Regulatory Capacity and Hard-to-Enforce Requirements*

Jacopo Gambato† Bernhard Ganglmair‡ Julia Krämer§

January 9, 2026

Abstract

In an asymmetric-regulation model as a simultaneous-move game, a firm can comply with two regulatory targets, and a regulator can audit the firm to verify compliance. Inspection by the regulator is imperfect, and it assesses the firm's compliance with the targets with different success probabilities. In equilibrium, the firm fully complies only if compliance costs are low. Otherwise, the firm always prioritizes the requirement that is easier to enforce with a higher success probability. Expanding regulatory capacity positively affects compliance with the easy-to-enforce target; however, a higher capacity for the regulator, allowing it to enforce both targets, can harm compliance with the hard-to-enforce target. The analysis highlights that higher regulatory capacity can backfire if policymakers care about hard-to-enforce requirements but fail to align the regulator's objectives with these priorities.

Keywords: agency resources, asymmetric enforcement, audits, compliance, multi-tasking, regulation

JEL Codes: G28; H11; H32; K20; L51

*Gambato acknowledges financial support from the Austrian Science Fund FWF under project number P37282; Ganglmair acknowledges support by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) through CRC TR 224 (Project B02). The authors declare that they have no relevant or material financial interests that relate to the research described in this paper. An earlier version of this paper was circulated under the title "Regulatory Capacity in a Game of Asymmetric Regulation."

†University of Vienna, ja.gambato@gmail.com

‡Corresponding author: University of Mannheim and ZEW Mannheim, b.ganglmair@gmail.com

§Erasmus University Rotterdam, j.k.kramer@law.eur.nl

1 Introduction

Regulation is often multidimensional, requiring firms to comply with multiple targets or tasks. When some of these tasks are easier to verify than others, then the enforceability of the regulation is asymmetric. The literature is full of such examples, ranging from the Environmental Protection Agency's regulation of environmental pollutants (Viscusi et al., 2005) to the EU's Digital Markets Act (Colangelo and Martínez, 2025).[1] In practice, asymmetry in enforceability means that firms and regulators will struggle to assess compliance with some of the requirements more than with others. Analogous to a multitask setting in incentive contracting (e.g., Holmstrom and Milgrom, 1991), where agents allocate more effort towards the highly incentivized and easily measured (or verifiable) tasks,[2] in a regulatory setting, we expect firms to neglect the hard-to-enforce task. This outcome is particularly prevalent when agencies and regulators have limited resources and prioritize the easy-to-enforce tasks. Expanding the regulator's *capacity* to counter this (mis)allocation of regulatory effort then becomes a policy instrument.

In this paper, we demonstrate, using a stylized model, that in a setting with asymmetric enforceability of regulatory targets, expanding regulatory capacity alone is insufficient to enhance compliance with hard-to-enforce targets. On the contrary, expanding regulatory capacity may induce firms to comply with easier-to-enforce targets at the expense of harder ones—higher regulatory capacity may lower compliance with hard-to-enforce targets. This is because a regulator with a low capacity may also not always enforce the easy target; a regulator with expanded capacity, however, might enforce it with certainty. When the firm's compliance costs are high (and compliance with both targets becomes prohibitively costly), this anticipated increase in enforcement by the regulator shifts the firm's attention towards the easy-to-enforce target—because not com-

[1] Conventional pollutants are generally viewed as simple to enforce, whereas the enforcement with respect to toxic chemicals (because of the needs for specific testing) is more difficult (Viscusi et al., 2005, pp. 775–6). The Digital Markets Act required Apple to open its ecosystem to third-party app stores and to avoid self-preferencing when competing for users' attention (Colangelo and Martínez, 2025) (the latter requirement arguably more difficult to prove).

[2] For empirical evidence, see Hong et al. (2018), Knutsson and Tyrefors (2022), or de Janvry et al. (2023).

plying with the easy target is now more likely to result in sanctions—at the expense of the harder-to-enforce target.

