

Rule Versus Discretion:  
Regulatory Uncertainty, Firm Investment, and Bureaucratic  
Organization

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## Abstract

As markets evolve, new regulatory concerns emerge. In response, policymakers institute new requirements for private businesses. Because they impose costs and generate uncertainty, these requirements may deter firm investment. To reduce regulatory uncertainty and favor investment, a principal can choose a rule-based regulatory framework. However, unlike discretion, rules do not adapt to circumstances and are thus inefficient. Using a micro-founded model, we uncover circumstances under which the ex-ante certainty provided by a rule dominates the ex-post efficiency provided by delegation to an unbiased agent. We also establish when delegating to a biased agent is optimal for a policymaker. Our main results highlight that the anticipated economic responses of firms can indirectly influence the organization of the bureaucracy. As such, any attempt to evaluate firms' direct influence in the rule-making process—through lobbying or information disclosure—needs to establish the proper counter-factual that accounts for the indirect effects this paper identifies.

*Keywords: Regulation, Discretion, Delegation, Regulatory Uncertainty, Bureaucracy*

Supplementary material for this article is available in appendices A, B and C in the online edition.”

# 1 Introduction

As technology evolves, industries adapt and new markets emerge, generating previously unknown regulatory concerns. In response, policymakers create bureaus and agencies and impose new requirements on private businesses. This process of technological evolution and regulatory adaptation generates uncertainty for firms as changing regulations impose costs and affect the structure of the market.<sup>1</sup> As has been stressed in a large business and economic literature, regulatory uncertainty can discourage firm investment and, as a result, depress economic growth and social welfare (see Pindyck, 1991; Milliken, 1987; Hoffmann et al., 2009). Lloyd Blankfein, the CEO of Goldman Sachs, addressed this issue when discussing the domestic gas industry in an interview on CNBC on June 11, 2014:

We have to resolve some of the uncertainties ... Without stable regulation, without an agreement and a compromise, an accommodation between the forces that are focused on the environment and those that are focused on jobs and growth, we've managed to do a lot of production of energy. What we haven't done is gotten a lot of commitment to build the downstream plants that create the manufacturing and the jobs.

In this paper, we examine how the downstream economic consequences of regulatory uncertainty shape the organization of the bureaucracy (the regulatory framework and the preferences of agents in charge of it). To reduce regulatory uncertainty and encourage investment, a policymaker (henceforth, principal) can choose a rule-based regulatory framework which establishes clear and unchanging standards. But rules do not adapt to circumstances and unlike a discretion-based regulatory framework, lead to ex-post inefficient regulation. A principal who cares about the private (consumer surplus and profit) and social (externality) impact of firm investment faces a trade-off between ex-ante certainty and ex-post efficiency. Using a micro-founded model, we establish the circumstances under which a principal prefers an inefficient rule.

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<sup>1</sup>For example, looking at changes in Occupational Safety and Health Administration regulations, Crain and Crain (2010) estimate that the yearly cost of compliance increased by approximately US\$450m, or 4.5%, between 2001 and 2008.

In our baseline set-up, a firm must decide whether to pay a cost to enter and be a monopolist provider in a new market.<sup>2</sup> Production in this new market generates a per-unit externality—henceforth, “degree of externality” or state of the world— that is initially unknown to all actors, but is revealed after the firm’s investment. Regulation takes the form of requirements that mitigate the negative impact of the externality. Examples include treatment of waste water for the fracking industry, safety standards for automobiles, permissible emission levels of air pollutants for various industries, and accessibility requirements in the housing code. If regulation were costless for firms, the problem would be trivial: the principal would require full mitigation, and there would be no uncertainty. In many cases, however, regulatory requirements increase a firm’s production cost (additional investment on fracking sites or production plants, additional features on automobiles, etc.), and thus reduce production, firm profit, and consumer surplus. When choosing the level of regulation, the principal must then balance the benefit of mitigation against these distortionary costs.

For a low degree of externality, the loss associated with the externality is limited, whereas the distortionary effects of regulation are bounded away from zero. Consequently, the principal always prefers to impose no regulation. If possible, she would even choose a “negative” level of regulation. Equilibrium regulation thus differs from the (unconstrained) first best whenever there is a floor on the feasible level of regulation. Limits on regulation, which are critical for our analysis, are relatively common. They can arise due to technical constraints. For example, laws governing reporting can do no less than require no disclosure. Safety and environmental regulation cannot mandate that products become more dangerous or firms pollute more. Such regulations would constitute a requirement and increase firm costs. In a similar vein, the National Highway Traffic Safety Administration can initiate recalls of an unsafe car model, order modifications, and impose safety standards, but cannot reward companies that exceed its standards. Lower bounds on regulation may also result from the structure of the government. State regulators are constrained by federal regulation in the United States. Nation states are also constrained by treaties or supra-national entities like the European Union (EU). These upper levels of government often impose minimum stan-

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<sup>2</sup>Our key insights hold when there are multiple potential entrants.

dards of regulation (e.g., the Clean Air and Clean Water Acts in the United States and Health and Safety at Work Framework Directive in the EU) on lower levels.

When the degree of externality is relatively large, the lower bound on regulation no longer binds since the principal always chooses a strictly positive level of regulation, increasing in the degree of externality. However, depending on the strength of its distortionary effects, the level of regulation can be more or less responsive to the degree of externality. It is concave whenever the marginal cost of regulation increases at a high rate (due, for example, to an ever increasing marginal cost of production).<sup>3</sup>

While the previous analysis considers the optimal level of regulation as a function of the degree of externality, the state of the world is revealed only after the firm invests. Under a rule-based framework, the principal chooses a level of regulation as a function of her prior belief about the possible degrees of externality. Under what we refer to as “unbiased discretion,” the principal, via delegation to an agent who shares her preferences, tailors the level of regulation to the realized state of the world.<sup>4</sup> When all possible degrees of externality are relatively large, the principal always prefers a positive level of regulation, and the firm faces uncertainty about how much it will be regulated. When there is a positive probability that the principal chooses no regulation, the firm faces uncertainty about whether it will be regulated. These different types of uncertainty have implications for the principal’s choice between rule and discretion.

When uncertainty is about how much the firm will be regulated, unbiased discretion dominates a rule whenever the level of regulation is concave, and the resulting firm’s profit (conditional on investment) is convex in the degree of externality. The average level of regulation between realized states is then always strictly lower than the the level of regulation in the average state. Consequently, the firm’s expected regulatory burden is strictly lower,

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<sup>3</sup>When the marginal cost of production increases at an increasing rate with the level of regulation, production decreases at a constantly increasing rate. The marginal benefit of regulation then decreases at an increasing rate since the degree of externality left unmitigated becomes smaller and quantities produced decrease quickly. The marginal cost of regulation, in turn, increases at an increasing rate as profit and consumer surplus decrease at an increasing rate. The combination of these effects imply that the regulatory burden imposed on the firm is concave.

<sup>4</sup>We use the terms discretion and delegation interchangeably in our model as delegation grants the agent full autonomy to set policy. As such, our paper studies the traditional principal’s choice whether to retain or delegate decision power to an agent.

and the firm’s expected profit strictly higher under delegation to an unbiased agent than under a rule. When regulatory uncertainty is about how much a firm is regulated, unbiased discretion is not only ex-post efficient, but can also be more favorable to firm investment than a rule.

In contrast, when uncertainty is about whether the firm will be regulated, a rule can dominate delegation to an unbiased agent. Under unbiased discretion, the agent “over-regulates” when the degree of externality is low. Because the agent is optimally responding to circumstances, he cannot commit to compensate for the over-regulation in states with a low degree of externality by under-regulating in states with a high degree of externality. Under a rule, the principal can choose an average level of regulation which takes into account the cost of over-regulation for low degrees of uncertainty. Consequently, regulation under a rule can be strictly lower than the average regulation under unbiased discretion, leading to greater profit and higher likelihood of investment. When the cost of investment is likely to be high—meaning the probability of investment under unbiased discretion is low—the principal prefers a rule and its associated regulatory certainty over discretion and its associated ex-post efficiency.

A principal may refrain from delegating to an unbiased agent in order to gain ex-ante commitment power when uncertainty is about whether the firm will be regulated. In these circumstances, however, she generally prefers delegation to an agent sufficiently biased in favor of business (i.e., who weights the firm’s profit in his decision sufficiently more than the principal) to a rule-based regulatory framework. A pro-business agent chooses the same (null) level of regulation as the principal when the degree of externality is low. When the degree of externality is high, he under-regulates compared to the principal. However, the level of regulation is closer to the principal’s preferred level than under the rule while still generating investment by the firm with high probability. Consequently, delegating to a biased agent gives ex-ante commitment power to the principal while recovering some of the ex-post efficiency, and the principal is necessarily better off. Our model thus predicts that more preference divergence between the principal and an agent can lead to *more* discretion.

Delegation to a biased agent, however, supposes that the principal can commit not to replace the agent with someone whose preferences are closer to her own once the firm investment has been realized and the degree of externality has been revealed to all. As the expected cost of investment increases, to encourage firm investment, the principal must delegate to an increasingly biased agent. This agent chooses a level of regulation further away from the principal's ideal whenever the degree of externality is high. Absent a high cost of replacing the agent, the principal may not be able to credibly commit to retain the biased agent and may be unable to do better than a suboptimal rule. As such, our paper provides an additional justification for civil service protection distinct from the need to encourage the acquisition of expertise (as in, among others, Gailmard and Patty, 2007, 2012b).

