Proposition 3

Continuity makes $K_\rho(g)$ compact. By section 4.4, minimizing T is equivalent to minimizing $(x-\chi)^2$, giving the projection and premium. Concave P and convex L are sufficient for the interval condition, since $P - \rho L$ is then concave.

C.2 The Access Frontier

At authorized x, monotonicity of h makes $\iota = g + \rho L(x)$ least costly. Minimizing the resulting raw requirement over $K_\rho(g)$ and taking its positive part gives the frontier. Continuity and compactness ensure attainment; an empty authorized set rules out feasibility.

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C.3 Proof of Proposition 4

Individual optimization and symmetry give the first identity below; substitution into T' gives the second:

$$\alpha - (c + bn + \sigma)x^O = 0,$$
$$M(x^O - \chi) = -\sigma x^O < 0.$$

The burden difference follows from the completed square in section 4.4.

C.4 Proof of Theorem 2

Let $\mathcal{F}_A$ contain the pairs satisfying $x \in X$, $0 \le \iota \le P(x)$, and $k + T(x) + h(\iota) \le A$. This is a fixed compact set, nonempty for $A \ge A_0$. Define

$$W_A(\rho) = \max_{(x,\iota)\in\mathcal{F}_A} \{\iota - \gamma + \rho[L(x^O) - L(x)]\}.$$

Joint feasibility is equivalent to $W_A(\rho) \ge 0$.

Since T decreases below χ, $x < x^O$ implies $k + T(x) > A^R$, ruling out restraint when $A \le A^R$. If $A < A^R$, compactness gives

$$\delta = \min_{(x,\iota)\in\mathcal{F}_A} [L(x) - L(x^O)] > 0,$$
$$W_A(\rho) \le 1 - \gamma - \rho\delta \longrightarrow -\infty.$$

If $A > A^R$, continuity gives $x_R < x^O$ with $k + T(x_R) < A$. The policy $(x_R, 0)$ is feasible since $h(0) = 0$, giving

$$W_A(\rho) \ge -\gamma + \rho[L(x^O) - L(x_R)] \longrightarrow +\infty.$$

At equality, $(x^O, 0)$ is supportable and has zero restraint benefit, so neither strict conclusion follows.

Finally, W_A is a maximum of affine functions with uniformly bounded slopes. It is continuous and convex, so $\{\rho \ge 0 : W_A(\rho) < 0\}$ is an interval, possibly empty.

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致谢

本研究以列宁格勒摇滚俱乐部的历史为切入点，关注中介机构如何同时维持参与者的服从意愿并取得外部权威的许可。历史中，合法活动机会、内部约束与外部监督并存的现象构成了论文选题的背景。围绕这一问题，本文建立经济学理论模型，分析参与者激励与权威授权之间的冲突，并讨论信息披露、资源及制度设计对中介机构运行条件的影响。

衷心感谢杨洋老师给予的指导。杨老师是本人的学校学术指导老师，双方为学校学术指导老师与学生的关系，指导全程无偿，不涉及任何指导费用或其他报酬。杨老师主要在论文修改环节提供指导，通过审阅稿件、提出修改建议，帮助我发现和完善论文中需要改进的内容。具体文字撰写与修改整理由本人承担。

本团队仅有本人一名参赛学生，各研究环节由本人负责推进。在选题阶段，我负责阅读历史材料、梳理相关现象并明确研究问题；在资料获取阶段，我负责搜集和整理列宁格勒摇滚俱乐部的研究文献，以及自我监管、监管中介和信息治理等领域的理论成果。本文属于理论研究，历史资料用于提出问题，当代制度案例用于说明机制，未开展问卷调查、实地实验或基于实际样本的统计估计。

在分析与推导阶段，我负责设定参与者收益、退出选择和外部权威的决策条件，推导服从约束、最低信息要求与联合可行条件，并分析权威对活动的关注及完全去中介化情形。论文的摘要、引言、文献综述、模型设定、理论分析、结论及附录均由本人撰写。

研究过程中，主要困难在于将现实转化为一般模型，并准确区分不同约束与比较基准。对此，我主要通过参考文献，广泛阅读的方式积累建模方法，并将与本问题相关的经济现象通过数学转化为模型。

除杨老师外，无其他人员参与论文撰写。研究过程中人工智能工具（OpenAI Chatgpt Sol 5.6）仅用于在初期和末期辅助查找文献、检查模型以及润色论文语言。模型本身及论文均由本人完成，人工智能的意见在被采纳前全部经过人工检查。

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