In Section 2, we propose a simple framework for studying the compliance of multi-dimensional regulation with asymmetrically enforceable requirements. We build on the game-theory literature on audits and tax avoidance (e.g., Dresher, 1962; Fellingham and Newman, 1985; Graetz et al., 1986; Erard and Feinstein, 1994) and model this interaction as a simultaneous-move game: The firm chooses which requirements to comply with, and the regulator chooses which requirements, if any, to audit. Audits are assumed to be imperfect (non-compliance might go undetected) but error-free (compliance is always identified). Our framework is closest to Heyes (1994), which models the thoroughness of inspection of a single requirement as an endogenous choice. Expanding on this earlier work, we assume asymmetric success probabilities for detecting non-compliance with multiple requirements as given (e.g., Macho-Stadler and Perez-Castrillo, 2006), and focus on the firm's and regulator's choices of which requirements to comply with and to audit. Our model is then akin to an adaptation of the Holmström-Milgrom framework to a regulatory setting.[3]

In Section 3, we derive equilibrium outcomes for regulators with low capacity (that can enforce only one of the requirements and, therefore, have to prioritize) and regulators with high capacity (that can enforce one or both requirements). Our equilibrium analysis demonstrates that enforceability asymmetry leads to (weak) under-compliance with hard-to-enforce requirements, regardless of the regulator's capacity. A high-capacity regulator chooses full inspection of both targets (its dominant strategy), while the firm chooses full compliance only for sufficiently low compliance costs (but no compliance with the hard-to-enforce target otherwise) (Proposition 1). When the regulator is of low capacity, a pure-strategy equilibrium cannot exist. Instead, the regulator randomizes either between the two targets or the easy-to-enforce target and no enforcement, while the firm, again, chooses full compliance only for sufficiently low compliance costs. With higher costs, the

[3]This assumption of asymmetric (and strictly positive) success probabilities distinguishes our analysis from, for instance, Laffont and Tirole (1993, chs. 3.8, 4) where multi-dimensional effort is not verifiable at all.

firm instead randomizes and chooses the easy-to-enforce target with higher probability than the hard-to-enforce target (Proposition 2).

Our stylized model relies on three key assumptions.[4] First, the asymmetry in regulation stems from an asymmetry in the enforceability of the regulatory targets, while assuming the same values and costs (for both the firm and the regulator) for the targets. We model asymmetric enforceability as the regulator's exogenous probabilities of successfully detecting non-compliance of either target. Second, detecting *partial* non-compliance (i.e., of just one requirement) is sufficient for the regulator to prevent any adverse societal effects of a firm's activities (by sanctioning the firm, imposing a fine, and possibly compelling a corrective action). For our model, this implies that auditing both targets simply increases the probability that the regulator detects at least one instance of non-compliance. Third, we take a reduced-form approach to the regulator's budget constraint and the costs of regulation. Enforcing a regulatory target is (symmetrically) costly inasmuch as a constrained regulator (with a binding budget constraint) is not able to enforce both targets (but has to choose), while an unconstrained regulator is able to enforce both. We do not rule out the use of mixed strategies when deciding what to regulate in this case, but we assume that auditing a single requirement can detect only non-compliance with that requirement.

Expanding the regulator's capacity is a policymaker's choice to counter the (mis)allocation of regulatory activity and the under-compliance response by firms. In Section 4, we establish that higher capacity is indeed effective in ensuring compliance with the easy-to-enforce requirement, even in the presence of imperfect audits. However, expanding regulatory capacity can undermine compliance with the hard-to-enforce requirement. As the regulator with expanded capacity also increases enforcement of the easy-to-enforce target, the firm shifts attention to that target—and at sufficiently high compliance costs, this shift comes at the cost of the firm's compliance with the hard-to-enforce target (Proposition 3). So, while on average, compliance increases as regulatory capacity expands, higher capacity can backfire if the legislator cares about the hard-to-enforce target

[4]We discuss the implications of these assumptions in greater detail in the concluding section.

but has not properly incentivized or instructed the regulator of its preferences.[5]

Our paper contributes to the literature in regulation and public economics. First, we study firm compliance and regulatory scrutiny in a setting of multi-dimensional regulation with asymmetric (and imperfect) enforceability.[6] Studying effort provision by Chinese civil servants, de Janvry et al. (2023) show that disproportionate effort goes toward tasks that are "more important and observable to the evaluator." Similar disproportionate efforts toward measurable (and easy-to-enforce) metrics, at the expense of unmeasurable (and hard-to-enforce) ones, have been reported for factory workers in industrial settings (Hong et al., 2018) and when comparing the provision of the same service by privately vs. publicly owned entities (Knutsson and Tyrefors, 2022). Also, Ganglmair et al. (2024) find that uncertainty in regulatory requirements can interact with a regulator's budget constraint, particularly when regulation is multi-dimensional.