Importantly, our key result that a rule can dominate unbiased discretion when there is uncertainty about whether the firm will be regulated still holds when the set of available policy instruments includes a subsidy. A subsidy encourages more production and, therefore, bears some similarity with a negative level of regulation. It is, however, not equivalent. The cost for the principal of negative regulation (if feasible) depends on the degree of externality and thus goes to zero as the degree of externality goes to zero. In turn, a subsidy must be financed through taxation, which generates costly distortions in other markets. The cost of a subsidy, therefore, does not vary with the degree of externality. As a result, the principal cannot reproduce the first-best unconstrained negative level of regulation with a subsidy. A rule can still lead to greater profit and greater likelihood of firm investment and thus be preferred to unbiased discretion.

This paper highlights a fundamental trade-off governing the choice between a rule and discretion, distinct from concerns related to political control (Epstein and O'Halloran, 1994) or information acquisition (Gailmard and Patty, 2012b). While discretion allows for the possibility of ex-post efficiency, it also introduces regulatory uncertainty. The resolution of this trade-off depends critically on the strategic behavior of regulated firms. Thus, quite apart from channels of direct influence (lobbying or information disclosure), firms can have significant indirect influence on the internal organization of the bureaucracy. Further, the

choices of a principal who anticipates the downstream economic consequences of regulatory uncertainty are not uniform; the optimal structure of the bureaucracy may, for example, vary with the nature of regulatory uncertainty. As such, any attempt to assess the direct influence of firms on the rule-making process needs to establish the proper counterfactual that accounts for the indirect effects identified in our paper.

## 1.1 Literature

A large literature studies internal bureaucratic problems inherent to delegation, namely the relationship between a principal and a bureaucratic agent (see Gailmard and Patty, 2012a, for a review). In the presence of costless information acquisition, the primary finding from this literature is the *ally principle*: Whenever possible, the principal chooses “an ideological clone of one’s self as one’s agent” (Gailmard and Patty, 2012b, page 5). She also grants more discretion when the agent’s preferences are closer to her own (Epstein and O’Halloran, 1994), when uncertainty is high (Bendor et al., 2001; Gailmard and Patty, 2012a; Moe, 2012), or when she wants to encourage the acquisition of expertise (Gailmard and Patty, 2007).

In contrast, our paper focuses on the impact of the regulatory framework on regulated actors, such as firms. Like Boehmke et al. (2006), Gailmard and Patty (2012b), and McCarty (2013), we show that due to a firm’s strategic behavior, a principal may choose to limit discretion to an unbiased agent or delegate to a pro-business one.<sup>5</sup> There are, however, two critical differences. In previous work, delegating to a biased agent is meant to prevent a firm’s opportunism in information transmission either through the retention of policy-relevant information (Boehmke et al., 2006; Gailmard and Patty, 2012b) or under-investment in expertise (McCarty, 2013).<sup>6</sup> We abstract away from informational concerns and instead

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<sup>5</sup>Several other studies have also shown that the ally principle fails to hold when the principal needs to provide incentives for the bureaucratic agent to collect information (Dewatripont and Tirole, 1999; Bendor and Meirowitz, 2004) or to credibly reveal his private information (Gailmard and Patty, 2013).

<sup>6</sup>A few other papers examine how information provision by regulated actors affects the internal organization of the bureaucracy. Laffont and Tirole (1993) show that to encourage information transmission, a principal may prefer to impose limits on possible regulation which is akin to restricting discretion. Gordon and Hafer (2007) analyze how politicians choose a regulatory framework to maximize firm’s contributions when only firms have information about the impact of regulation. Carpenter and Ting (2007) show that the regulatory stance and the behavior of firms are self-reinforcing: more skeptical regulators lead to more provision of information by regulated firms.



consider the role of regulatory uncertainty on firm investment. Second, we do so in a micro-founded model that considers the downstream economics consequences of regulation.

Closest to the present work is the central bank literature.<sup>7</sup> A well-known result in this literature is that politicians can be better off appointing conservative central bankers who care about inflation more than they do in order to gain commitment power. Furthermore, like in our paper, this literature shows that rules can lead to more socially beneficial outcome than delegation to a welfare-maximizing central banker (Athey et al., 2005). Our analysis, however, differs in three important aspects. First, in the central bank literature, a politician faces a commitment problem only because he is self-interested (e.g., seeking reelection), whereas here, the principal might prefer to appoint a biased agent even if she shares the exact same preference as an unmodeled median voter. Second, while the principal's commitment problem arises because of exogenous shocks in the central bank literature, it is endogenous to firms' strategic behavior in our paper. Finally, the present work highlights that the nature of the regulatory uncertainty can play a central role in the internal organization of the bureaucracy. This aspect of the problem cannot be foreseen from the central bank literature due to its focus on exogenous shocks.

## 2 Model Set-up

In this section, we present a micro-founded model which illustrates how the organization of the bureaucracy depends on the strategic interactions between the principal, her bureaucratic agent, and regulated firms.

A firm decides whether to enter a new market. Entry requires an irreversible, fixed cost of investment  $C \geq 0$ . The cost of investment is initially unknown to all and becomes observable only after the regulatory environment is in place. It is common knowledge that  $C$  is distributed over the interval  $[\underline{C}, \overline{C}]$ , with  $0 \leq \underline{C} \leq \overline{C}$ , according to some cumulative distribution function  $F(\cdot)$ .<sup>8</sup> If the firm does not enter, its profit is 0. The firm thus enters the

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<sup>7</sup>Our paper can also be related to the idea that patents are essential for firms' investment in research and development.

<sup>8</sup>The main thrust of our argument still holds if the cost of investment is deterministic, i.e.  $\underline{C} = \overline{C}$

market if and only if the expected profit conditional on entry exceeds the cost of investment  $C$ . If the firm enters, it becomes a monopoly provider facing linear consumer demand:<sup>9</sup>

$$D = (1 - \kappa p), \quad (1)$$

where  $p$  denotes the price charged by the firm and the parameter  $\kappa$  determines the slope of the demand curve. The firm's profit also depends on the level of regulation  $R \in [0, 1]$ , which affects the costs of production of  $Q$  units of the good:  $c(Q; R) = \frac{Q^2}{(1-R)}$ . The firm's profit function is:

$$\Pi(Q; R) = pQ - \frac{Q^2}{(1-R)} \quad (2)$$

Production in the new market generates a per unit degree of externality  $S$ , which (for ease of exposition) takes one of two values  $\{\underline{S}, \bar{S}\}$ .<sup>10</sup> The realized degree of externality is unknown before the firm investment but is revealed to all players after investment is realized. It is common knowledge that the level of externality is low ( $S = \underline{S}$ ) with probability  $q$ . We assume that regulation has a direct positive effect in the sense that requirements do (partially) reduce the harm associated with the externality. Put differently, rather than simply being a burden and increasing firm production cost, regulation is also assumed to improve the social value associated with production. Regulations that both mitigate harm and increase costs are common. Examples include safety features for products (air bags and crash standards for car, nonflammable children's clothing standards), fire and accessible codes for building, scrubbers that reduce air pollution from power production, and waste water treatment requirements for industry. Each of these regulatory requirements increase the cost of production, but also reduce the negative externalities associated with the product. Thus, when the level of regulation is  $R$ , the social cost of the externality is equal to  $(1 - R)SQ$ .<sup>11</sup>

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<sup>9</sup>We consider the case of multiple entrants in Section 6.

<sup>10</sup>Our main results extend to any number of degrees of externality and even to continuous distribution (see footnote 15 for more details).

<sup>11</sup>The assumption that the level of regulation proportionally decreases the negative effect of production is made both to increase the fidelity of the model to the actual real world regulatory instruments that we are attempting to capture and to make clear the direct and indirect effects of regulation. Absent an abatement

The principal cares about consumer surplus ( $CS(Q; R)$ ), the firm's profit, and the total level of the externality. We parameterize the principal's utility as a weighted sum:

$$W_P(R; S, \alpha_P) = \alpha_P CS(Q; R) + (1 - \alpha_P - \gamma)\Pi(Q; R) - \gamma(1 - R)SQ \quad (3)$$

The parameter  $\alpha_P$  corresponds to the principal's bias in favor of consumers relative to business. We fix  $\gamma \in (0, \frac{1}{2})$  to focus the analysis on the degree of bias towards consumers or business interests.

The principal chooses a regulatory framework that first consists of a decision to establish a rule or to grant discretion to an agent (delegation). A rule is a fixed level of regulation imposed prior to the firm's investment and the realization of the degree of externality. Under discretion, the agent chooses the level of regulation after the firm's investment and can condition it on the realized degree of externality. In addition, under discretion, the principal decides to whom she delegates. That is, the principal may choose an agent with a different bias in favor of consumers (i.e.,  $\alpha_A$  needs not be equal to  $\alpha_P$ ). The utility function of the agent with bias  $\alpha_A$  is:

$$W_A(R; S, \alpha_A) = \alpha_A CS(Q; R) + (1 - \alpha_A - \gamma)\Pi(Q; R) - \gamma(1 - R)SQ \quad (4)$$

We say that an agent is *unbiased* if he shares the same preference as the principal:  $\alpha_A = \alpha_P$ . We call an agent *pro-consumer* if the agent weighs consumer surplus more than the principal:  $\alpha_A > \alpha_P$ . In turn, we call an agent *pro-business* if the agent weighs the firm's profit more than the principal:  $\alpha_A < \alpha_P$ . To summarize, the timing is as follows:

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effect (and even when regulation only affects the production cost), the underlying logic of our main results would still hold, but the details of proposition would change. In particular, in Supplemental Appendix D, we consider the case where a tax serves as a regulatory instrument and show that our main results carry through in this setting.