Second, we examine the effect of an expansion of a regulator's enforcement capacity. Systematic limitations to regulation have been shown to relate to limited regulatory resources (Stern, 2000; Armstrong and Sappington, 2006) or capacity (Zhang et al., 2025). Our results also parallel the classic findings in (suboptimal) rate-of-return regulation (Averch and Johnson, 1962; Sherman, 1992). Bailey and Coleman (1971) and Sweeney (1981) show that lagged adjustments of regulation (for instance, because of low-capacity regulators) can have positive effects on technology adoption when more dynamic adjustments, implementable only by high-capacity regulators, would undermine investment incentives. Regulatory capacity is also related to a more general notion of the state's capacity to enforce rules and implement policy (Fernández-i Marín et al., 2024). For instance, in the context of procurement, Decarolis et al. (2021) show that a negative shock to agency staff can adversely affect innovation.

[5]For a discussion of potential misallocation of enforcement effort as the consequence of improper regulatory delegation, see McLaughlin and Richards (2025). See also Keeler (1995) for an examination of socially optimal regulation in a model that incorporates varying assumptions about regulatory objectives.

[6]Unlike Hunter and Nelson (1995) or Gulen and Myers (2024) who examine differential (i.e., asymmetric) enforcement by a regulator (the Internal Revenue Service and the Environmental Protection Agency, respectively) across states, we study asymmetric enforcement of the same firm.

2 A Model of Asymmetric Regulation

We present a stylized model of asymmetric regulation as a simultaneous-move game in which one firm chooses which requirements to comply with, and the regulator chooses which requirement, if any, to audit. In this model, we take a specific approach to introduce asymmetry. We provide a detailed discussion of the role of this and other modeling assumptions in Section 5.

A regulated firm acts subject to two distinct regulatory targets, $j = a$ and $j = b$. Compliance costs are c per target.[7] The firm's compliance choice is an action profile $(a, b) \in \{0, 1\} \times \{0, 1\}$ where $j = 1$ indicates compliance and $j = 0$ non-compliance. A regulator enforces these targets by auditing the firm to assess compliance with either target, with neither target, or with both targets. If it finds at least partial non-compliance, it can challenge the firm's activity and prevent any adverse societal effects by sanctioning the firm.[8]

The firm's gross value of its activity is $v > 0$. Compliance lowers the firm's payoffs from the activity so that, given its compliance choices, the firm's net value is $v - ca - cb$. The costs of compliance thus affect the profitability of the firm's activity under regulatory pressure.[9] If the regulator finds (at least partial) non-compliance and sanctions the firm, the firm does not generate the net value of the activity, and payoffs are zero (regardless of the extent or direction of non-compliance). Given Assumption 1, compliance never leads to negative payoffs:

Assumption 1. $0 < c < \frac{v}{2}$

[7] We rule out complementarities (or redundancies) across targets; we also do not consider trade-offs that might arise when compliance with one target increases the costs of compliance with another. One such example is the "transparency paradox" (Nissenbaum, 2011). It posits that greater disclosure of a firm's data collection practices (as mandated by the EU General Data Protection Regulation) inherently increases the complexity of the language in firms' privacy policies, thereby increasing the costs of compliance with another GDPR requirement (i.e., greater accessibility to disclosed information).

[8] For a successful challenge, the regulator needs to detect non-compliance with only one requirement; auditing both requirements eventually increases the probability of detecting *at least* one non-compliance.

[9] The cost associated with compliance is not fixed (and sunk before auditing) but, rather, reflects the additional costs associated with operating following regulatory mandates. We discuss an alternative specification with sunk compliance costs in the concluding section.

Non-compliance generates a social loss of $-\gamma < 0$. The regulator's objective is to minimize this social loss. Its payoffs under an unchallenged non-compliant policy are $-\gamma$; and under a challenged policy (with the firm sanctioned) or a compliant policy, they are zero. We assume that inspecting a target takes time, and that regulators differ in their *capacity*. A *high-capacity* regulator has sufficient resources to inspect both targets. A *low-capacity* regulator can inspect at most one target.