1. Principal chooses between rule or granting discretion to an agent.

If the principal chooses rule:	If the principal grants discretion:
<ol style="list-style-type: none"> <li>2. Principal chooses the level of regulation <math>R^r \in [0, 1]</math>, observed by all.</li> <li>3. The investment cost <math>C</math> is realized, and the firm decides whether to enter the new market.</li> <li>4. If the firm enters the market, the externality is realized .</li> <li>5. Payoffs are realized.</li> </ol>	<ol style="list-style-type: none"> <li>2. Principal chooses an agent with bias <math>\alpha_A</math>, observed by all.</li> <li>3. The investment cost <math>C</math> is realized, and the firm decides whether to enter the new market.</li> <li>4. If the firm enters the market, the degree of externality <math>S \in \{\underline{S}, \bar{S}\}</math> is realized, and the agent sets the level of regulation <math>R^d(S)</math>.</li> <li>5. Payoffs are realized.</li> </ol>

The equilibrium concept is Subgame Perfect Nash Equilibrium, which requires that at each stage, a player (firm, agent, or principal) maximizes her utility anticipating other players' strategies at later node(s) of the game.

For simplicity and clarity of exposition, we make the following assumption related to the firm's investment cost and the principal's preferred rule. Let the unconstrained rule be the level of regulation that the principal would impose ex-ante assuming (possibly naively) that the firm always invests. We assume that under this unconstrained rule, the firm does in fact always invest (i.e.  $\bar{C}$  is sufficiently low). We, henceforth, refer to the principal's unconstrained rule as the welfare-maximizing rule.<sup>12</sup>

<sup>12</sup>Notice that under the welfare-maximizing rule, the principal is always weakly better off when the firm invests. In section 6, we consider the case where the principal may prefer to forestall investment.

### 3 Rules Versus Unbiased Discretion

In this section, we restrict attention to a principal deciding between a rule-based regulatory framework and delegation to an unbiased agent or, equivalently, unbiased discretion. Even though the principal and agent have the exact same preference, we show that the principal may prefer to establish a rule rather than to delegate since a rule acts as a commitment device that resolves the regulatory uncertainty faced by the firm and encourages investment.

We first characterize the level of regulation as a function of the degree of externality conditional on the firm entering the market. If regulation was costless for the firm, full regulation would always be optimal. A greater level of regulation, however, increases the cost of production, reducing the quantity produced, the firm's profit, and consumer surplus, as illustrated in Figure 1.

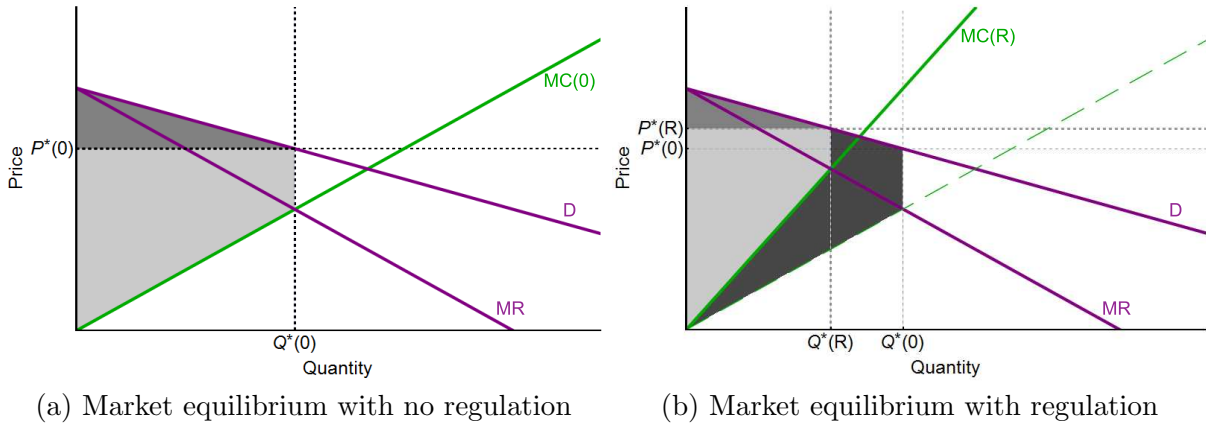


Figure 1: Market equilibrium with different levels of regulation

The green area below  $P^*(.)$  corresponds to the firm's profit, the purple area above  $P^*(.)$  to the Consumer Surplus, and the dark red area to the loss associated with a positive level of regulation ( $R = 0.5$ ). Parameter value:  $\kappa = 1$ .

Under our assumptions, more regulation increases the firm's (marginal) cost at a constantly increasing rate. Consequently, the level of production and the firm's profit decrease at a constantly increasing rate as the level of regulation increases. This implies that as the level of regulation increases, the marginal cost of regulation increases at a constantly increasing rate.

Regulation, on the other hand, is beneficial since it reduces the costs imposed by the externality. When the level of regulation is low, a small proportion of the cost of externality is mitigated, and production is high. Consequently, there is a large benefit to increasing the level of regulation. In turn, when the level of regulation is high, a high proportion of the cost of the externality is already mitigated and production is low. Consequently, there is a small benefit to increasing the level of regulation.<sup>13</sup> As such, holding fixed the degree of externality, as the level of regulation increases, the marginal benefit of regulation decreases. The combination of decreasing marginal benefit and increasing marginal cost implies that for any degree of externality, there exists a unique optimal level of regulation.

For a low degree of externality, the marginal benefit of regulation is extremely low, whereas the marginal cost is always bounded away from zero since regulation reduces production, the firm's profit, and consumer surplus. Consequently, there exists a strictly positive threshold  $\widehat{S}(\alpha_P)$  such that whenever the degree of externality  $S$  is lower than this threshold, the optimal level of regulation is 0. When the degree of externality is above this threshold ( $S > \widehat{S}(\alpha_P)$ ), a strictly positive and strictly increasing level of regulation is optimal.

The optimal level of regulation displays another interesting property with respect to the degree of externality. Since regulation conveys decreasing marginal benefit and increasing marginal cost,<sup>14</sup> the optimal regulatory response associated with an increase in the degree of externality is decreasing with the degree of externality. That is, whenever  $S > \widehat{S}(\alpha_P)$ , the optimal level of regulation is concave in the degree of externality as illustrated in Figure 2. Lemma 1 summarizes the properties of the optimal level of regulation.

**Lemma 1.** *There exists a unique level of regulation ( $R^*(S; \alpha_P)$ ) for all degrees of externality. The relationship between regulation and the degree of externality exhibits the following properties:*

(i) *There exists a unique and strictly positive degree of externality,  $\widehat{S}(\alpha_P) > 0$  such that the*

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<sup>13</sup>Even though an increase in regulation has a greater negative effect on production for high compared to low levels of regulation, the gain from a significant reduction in production is limited since a large portion of the degree of externality is already mitigated.

<sup>14</sup>In addition, the marginal cost of regulation is convex in the level of regulation (since the production cost increases and production decreases at a constantly increasing rate) and the marginal benefit of regulation is concave (since there is less externality left unmitigated and production decreases as  $R$  increases).

level of regulation is zero for all degrees of externality below  $\widehat{S}(\alpha_P)$ .

(ii) For all degrees of externality above  $\widehat{S}(\alpha_P)$ , the level of regulation is strictly positive, increasing and concave in  $S$ .

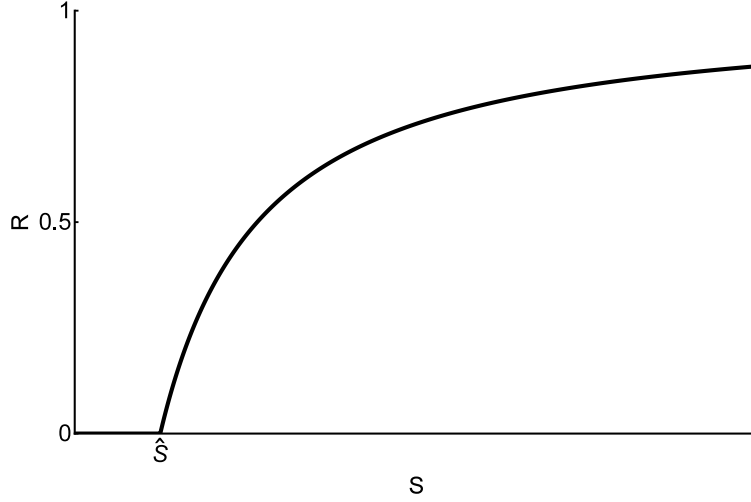


Figure 2: Level of regulation as a function of the degree of externality

Parameter values:  $\kappa = 1$ ,  $\alpha_P = 0.3$ ,  $\gamma = 0.4$

Since regulation increases the firm's production cost, the firm's profit is inversely correlated with the level of regulation. Consequently, for low degrees of externality ( $S \leq \widehat{S}$ ), the firm's profit is constant since there is no regulation. For high degrees of externality, the firm's profit is decreasing in the degree of externality. Since the level of regulation increases at a decreasing rate with the degree of externality, the cost imposed on the firm increases at a decreasing rate with  $S$ . As a result, whenever the level of regulation is strictly positive (equivalently,  $S > \widehat{S}(\alpha_P)$ ), the firm's profit is convex in the degree of externality as illustrated in Figure 3. This convexity arises as a consequence of the regulatory response, and not from a risk-seeking behavior by the firm.

**Lemma 2.** *Conditional on entry, the firm's profit exhibits the following properties:*

- (i) *For all degrees of externality below  $\widehat{S}(\alpha_P)$ , the firm's profit is constant.*
- (ii) *For all degrees of externality above  $\widehat{S}(\alpha_P)$ , the firm's profit is strictly decreasing and convex in  $S$ .*

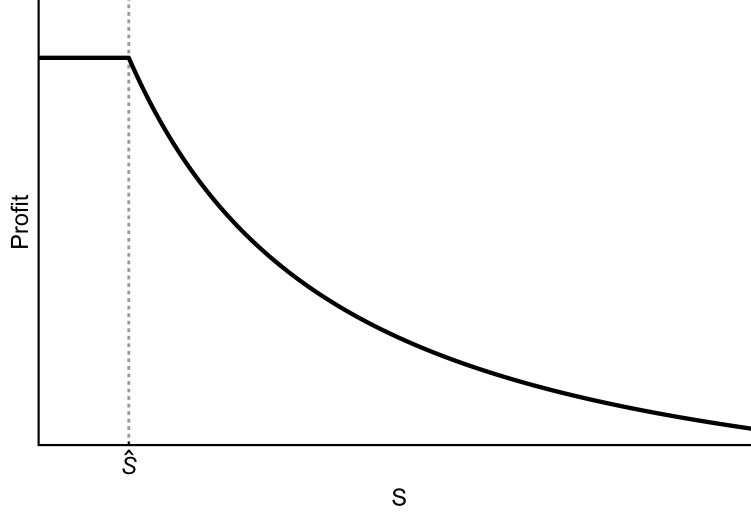


Figure 3: Firm profit as a function of the degree of externality

Parameter values:  $\kappa = 1$ ,  $\alpha_P = 0.3$ ,  $\gamma = 0.4$

The previous analysis characterizes the optimal level of regulation for different degrees of externality. However, the actual regulation faced by the firm depends on the regulatory framework. Under a rule-based regulatory framework, the level of regulation depends on the expectation of the degrees of externality. Under unbiased discretion, *if* the firm invests, the level of regulation depends on the realized degree of externality ( $\underline{S}$  or  $\bar{S}$ ). Thus, a rule is associated with regulatory certainty for the firm, while delegation is associated with ex-post efficiency for the principal.

The firm, however, does not always value more regulatory certainty. As Figure 4 illustrates, when the level of regulation is always positive ( $\underline{S} \geq \hat{S}(\alpha_P)$ )—meaning the regulatory uncertainty is about how much the firm will be regulated—the firm’s profit under unbiased discretion, denoted  $\Pi(Disc; \alpha_P)$ , is higher than its profit under the welfare-maximizing rule, denoted  $\Pi(Rule)$ . Under unbiased discretion, the firm faces a lottery over two outcomes: the levels of regulation and associated profits when the degree of externality is low ( $\underline{S}$ ) and high ( $\bar{S}$ ). Since the firm’s profit is convex in this range, the firm strictly prefers this lottery over the certain level of regulation based on the expected level of externality imposed by the rule.<sup>15</sup>

<sup>15</sup>Observe that the logic described above applies to any finite number of states as well as a continuous state variable.



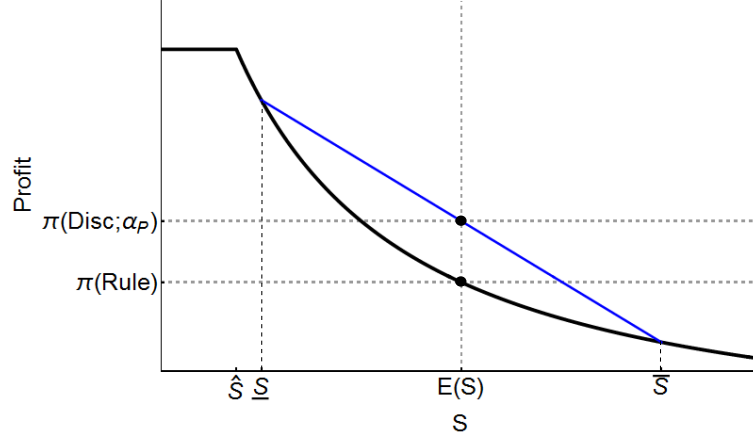


Figure 4: Profit under different regulatory frameworks for high degrees of externality

Parameter values:  $\kappa = 1$ ,  $\alpha_P = 0.3$ ,  $\gamma = 0.4$ ,  $\underline{S} = 0.25$ ,  $\bar{S} = 1.25$ ,  $q = 0.5$

In turn, when the optimal level of regulation in the low state entails no regulation ( $\underline{S} < \hat{S}(\alpha_P)$ )—meaning the regulatory uncertainty is about whether the firm will be regulated—the firm’s profit can be strictly higher under the welfare-maximizing rule. When the realized degree of externality is low, an unbiased agent would like to choose a negative level of regulation. Since this is unfeasible, there is “over-regulation” in state  $S = \underline{S}$ . Under unbiased discretion, the agent optimally responds to the revealed degree of externality in state  $S = \bar{S}$  by choosing a high level of regulation and so cannot compensate for over-regulation in state  $S = \underline{S}$ . In contrast, under the rule, the principal balances over-regulation in the low state ( $S = \underline{S}$ ) and under-regulation in the high state ( $S = \bar{S}$ ). Due to the heightened cost of over-regulation in the low state, the principal imposes a relatively lenient rule. Consequently, the expected level of regulation can be strictly lower and the firm’s expected profit strictly higher under the welfare-maximizing rule than under unbiased discretion. Such a case is illustrated in Figure 5.<sup>16</sup>

<sup>16</sup>Notice that even if  $\underline{S} < \hat{S}$ , unbiased discretion leads to greater expected profit if the degree of externality in the high state ( $S = \bar{S}$ ) is sufficiently large and the high state is sufficiently likely to occur ( $q$  is sufficiently low). See Lemma A.4 in Appendix A for details. The analysis of this case parallels the analysis of the case when the level of regulation is strictly positive in both states and is excluded from the text for brevity.

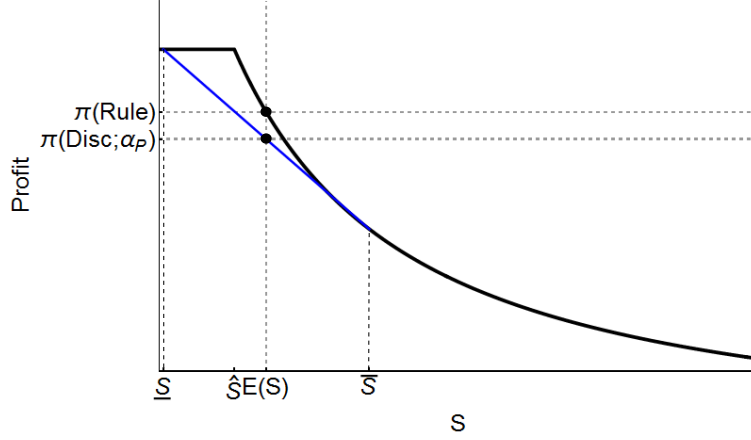


Figure 5: Profit under different regulatory frameworks for low degrees of externality

Parameter values:  $\kappa = 1$ ,  $\alpha_P = 0.3$ ,  $\gamma = 0.4$ ,  $\underline{S} = 0.01$ ,  $\bar{S} = 0.525$ ,  $q = 0.5$

Having examined the relationship between the regulatory framework and the firm's profit, we now return to the principal's decision to enact a rule or to delegate to an unbiased agent.

With delegation to an unbiased agent, the principal can achieve ex-post efficiency. When regulatory uncertainty is about how much the firm will be regulated, discretion also leads to higher expected profit than the welfare-maximizing rule, and the firm invests with probability 1 under both regulatory frameworks. Thus, the principal strictly prefers unbiased discretion since it is ex-post efficient and encourages investment. In other words, the ally principle holds in full when regulatory uncertainty centers around how much the firm will be regulated.

**Proposition 1.** *Suppose the firm always faces a strictly positive level of regulation ( $\underline{S} \geq \hat{S}(\alpha_P)$ ). Then the principal prefers unbiased discretion to the welfare-maximizing rule.*

The conclusion is different when regulatory uncertainty instead is about whether the firm will be regulated. In this environment, discretion leads to lower expected profit than the welfare-maximizing rule. The principal then trades off ex-post efficiency for a lower ex-ante probability of investment. When the cost of investment is very likely to be high, so that there is a low probability that the firm invests under unbiased discretion, the principal prefers the welfare-maximizing rule even at the expense of ex-post efficient regulation because the rule gives the principal ex-ante commitment power. In these circumstances, the principal prefers

to reduce the discretion granted to an agent with similar preferences as her own: The ally principle fails to hold.

**Proposition 2.** *The principal prefers the welfare-maximizing rule to unbiased discretion whenever the following conditions are satisfied:*

- (i) *The probability of investment under unbiased discretion is sufficiently low,*
- (ii) *The lower degree of externality ( $\underline{S}$ ) is strictly less than  $\widehat{S}(\alpha_P)$ , and*
- (iii) *The upper degree of externality ( $\bar{S}$ ) is strictly below some  $\check{S}(\underline{S}; \alpha_P) > \widehat{S}(\alpha_P)$*

The case of the fracking industry in the United States illustrates how investment can vary with the regulatory framework. As in our setup, this industry requires large irreversible investment and is marked by a high degree of uncertainty about the environmental impact of fracking (e.g., effect on aquifers and seismic activity). In response, states have chosen different regulatory options. Some states, such as Texas and North Dakota, have passed legislation guaranteeing no additional regulation above and beyond federal requirements—a regulatory framework which arguably resembles a rule. In contrast, other states, such as Ohio and Pennsylvania, have adopted a wait-and-see approach, monitoring water and air quality before making regulatory decisions—a regulatory framework which arguably resembles discretion. While the first set of states has seen a boom in fracking, the second has only experienced moderate growth. Our theoretical results suggest that the regulatory framework is probably one of the many factors explaining this difference.