Finally, we assume that audits are imperfect, in that the inspection for target j reveals its state (either $j = 1$ or $j = 0$) with probability $\pi_j < 1$. To capture asymmetric enforceability, we assume (without loss of generality) that inspecting a has a higher chance of discovering its actual state, $\pi_a > \pi_b$. Given Assumption 2, for all feasible values c, the firm does not always strictly prefer not to comply with either of the targets (that is, action profile $(0, 0)$ is never dominant):

Assumption 2. $\frac{1}{2} < \pi_b < \pi_a < 1$.

We summarize the firm's and regulator's pure strategies and respective payoffs in Table 1. The firm chooses *full non-compliance* $(a = 0, b = 0)$, *partial compliance* $((a = 0, b = 1) \vee (a = 1, b = 0))$, or *full compliance* $(a = 1, b = 1)$. To ease notation, we refer to $j = 1$ as j, and $j = 0$ as 0, for $j \in \{a, b\}$. A regulator chooses *no inspection* (i_0), *partial inspection* (i_j), or *full inspection* $(i_{a,b})$; the last option is unavailable to a low-capacity regulator.

Consider, for instance, a firm strategy of full non-compliance with $(0, 0)$, and the regulator inspects only target b (so that i_b). Because the regulator detects partial non-compliance with probability π_b and does not detect non-compliance with $(1 - \pi_b)$, adverse societal effects arise with probability $(1 - \pi_b)$, and the regulator's payoffs are $-(1 - \pi_b)\gamma$ (and the firm's $(1 - \pi_b)\, v + \pi_b \cdot 0$). Now compare these payoffs with the outcome where the regulator inspects both targets $(i_{a,b})$. It does not detect non-compliance of either a or b with probability $(1 - \pi_a)(1 - \pi_b)$ so that its payoffs are $-(1 - \pi_a)(1 - \pi_b)\gamma$.[10] Alternatively, suppose the firm chooses a partial-compliance strategy, complying only

[10] The firm's payoffs are $(1 - \pi_a)(1 - \pi_b)\, v + [1 - (1 - \pi_a)(1 - \pi_b)] \cdot 0$.

Table 1: Normal-Form Representation of the Compliance-Inspection Game

Payoffs: (firm, regulator)	**Regulator's strategy ($\to q$)**			
Firm's strategy ($\to p$)	i_0	i_a	i_b	$i_{a,b}$
$(0,0)$	$\begin{pmatrix} v, \\ -\gamma \end{pmatrix}$	$\begin{pmatrix} (1-\pi_a)v, \\ -(1-\pi_a)\gamma \end{pmatrix}$	$\begin{pmatrix} (1-\pi_b)v, \\ -(1-\pi_b)\gamma \end{pmatrix}$	$\begin{pmatrix} (1-\pi_a)(1-\pi_b)v, \\ -(1-\pi_a)(1-\pi_b)\gamma \end{pmatrix}$
$(a,0)$	$\begin{pmatrix} v-c, \\ -\gamma \end{pmatrix}$	$\begin{pmatrix} v-c, \\ -\gamma \end{pmatrix}$	$\begin{pmatrix} (1-\pi_b)(v-c), \\ -(1-\pi_b)\gamma \end{pmatrix}$	$\begin{pmatrix} (1-\pi_b)(v-c), \\ -(1-\pi_b)\gamma \end{pmatrix}$
$(0,b)$	$\begin{pmatrix} v-c \\ -\gamma \end{pmatrix}$	$\begin{pmatrix} (1-\pi_a)(v-c), \\ -(1-\pi_a)\gamma \end{pmatrix}$	$\begin{pmatrix} v-c, \\ -\gamma \end{pmatrix}$	$\begin{pmatrix} (1-\pi_a)(v-c), \\ -(1-\pi_a)\gamma \end{pmatrix}$
(a,b)	$\begin{pmatrix} v-2c, \\ 0 \end{pmatrix}$	$\begin{pmatrix} v-2c, \\ 0 \end{pmatrix}$	$\begin{pmatrix} v-2c, \\ 0 \end{pmatrix}$	$\begin{pmatrix} v-2c, \\ 0 \end{pmatrix}$

with b, and the regulator inspects only b. With this inspection strategy, the regulator cannot detect partial non-compliance and sanction the firm, inevitably resulting in a loss of $-\gamma$.