This section establishes that the principal prefers unbiased discretion to the welfare-maximizing rule when uncertainty is about how much the firm will be regulated, whereas the reverse may hold true when uncertainty is about whether the firm will be regulated. This clear distinction arises whenever the level of regulation is concave, and the firm's profit is convex in  $S$  for  $S > \widehat{S}(\alpha_P)$ , which is guaranteed by our functional form assumptions. When, in some range, the level of regulation is convex and the firm's profit concave in  $S$ , profit is higher under the welfare-maximizing rule than under unbiased discretion.<sup>17</sup> Even though the uncertainty is about how much regulation, the principal chooses a rule-based regulatory

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<sup>17</sup>We establish sufficient conditions for a convex level of regulation and concave profit in Appendix C.

framework over unbiased discretion whenever the cost of investment is likely to be high. In contrast, the principal's preference for the welfare-maximizing rule under the conditions of Proposition 2 results from the existence of a binding floor on the level of regulation—due to technical constraints or the structure of government—and holds as long as regulation increases the marginal cost of production.<sup>18</sup> When our functional form assumptions are relaxed, the welfare-maximizing rule may therefore dominate unbiased discretion when regulatory uncertainty is about whether *and* how much the firm will be regulated.

## 4 Optimal Biased Delegation

In the previous section, we assumed that the principal can only delegate to an unbiased agent, that is an agent who shares her preferences. Now, we enrich the set of possible delegates and show that given freedom to choose agents of any bias, a principal generally does better under discretion than under a rule.

This result holds trivially when the regulatory uncertainty is about how much the firm will be regulated since the principal always prefers delegation to an unbiased agent. This type of delegation has no effect on the probability of investment by the firm and leads to ex-post efficient regulation for the principal.<sup>19</sup>

When regulatory uncertainty is about whether the firm will be regulated, the welfare-maximizing rule can do better than delegation to an unbiased agent as it guarantees a higher profit to the firm. The firm's profit is also relatively high when the principal delegates to a pro-business agent who weighs the firm's profit more and thus regulates less than an unbiased agent (see Figure 6 for an illustration).

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<sup>18</sup>A general condition for the existence of  $\hat{S}$  is  $\left. \frac{dW_P(R;S,\alpha_P)}{dR} \right|_{R=0,S=0} < 0$ . Some algebra yields:  $\left. \frac{dW_P(R;S,\alpha_P)}{dR} \right|_{R=0,S=0} = \alpha_P \left. \frac{\partial Q}{\partial R} \right|_{R=0} \frac{\partial CS(Q;0)}{\partial Q} + (1 - \alpha_P - \gamma) \left. \frac{\partial \Pi(Q;R)}{\partial R} \right|_{R=0}$  (since  $\partial \Pi(Q;R)/\partial Q = 0$ ). Since  $\frac{dCS(Q;0)}{dQ} > 0$ ,  $\left. \frac{dW_P(R;S,\alpha_P)}{dR} \right|_{R=0,S=0} < 0$  holds as long as regulation increases the marginal cost of production so  $\frac{\partial Q}{\partial R} < 0$  and  $\frac{\partial \Pi(Q;R)}{\partial R} < 0$ .

<sup>19</sup>This result also holds for the case described in footnote 16.

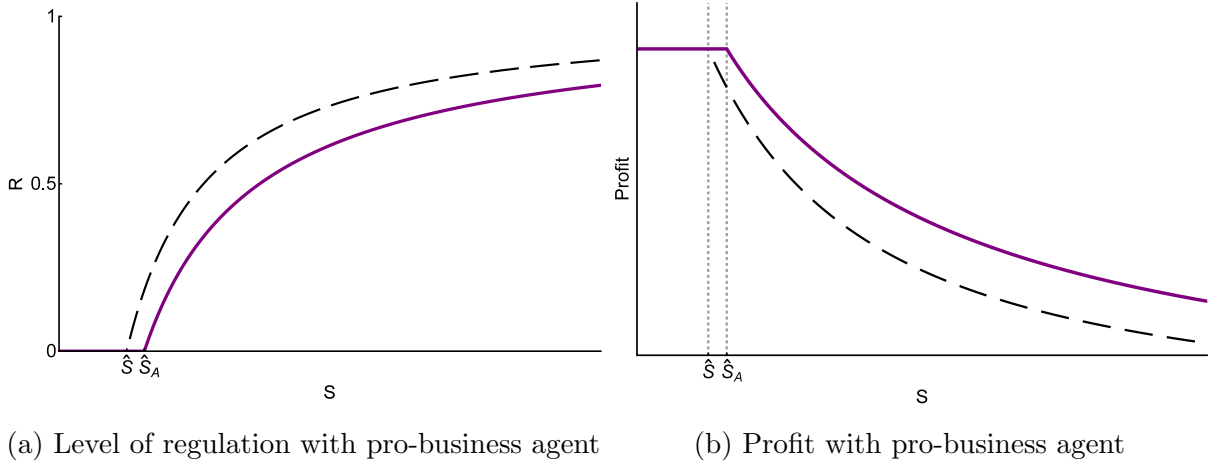


Figure 6: Market equilibrium with different levels of regulation

Dashed black line corresponds to the level of regulation and profit with an unbiased agent, and the solid purple line with a pro-business agent. Parameter values:  $\kappa = 1$ ,  $\alpha_P = 0.3$ ,  $\alpha_A \approx 0.067$ ,  $\gamma = 0.4$

Suppose that by delegating to an appropriately pro-business agent (which we refer to as biased discretion) the principal can guarantee a profit as high as under the welfare-maximizing rule.<sup>20</sup> The firm then invests with probability 1. Furthermore, whenever the rule leads to strictly positive level of regulation, the principal is strictly better off with biased delegation. In the low state ( $S = \underline{S}$ ), she achieves her first best level of regulation and in the high state ( $S = \bar{S}$ ), the level of regulation, while lower than her first best, is strictly higher than the welfare-maximizing rule.<sup>21</sup> Figure 7 illustrates this result, Proposition 3 formally states it.

**Proposition 3.** *The principal prefers biased discretion to the welfare-maximizing rule and to unbiased discretion if conditions (i)-(ii) described in Proposition 2 hold and in addition:*

- (iii') *The upper degree of externality ( $\bar{S}$ ) is less than  $\hat{S}(0)$ , and*
- (iv) *the agent is moderately pro-business.*

<sup>20</sup>This is feasible unless  $\bar{S}$  is very large. In this case, the level of regulation in  $\bar{S}$  is almost the same for an unbiased and a pro-business agent and so is the firm's expected profit. Biased delegation then does not necessarily improve upon a rule for the principal (see point (iii') of Proposition 3).

<sup>21</sup>Notice that choosing a pro-business agent who replicates the firm's expected profit under the welfare-maximizing rule always leads to better results than the rule, but might not be the optimal strategy for the principal.

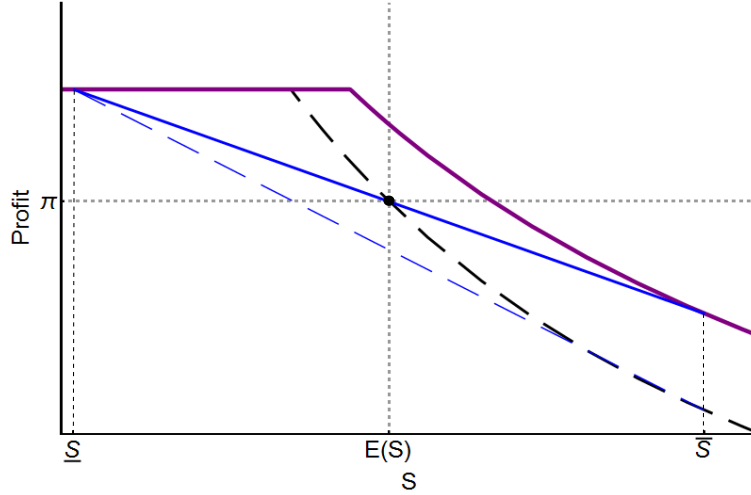


Figure 7: Delegation to a pro-business agent

Dashed lines correspond to the profit with an unbiased agent, and the solid purple line to the profit with a biased agent. Parameter values:  $\kappa = 1$ ,  $\alpha_P = 0.3$ ,  $\alpha_A \approx 0.067$ ,  $\gamma = 0.4$ ,  $\underline{S} = 0.01$ ,  $\bar{S} = 0.525$ ,  $q = 0.5$

Under the conditions of Proposition 3, the principal prefers to delegate to a pro-business rather than an unbiased agent. By doing so, she gains some of the ex-ante commitment power of the rule (which increases the probability that the firm invests compared to unbiased discretion) and recovers some of the ex-post efficiency of delegation to an unbiased agent (given investment).<sup>22</sup> As such, it is difficult to recover a principal's policy preference from his choice of agent: Even a pro-consumer principal (large  $\alpha_P$ ) may appear pro-business (by delegating to an agent with low  $\alpha_A$ ).

Biased discretion may, however, be dominated by a rule when available agents are either too dissimilar or too similar to the principal as illustrated in Figure 8.<sup>23</sup> In the first case, the gain from an increased probability of investment does not compensate for the loss from under-regulation when the degree of externality is high ( $S = \bar{S}$ ). This result corresponds to the well-known cost associated with drift in delegation models (as a result, it extends naturally to the case when uncertainty is about how much the firm will be regulated). In the second case, delegation does not buy enough ex-ante commitment power to induce a sufficiently

<sup>22</sup>Notice that optimal biased delegation reproduces the optimal incentive compatible contract the principal could offer to an unbiased agent.

<sup>23</sup>In Supplemental Appendix A, we provide simple conditions such that the principal does not delegate to agents too biased in favor of business or too close to herself (see Corollaries A.1 and A.2).

large increase in the probability of investment. The principal prefers biased discretion to the welfare-maximizing rule only when the set of available agents is sufficiently rich.

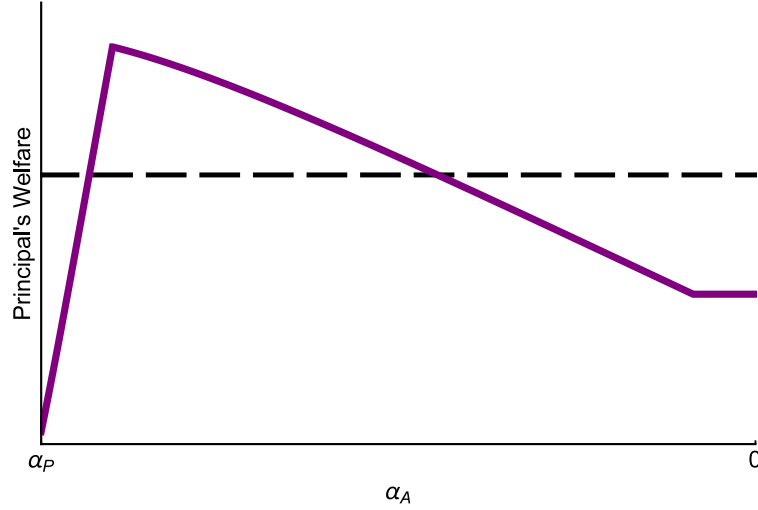


Figure 8: Principal's welfare as a function of agent's bias

Dashed black line is the principal's welfare under the welfare-maximizing rule, and the solid purple line under delegation to an agent with bias  $\alpha$ . Parameter values:  $\kappa = 1$ ,  $\alpha_P = 0.55$ ,  $\gamma = 0.4$ ,  $\underline{S} = 0.01$ ,  $\bar{S} = 0.24$ ,  $q = 0.2$ ,  $F(C) = (C - \underline{C})^2 / (\bar{C} - \underline{C})^2$ ,  $\underline{C} = 0.08$ ,  $\bar{C} = \pi(Rule) \approx 0.098$

This section establishes conditions under which the principal prefers to delegate to a biased agent even if a clone of herself is available and agents have no special expertise or advantage over the principal. This reversal of the ally principle is a consequence of the firm's strategic responses to regulation. Absent concerns about the economic consequences of regulatory uncertainty, the principal would always prefer delegation to an unbiased agent.

## 5 Credible Commitment to a Biased Agent

The previous section implicitly assumes that the principal can commit to never replace the agent. However, this commitment may not be tenable since in many countries, including the United States, the executive has the authority to replace agency heads (e.g., Lewis, 2008, but see Gailmard and Patty, 2012b, pages 236-7, for a discussion on the limits to such authority).

After delegating to an optimally pro-business agent, the principal never faces a commitment problem when the realized degree of externality is low ( $S = \underline{S}$ ), as both prefer no

regulation. In the high state ( $S = \bar{S}$ ), in contrast, the biased agent under-regulates from the principal's perspective. Since investment has already been undertaken when the externality is revealed to all players, the principal has an incentive to replace the sitting bureaucrat with an agent with preferences closer to her own unless the cost of doing so is sufficiently high as illustrated in Figure 9.<sup>24</sup> When the likelihood that the cost of investment is high, the principal must delegate to a pro-business agent with preferences further away from her own to induce investment with high probability. This increases the temptation to replace the agent and so credible commitment requires that the minimum replacement cost increase with the likelihood that the cost of investment is high. Whenever the replacement cost is below this threshold, the firm does not find the principal's commitment to a pro-business agent credible and invests as if it were facing an unbiased agent. Absent a sufficiently high cost of replacing the agents, the principal may thus be unable to do better than commit to a sub-optimal rule as only a rule resolves both the firm's ex-ante regulatory uncertainty and the principal's ex-post commitment problem.<sup>25</sup>

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<sup>24</sup>Naturally, such a commitment problem never arises when the regulatory uncertainty is about how much the firm will be regulated. The principal can then delegate to an unbiased agent who always implements her preferred policy.

<sup>25</sup>Commitment to a regulatory framework entails more credibility than commitment to an agent since any modification to the regulatory framework—from rule to discretion or vice versa—often requires legislative intervention (e.g., the Chevron doctrine in the United States).



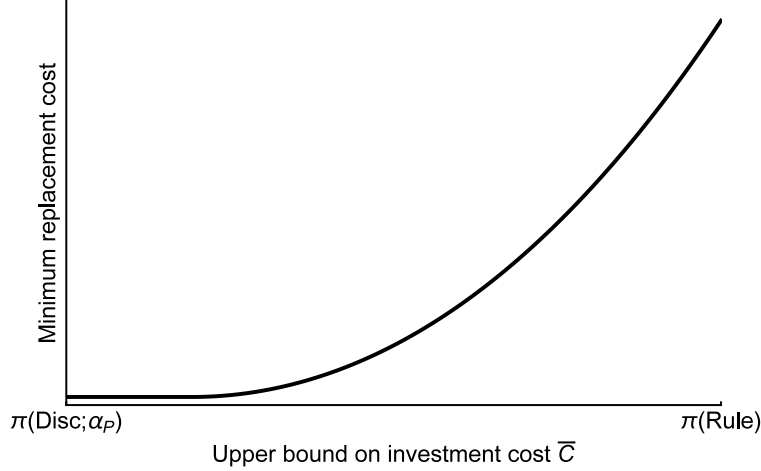


Figure 9: Minimum replacement cost required for credible commitment to a pro-business agent as a function of  $\bar{C}$

Parameter values:  $\kappa = 1$ ,  $\alpha_P = 0.55$ ,  $\gamma = 0.4$ ,  $\underline{S} = 0.01$ ,  $\bar{S} = 0.24$ ,  $q = 0.2$ ,  $F(C) = (C - \underline{C})/(\bar{C} - \underline{C})$ ,  $\underline{C} = 0.085$

The reasoning above suggests that the principal might be made better off if she can impose high replacement costs on herself. Common replacement costs include life-long tenure or fixed-term appointments.<sup>26</sup> In our setting, these protections benefit the principal by encouraging firm investment. Our rationale for civil service protections thus complements previous explanations which focus on encouraging investment in expertise (e.g., Gailmard and Patty, 2007).

## 6 Extensions

In this section, we present a series of extensions to demonstrate the robustness of our results. We first show that the welfare-maximizing rule may dominate unbiased delegation when multiple firms can enter the market. We then return to the case of a single potential entrant and demonstrate that our results are robust if the principal can subsidize the firm. Finally, we show that a rule can dominate discretion when the principal seeks to avoid a firm exiting a market or when the firm investment is welfare reducing.

<sup>26</sup>Regulators appointed to fixed terms can serve their full term without the support of the president (Lewis, 2004).

## 6.1 Multiple firms

We consider the situation when at most  $N > 1$  firms can enter the market. All firms face a common fixed cost of entry, and when  $L$  firms enter the market ( $L \leq N$ ), they engage in Cournot (quantity) competition.<sup>27</sup> In line with the baseline setup, we assume that the welfare-maximizing rule chosen by the principal guarantees that all firms enter the market.

As above, when choosing a level of regulation, an agent trades off the mitigating effect of regulation on the externality with the costs in terms of firms' profits and consumer surplus. Since the trade-offs are similar to those in the baseline model, we find that there exists a unique optimal level of regulation for each degree of externality ( $S$ ), and this level of regulation is increasing and concave in  $S$  (Figure 10).

The presence of multiple firms, however, has three important consequences. First, it increases the total quantity produced, which worsens the negative impact of any degree of externality. Second, it increases the consumer surplus (higher quantity, lower price). Third, it decreases a firm's and the industry (total) profit. These three effects have important implications for the choice of a level of regulation. Since an increase in the level of regulation at first has little effect on the already low industry profit, an agent who puts a lot of weight on profit relative to consumer surplus in his welfare function chooses a level of regulation taking into consideration mostly the negative impact of increased production. Further, a pro-business agent may prefer to limit firm entry because more entrants lead to decreased profits and increased costs associated with the externality. Inversely, an agent who puts a lot of weight on consumer surplus (which increases with the number of entrants) always wants to encourage more entry. In addition, in choosing the level of regulation, a pro-consumer agent balances the mitigating effect with the cost for consumers as more regulation decreases quantity and increases price. Consequently, for a sufficiently low degree of externality, a pro-consumer agent regulates less than a pro-business agent as shown in Figure 10.<sup>28</sup>

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<sup>27</sup>For more details on the entry process, as well as all formal results and proofs, see Appendix B.