These two payoff comparisons reflect one of our key assumptions: The regulator's challenge and sanctions are directed at the firm's activity, not at the specific requirement the firm is failing to comply with. In practice, this amounts to the regulator's challenge to reject the firm's activity in its entirety if it detects any form of non-compliance. Conversely, if any non-compliance goes undetected, it induces the same societal loss, regardless of the nature of non-compliance. In doing so, we argue that the activity itself (characterized by two regulatory targets) is subject to regulatory pressure, and that there is no such thing as partial compliance with the regulation. In our framework, regulation with multiple requirements should be treated as a unit, and therefore, complying only with parts of it is equivalent to not complying with the regulation as a whole.

3 Equilibria for Both Regulator Types

We first derive the Nash equilibrium for the high capacity regulator (Proposition 1) and then proceed to the low capacity regulator (Proposition 2).

3.1 High-Capacity Regulator

From Table 1, it is immediate to see that full inspection $i_{a,b}$ is the **high-capacity regulator**'s dominant strategy. The following proposition summarizes the Nash equilibria in this scenario:

Proposition 1 (High-Capacity Regulator)**.** *Let* $c_h = \frac{\pi_b}{1+\pi_b} v$*. If* $c < c_h$*, the equilibrium is* $(i_{a,b}, (a, b))$*. If* $c \geq c_h$*, the equilibrium is* $(i_{a,b}, (a, 0))$*.*

Proof. We solve the game by iterated dominance. Full inspection $i_{a,b}$ is the regulator's (weakly) dominant strategy. Firm strategies $(0, 0)$ and $(0, b)$ are dominated by $(a, 0)$ in the resulting reduced game. Firm strategy $(a, 0)$ dominating $(0, b)$ follows from Assumption 2 where $\pi_a > \pi_b$ implies $(1 - \pi_b)(v - c) > (1 - \pi_a)(v - c)$. Firm strategy $(a, 0)$ dominating $(0, 0)$, follows from $(1 - \pi_b)(v - c) > (1 - \pi_a)(1 - \pi_b) v$ if, and only if, $c < \pi_a v$, which holds under Assumptions 1 ($0 < c < \frac{v}{2}$) and 2 ($\pi_a > \pi_b > \frac{1}{2}$). Lastly,

$$v - 2c > (1 - \pi_b)(v - c) \quad \iff \quad c < \frac{\pi_b}{1 + \pi_b} v = c_h. \qquad \square$$

Because full inspection $i_{a,b}$ is a dominant strategy, the firm always prefers compliance with the easy-to-enforce target, $(a, 0)$, to compliance with the hard-to-enforce target, $(0, b)$. When choosing partial compliance, the firm opts for the target for which non-compliance is easier to detect. Moreover, by Assumption 2, the firm either chooses full compliance (a, b) or non-compliance in b (so that $(a, 0)$). Because $\pi_a > \pi_b$, partial compliance with a dominates not complying at all under the assumption that compliance never leads to negative payoffs for the firm. Moreover, if compliance costs c are small, full compliance is cheap, and the benefits outweigh the costs. Alternatively, when c is high, the firm prefers not to comply with b, hoping its non-compliance goes undetected. All else equal, as the success probability π_b of the hard-to-enforce target increases, the firm strictly prefers to comply with both targets for more values of c.

3.2 Low-Capacity Regulator

For a **low-capacity regulator**, a full audit with $i_{a,b}$ is not feasible by assumption. The regulator always chooses i_a or i_b. It is straightforward to see that a pure-strategy equilibrium cannot exist. Suppose the regulator selects to inspect the easy-to-enforce target, i_a, with probability one. Then, the firm's best response is to choose $(a, 0)$. The regulator is then unable to challenge the non-compliant firm and instead deviates to i_b, inducing the firm to respond with $(0, b)$. But then the regulator's best response is to choose i_a, and so forth. In equilibrium, the regulator will always play a mixed strategy, choosing i_a and i_b with strictly positive probabilities.

To construct the resulting equilibria, we find the firm's probabilities for partial compliance $\Pr(a = 1, b = 0) =: p_a$ and $\Pr(a = 0, b = 1) =: p_b$ and no compliance $\Pr(a = 0, b = 0) = 1 - p_a - p_b$ that make the regulator indifferent between inspecting i_a and i_b:

$$p_a = \frac{\pi_a - (1 - p_b)\,\pi_b}{\pi_a}; \tag{1}$$

$$p_b \in \left[0, \frac{\pi_b}{\pi_a + \pi_b}\right]; \tag{2}$$

$$1 - p_a - p_b = (1 - p_b)\,\frac{\pi_b}{\pi_a} - p_b. \tag{3}$$

Note that he firm plays $(a, 0)$ with strictly positive probability (because $p_a > 0$).