<sup>28</sup>Since regulation imposes a convex cost on firms, a pro-business agent always regulates less than a pro-consumer agent for high enough degree of externality (see Figure 10a).

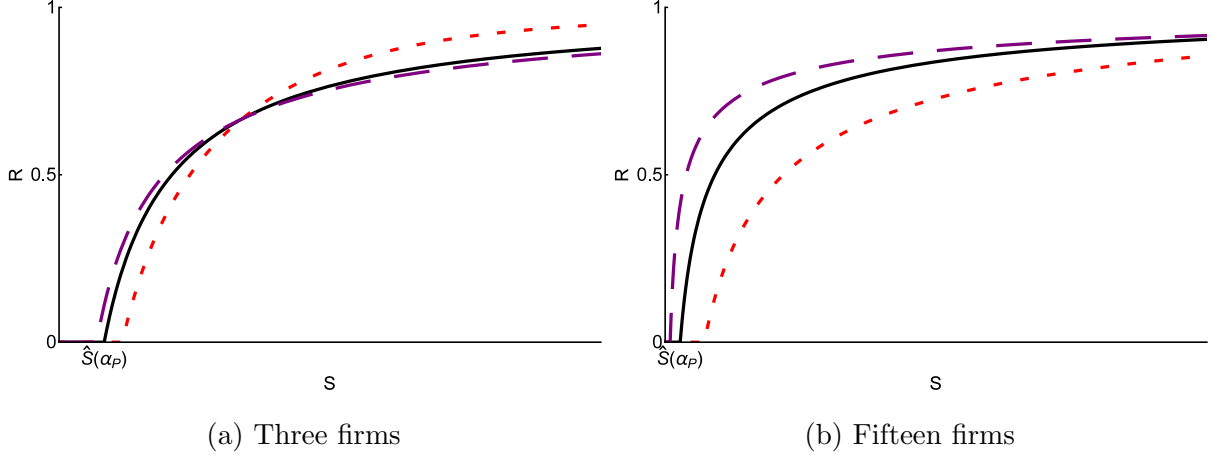


Figure 10: Optimal level of regulation with multiple firms

The plain black line corresponds to the optimal level of regulation for the principal, the dashed purple line to the optimal level of regulation for a pro-business agent, and the dotted red line to the optimal level of regulation for a pro-consumer agent. Parameter values:  $\kappa = 1$ ,  $\gamma = 0.4$ ,  $\alpha_P = 0.3$ , pro-business agent  $\alpha_A = 0.2$ , pro-consumer agent  $\alpha_A = 0.54$ .

Figure 10 also highlights that for a very low degree of externality, the optimal level of regulation is still 0. In fact, as in the case of a monopoly, the agent in charge of regulation would like to impose a negative level of regulation, but is otherwise constrained by the regulatory instrument or other jurisdictions.<sup>29</sup> Therefore, as long as the firm's profit is decreasing with the level of regulation, the binding lower bound on the optimal level of regulation implies that, as in the baseline model, at low degrees of externality, a rule can lead to higher profit than delegation to an unbiased agent. This is the case in Figure 11a. A rule may then dominate unbiased delegation since it increases the likelihood that a high number of firms enter the market. Biased discretion may dominate both since it gives the principal much of the ex-ante commitment power of a rule while limiting ex-post inefficiencies. However, given that a pro-consumer agent tends to regulate less than a pro-business agent for low degree of externality, the principal might strictly prefer to delegate to a pro-consumer agent rather than a pro-business agent to increase the likelihood of entry. These results are summarized in Proposition 4 and Corollary 1.

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<sup>29</sup>By the reasoning above, this occurs whenever the agent puts sufficiently high weight on the consumer surplus.

**Proposition 4.** *Suppose the number of firms is not too large ( $N \leq 3+2\kappa$ ), then the principal prefers the welfare-maximizing rule to unbiased discretion whenever the following conditions are satisfied:*

- (i) *The principal is not too pro-business,*
- (ii) *The probability of investment under unbiased discretion is sufficiently low,*
- (iii) *The lower degree of externality ( $\underline{S}$ ) is strictly less than some  $\widehat{S}(\alpha_P; N)$ , and*
- (iv) *The upper degree of externality ( $\overline{S}$ ) is strictly below some  $\check{S}(\underline{S}; N) > \widehat{S}(\alpha_P; N)$ .*

*Furthermore, there always exists a biased agent such that the principal prefers biased delegation to the welfare-maximizing rule when these conditions are satisfied and*

- (v) *The upper degree of externality ( $\overline{S}$ ) is strictly below  $\widehat{S}(0; N)$ .*

**Corollary 1.** *The principal prefers to delegate to a pro-consumer agent when conditions (i)-(v) described in Proposition 4 hold and in addition:*

- (vi) *The number of firms is not too small ( $N \geq 1 + \frac{2\kappa}{3}$ ).*

Competition between entrants, however, also changes how regulation affects firms' profit. By increasing the marginal cost, an increase in the level of regulation increases the equilibrium price and *total* cost. While a single firm benefits fully from the increase in price, it only bears a small portion of the cost increase: regulation mitigates the effect of competitive pressures on profit. Consequently, when the number of firms is large, profit *increases* with the level of regulation at low levels of regulation and, hence, low degrees of externality. However, as the cost of regulation is convex for firms, at high levels of regulation (high degrees of externality), profit always decreases with the level of regulation (with  $S$ ). A firm's profit thus exhibits an inverse U-shaped relationship with respect to the degree of externality. For intermediary degrees of externality—meaning when the uncertainty is about how much the firm will be regulated—the firm's profit is then always strictly lower under unbiased discretion than under the welfare-maximizing rule (Figure 11b), and the principal may prefer the rule.<sup>30</sup>

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<sup>30</sup>Notice that because uncertainty centers around how much the firm will be regulated, delegating to a biased agent always induces over- or under-regulation from the principal's perspective. As such—unlike in the baseline model—biased delegation does not necessarily limit ex-post inefficiencies, and a rule-based regulatory framework can be optimal for the principal. This suggests that rule-based regulatory frameworks might be optimal for very competitive industries, while discretion to a biased agent might be optimal for

**Proposition 5.** *Suppose the number of firms is large ( $N > 3 + 2\kappa$ ), then the principal prefers the welfare-maximizing rule to unbiased discretion whenever the following conditions are satisfied:*

- (i) *The principal is not too pro-business,*
- (ii) *The probability of investment under unbiased discretion is sufficiently low,*
- (iii) *The lower degree of externality ( $\underline{S}$ ) is between some  $S_m(\alpha_P; N)$  and some  $S^\pi(\alpha_P; N)$ ,*
- and
- (iv) *The upper degree of externality ( $\bar{S}$ ) is between  $S^\pi(\alpha_P; N)$  and some  $S^M(\underline{S}; \alpha_P, N)$ .*

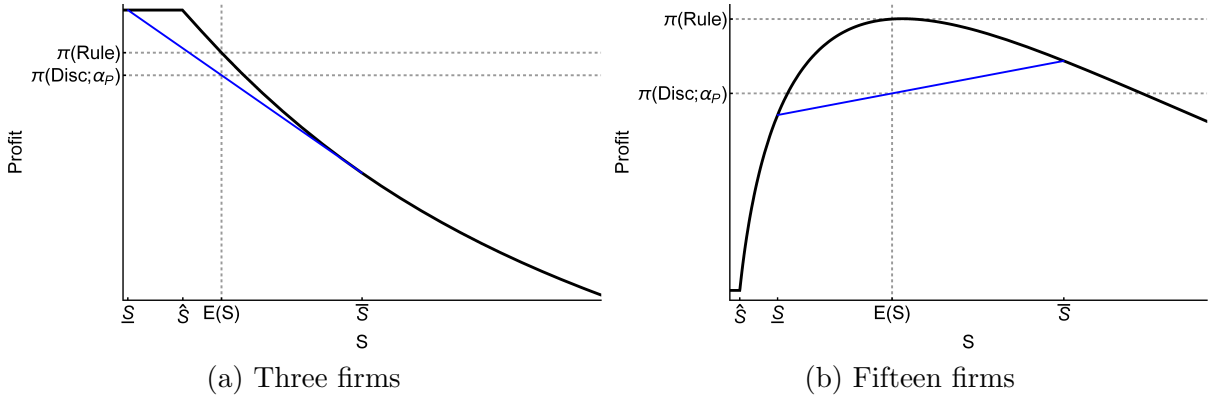


Figure 11: A firm's profit under different regulatory framework

Parameter values:  $\kappa = 1$ ,  $\gamma = 0.4$ ,  $\alpha_P = 0.3$   $q = 0.4$ , for Figure 11a:  $\underline{S} = 0.01$  and  $\bar{S} = 0.5$ , for Figure 11b:  $\underline{S} = 0.2$ ,  $\bar{S} = 1.4$ .

Introducing competition between entrants does not alter our main results. As for a monopoly, we identify circumstances under which the gains from ex-ante commitment power outweighs the loss from ex-post inefficiency, and the principal prefers a rule-based regulatory framework. She may also sometimes prefer to delegate to a biased agent (who may be pro-consumer). Since the introduction of competition only complicates the analysis, we return to the case of a single firm in what follows.

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industries exhibiting relatively low level of competition. A full characterization of this result is left for future research.

## 6.2 Subsidy

When technical and institutional constraints prevent an agent from achieving the unconstrained (i.e., negative) first-best level of regulation and encouraging production in low states, the welfare-maximizing rule can dominate unbiased discretion. Subsidies circumvent the lower bound on regulation. However, subsidies are an imperfect substitute for negative regulation, and the principal may still prefer a rule to delegation to an unbiased agent.