The low-capacity regulator has only two undominated strategies, i_a and i_b. We use $q_{a|b}$ and $q_{a|0}$ to denote the regulator's probabilities of playing i_a that make the firm indifferent between $(a, 0)$ and $(0, b)$ or $(a, 0)$ and $(0, 0)$, respectively:

$$q_{a|b} = \frac{\pi_b}{\pi_a + \pi_b}; \tag{4}$$

$$q_{a|0} = \frac{(1 - \pi_b)\,c}{\pi_a v - \pi_b c}. \tag{5}$$

The following proposition summarizes the Nash equilibria in this scenario of the low-capacity regulator:

Proposition 2 (Low-Capacity Regulator)**.** *Let*

$$\underline{c}_l := \frac{\pi_b \pi_a}{\pi_b + \pi_a + \pi_b \pi_a} v < \frac{\pi_b \pi_a}{\pi_b + \pi_a - \pi_b \pi_a} v =: \overline{c}_l.$$

Then:

i. if $\frac{1}{2} < \pi_b < \pi_a < 1$ *and* $0 < c < \underline{c}_l$*, there is a continuum of payoff-equivalent equilibria: the regulator plays* i_a *with probability* $q \in \left[\underline{q}^b, \overline{q}^b\right]$ *and* i_b *with the remaining probability, and the firm complies with both targets with probability one;*

ii. if $\frac{1}{2} < \pi_b < \min\left(\pi_a, \frac{\pi_a}{3\pi_a - 1}\right) \leq \frac{2}{3}$ *and* $\underline{c}_l < c < \overline{c}_l$*, in the unique equilibrium the regulator mixes following* $q_{a|b}$*, and the firm mixes between* $(a, 0)$ *and* $(0, b)$ *with* $p_a = \frac{\pi_a}{\pi_a + \pi_b}$ *and* $p_b = 1 - p_a$*;*

iii. if $\frac{1}{2} < \pi_b < \min\left(\pi_a, \frac{\pi_a}{3\pi_a - 1}\right) \leq \frac{2}{3}$ *and* $\overline{c}_l < c < \frac{v}{2}$*, in the unique equilibrium the regulator mixes following* $q_{a|0}$*, and the firm mixes between* $(a, 0)$ *and* $(0, 0)$ *with* $p_a = 1 - \frac{\pi_b}{\pi_a}$ *and* $p_b = 0$*;*

iv. if $\frac{\pi_a}{3\pi_a - 1} < \pi_b < \pi_a < 1$ *and* $\underline{c}_l < c < \frac{v}{2}$*, in the unique equilibrium the regulator mixes following* $q_{a|b}$*, and the firm mixes between* $(a, 0)$ *and* $(0, b)$ *with* $p_a = \frac{\pi_a}{\pi_a + \pi_b}$ *and* $p_b = 1 - p_a$*.*

Sketch of the proof. For the proof of the proposition, we find equilibria for all combinations of the relevant parameters. We first construct mixed-strategy equilibria by determining the probabilities p_a (of the firm complying with a) and p_b (of complying with b) that make the regulator indifferent between inspecting requirement a and requirement b, and vice versa. We then check for deviations through direct comparison of the deviation outcomes and obtain the segmentation above and, in particular, that $\underline{q}^b = \frac{c}{(v-c)\pi_a}$ and $\overline{q}^b = \frac{(v-c)\pi_b - c}{(v-c)\pi_b}$. The full proof of the proposition can be found in Appendix A. □

The game has either a unique equilibrium for high compliance costs $c \geq \underline{c}_l$ in which the firm is always more likely to comply with the easy-to-enforce target ($p_a > p_b$); or a continuum of payoff-equivalent equilibria for low compliance costs $c < \underline{c}_l$ in which the

firm fully complies with both targets. This multiplicity arises because the cheaper it is to comply, the easier it is for the regulator to induce the firm to play (a, b).[11]

4 Improving the Regulator's Funding

In equilibrium, the firm never focuses on the harder-to-enforce target b more than on target a (because $p_a \geq p_b$). That is, even if the regulator has the capacity to inspect both targets, the firm either complies fully (with action profile (a, b)) or ignores b altogether (Proposition 1). In fact, compliance with b can decrease if a regulator receives the capacity to conduct more thorough inspections. While a low-capacity regulator does not always inspect for a, a high-capacity regulator does. When compliance costs are high, anticipated enforcement of a shifts the firm's attention toward the easy-to-enforce target a—because not complying with a is more likely to lead to a challenge—thereby deterring b. Formally, after an increase in regulatory capacity, the firm would stop mixing between $(a, 0)$ and $(0, b)$, and instead play $(a, 0)$ with probability one. We summarize our results in Proposition 3.

Proposition 3 (Expanding Regulator's Capacity)**.** *When the regulator's capacity increases, equilibrium compliance with the easy-to-enforce target a increases if $c > \underline{c}_l$; compliance with the hard-to-enforce target b increases if $\underline{c}_l < c < c_h$, but decreases if $c_h < c < \min\{v/2, \bar{c}_l\}$.*

Proof. The proof follows immediately from Propositions 1 and 2 if $0 < \underline{c}_l < c_h < \bar{c}_l < \frac{v}{2}$ holds. The outer conditions are satisfied under Assumptions 1 and 2. It is then sufficient to show that:

$$\underline{c}_l = \frac{\pi_b \pi_a}{\pi_b + \pi_a + \pi_b \pi_a} < \frac{\pi_b}{1 + \pi_b} = c_h \quad \iff \quad 1 > \frac{\pi_a + \pi_b \pi_a}{\pi_b + \pi_a + \pi_b \pi_a},$$

[11] Proposition 2 accounts for all equilibria except for knife-edge scenarios in which the agents are indifferent between two of the above equilibria. In the Appendix, we demonstrate that no mixed-strategy equilibria exist except those characterized in Proposition 2.

and:

$$c_h = \frac{\pi_b}{1+\pi_b} < \frac{\pi_b \pi_a}{\pi_b + \pi_a - \pi_b \pi_a} = \overline{c}_l \quad \Longleftrightarrow \quad \pi_a > 1 - \pi_a.$$

Both hold under Assumption 2. □

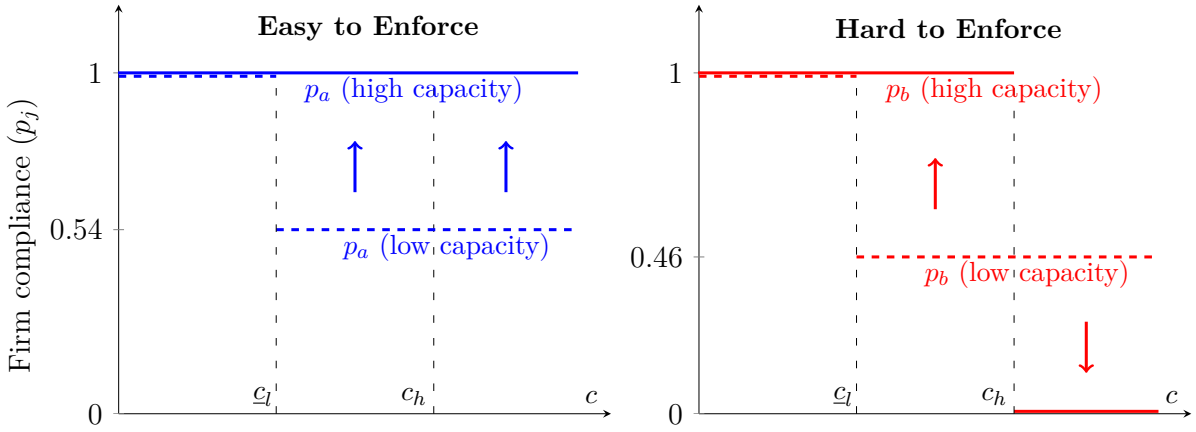
In Figure 1, we depict the equilibrium effects of improving a regulator's resources. In the panels on the left-hand side, we plot the firm's compliance (captured by its strategy p_a) with the easy-to-enforce target a (in blue) for the high-capacity regulator (solid lines) and the low-capacity regulator (dashed lines). The pictures show that expanding the regulator's capacity has an unambiguously (weakly) positive effect on the firm's compliance with a. In the panels on the right-hand side, we plot the firm's compliance with the hard-to-enforce target b (in red). For low or high compliance costs, when the firm is fully complying or not complying at all with b, increasing the regulator's capacity does not affect compliance in equilibrium. Conversely, for intermediate values of compliance costs, when under a low-capacity regulator, the firm randomizes between both targets for partial compliance (that is, for $c_h < c < \min\{\overline{c}_l, \frac{v}{2}\}$ as per Proposition 2(ii) and (iv)), increasing the regulator's capacity *reduces* compliance with the hard-to-enforce target b.