Adhering to the baseline set-up, we assume that the government can offer a cost subsidy  $I$  which acts analogously to negative regulation. With cost subsidy  $I$  and level of regulation  $R$ , the firm's production cost is  $C(Q; R, I) = \frac{Q^2}{1-R+I}$ . Subsidies must be financed by taxation. Because taxes generate distortions in other sectors, the cost of subsidies does not depend on the degree of externality. This last property turns out to be essential to our results. We assume that the cost of subsidy is  $v(I)Q$  with  $v(\cdot)$  increasing and strictly convex.<sup>31</sup> The timing remains the same. Under a rule-based regulatory framework, both regulation and subsidy are chosen prior to the firm investment, whereas they are both decided after the degree of externality is revealed under discretion.

Both negative regulation (if feasible) and subsidies encourage production. However, they differ in their costs. The cost of negative regulation ( $R < 0$ ) is  $\gamma SQ + \gamma S(-R)Q$ . The cost of a subsidy is:  $\gamma SQ + v(I)Q$ . The first term in both corresponds to the unmitigated cost of the externality, whereas the second term corresponds to the direct cost of negative regulation or subsidy. For negative regulation, this direct cost is a function of the degree of externality. It goes to 0 as the degree of externality goes to 0.<sup>32</sup> In contrast, the direct cost of subsidy remains strictly positive even as  $S$  approaches 0. Thus, for a very low degree of externality, the costs of reproducing the unconstrained first-best negative level of regulation are too high relative to the benefit. Consequently, the firm's profit with subsidy exhibits a kink, which implies it is concave over a range of degrees of externality (see Figure 12b for an illustration).

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<sup>31</sup>We also impose additional technical assumptions on  $v(\cdot)$  to facilitate the analysis. For details, see Appendix B.2. Importantly, our key insights hold when specific assumptions on the effect and cost of the subsidy are relaxed.

<sup>32</sup>The combined direct and indirect cost of negative regulation (whenever feasible) even goes to 0 as  $S$  goes to 0 in equilibrium (details available upon request).

We can then apply the same reasoning as above to establish that the welfare-maximizing rule can dominate discretion when the states ( $\underline{S}$  and  $\bar{S}$ ) are in this range. We thus obtain Proposition 6, which formally extends our key result to an environment with subsidies.

**Proposition 6.** *When subsidies are available, the principal prefers the welfare-maximizing rule to unbiased discretion whenever the following conditions are satisfied:*

- (i) *The probability of investment under unbiased discretion is sufficiently low,*
- (ii) *The lower degree of externality ( $\underline{S}$ ) is strictly less than some  $\hat{S}^I(\alpha_P)$ , and*
- (iii) *The upper degree of externality ( $\bar{S}$ ) is strictly below some  $\check{S}^I(\underline{S}; \alpha_P) > \hat{S}^I(\alpha_P)$ .*

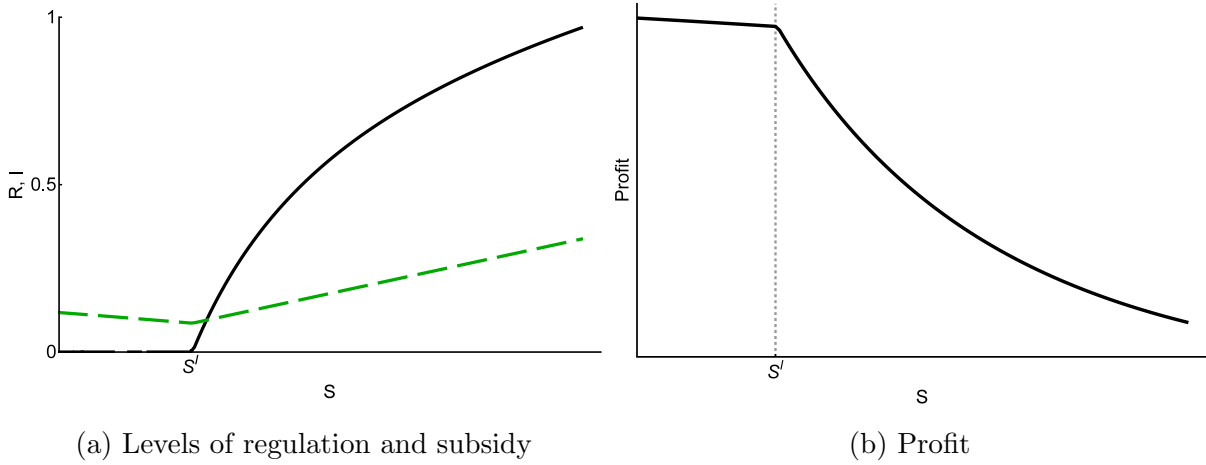


Figure 12: Regulation, subsidy, and profit as a function of the degree of externality

Parameter values:  $\kappa = 1$ ,  $\gamma = 0.4$ ,  $\alpha_P = 0.3$ .

A common alternative to a cost subsidy is an investment subsidy: a lump-sum payment to the firm conditional on investment.<sup>33</sup> An investment subsidy does not affect production, but it mitigates the costs associated with regulatory uncertainty and increases the likelihood of firm entry. However, as before, financing the subsidy imposes distortionary costs, and if these costs are sufficiently high, the welfare-maximizing rule (which always induces investment absent subsidy) dominates unbiased discretion. Furthermore, if the optimal investment subsidy fails to guarantee investment with probability 1, the principal always prefers delegating to a biased rather than unbiased agent (see Appendix B.2 for more details).

<sup>33</sup>Investment subsidies often take the form of sped-up depreciation schedules. Shorter depreciation schedules reduce the net cost of investment by bringing forward tax savings.

### 6.3 Avoiding exit

Our main results still hold when the firm must decide whether to stay or exit the market and allocate its capital to new activities that provide a profit  $\Pi^O > 0$  (possibly revealed after the regulatory framework is established). In this case, the principal's choice of a regulatory framework must take into account the firm's disinvestment decision. If the degree of externality changes over time, and the nature of regulatory uncertainty faced by the firm is about whether it will be regulated, the logic outlined above predicts that there exist circumstances under which the principal prefers the welfare-maximizing rule to unbiased discretion.<sup>34</sup>

The threat of exit, however, depends on the nature of the capital investment. If the firm cannot easily liquidate its capital, this threat is low, and the principal can delegate to an unbiased (or almost unbiased) agent. In contrast, if the firm can move its capital at low cost, the principal may prefer a rule-based regulatory framework or delegation to a pro-business agent. Consequently, our theory predicts that both the regulatory framework and the political orientation of regulatory agencies should depend on the nature of the firm's investment. Similarly, our theoretical results suggest that economic domains marked by a high level of jurisdictional competition should be associated with a lower level of regulation (also termed "the race to the bottom", Oates, 1972) as well as a greater adoption of an ex-post inefficient regulatory framework.

### 6.4 Welfare-reducing investment

Rules can also dominate discretion when the principal ex-ante prefers the firm to allocate resources to other sectors. This occurs when the principal gets higher expected utility from investment in other sectors or when there is a fixed cost for the principal associated with investment, such as systemic risk induced by investment in risky derivatives or environmental risk associated with a new pipeline.

To discourage investment, the principal may prefer a rule that guarantees a very low profit. The principal can also choose to delegate to a sufficiently *pro-consumer* agent who

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<sup>34</sup>A similar result holds when the firm is uncertain whether it will face new regulation in a second dimension.



always regulates more than the principal (conditional on investment) and prevents the firm from entering the market. In contrast to our previous results, the principal is never strictly better off by delegating to a pro-consumer agent than by imposing a rule. In both cases, investment is discouraged, and the principal obtains the utility from her outside option.

## 7 Conclusion

This paper studies how the downstream economic consequences of regulation shape the regulatory framework and the preferences of agents in charge of it. Because regulatory uncertainty affects firms' investment, a principal faces a trade-off between ex-ante commitment provided by a rule and the ex-post efficiency provided by unbiased discretion. When uncertainty is about whether the firm will be regulated and the cost of investment is likely to be high, the gain from commitment outweighs the loss from efficiency: The principal chooses a rule over unbiased discretion. She may, however, prefer delegation to a pro-business agent to both, as biased delegation guarantees investment with high probability without inducing a large loss in terms of ex-post efficiency. Our model thus predicts that even pro-consumer principals may sometimes appear as if they favor businesses.

Biased delegation requires additional commitment and is only feasible when it is costly for the principal to replace the agent. Absent this replacement cost, the principal might be forced to choose an inefficient rule-based regulatory framework. The principal is then made better off by restricting her ability to replace agents by, for example, offering life-long tenure to agents. Our theory thus suggests that civil service protections may be about commitment to regulated parties as much as internal concerns regarding investment in expertise.

Our conclusions highlight that the internal organization of the bureaucracy does not depend only on the presence of uncertainty about the effects of regulation, but also on how firms strategically respond to different regulatory frameworks. Firms can have a strong influence on the bureaucratic structure even absent any sort of lobbying. Empirical studies which fail to account for the indirect effects we identify are bound to yield biased estimates of firms' direct influence in the rule-making process.

To facilitate comparisons with existing models of the bureaucracy, we have focused on a static game. However, the regulatory framework evolves over time. This can be due, for example, to a delay in precisely evaluating the degree of externality generated by the firm. How this discovery problem and other dynamic features of the relationship between firms and agencies affect the internal structure of the bureaucracy is a promising avenue for future research.

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