The result in Proposition 3 (and Figure 1) generates a striking insight for regulatory design. When targets have asymmetric enforceability, regulatory capacity alone is not sufficient to enhance compliance with hard-to-enforce targets. While increasing average compliance, expanding regulatory capacity may induce firms to comply with easier-to-enforce targets at the expense of harder ones.

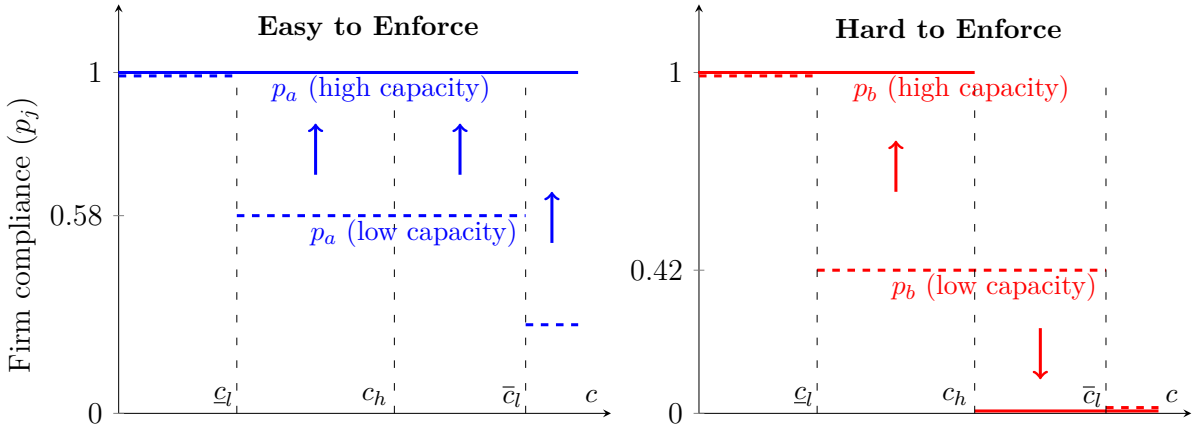
5 Discussion and Concluding Remarks

The model highlights three factors that drive equilibrium behavior in a setting of multi-dimensional (and asymmetric) regulation. The firm's cost of compliance, the regulator's (asymmetric) success probabilities, and the regulator's capacity. While the firm generally complies more with easier-to-enforce targets (in response to anticipating more enforcement by the regulator), the interplay of these factors determines whether and when we can

Figure 1: Effect of Expanding Capacity on Compliance



(a) Low asymmetry case ($\pi_a = 0.75$, $\pi_b = 0.65$)



(b) High asymmetry case ($\pi_a = 0.75$, $\pi_b = 0.55$)

Notes: Equilibrium probability of compliance p with the easy-to-enforce target a (blue) and hard-to-enforce target b (red), with a low capacity (dashed) and high capacity (solid) regulator. Arrows indicate the direction of compliance when the regulator increases its enforcement capacity.

expect more or less compliance with the hard-to-enforce regulatory target (with weaker anticipated enforcement). In this paper, we demonstrate that expanding regulatory capacity may indeed lower compliance when it induces firms to prioritize easy-to-enforce targets over more challenging ones. Improving enforceability by reducing ambiguity, rather than expanding agencies' capacity, is likely more effective in increasing compliance across targets.

We have made several key assumptions for our stylized model. First, the asymmetry in regulation stems from an asymmetry in the enforceability of the regulatory targets. While the regulator's success probabilities differ for the two targets, the compliance costs

and the targets' underlying values (for both the firm and the regulator) are symmetric. Modeling asymmetry in a single dimension while assuming symmetry in the other dimensions keeps the model tractable. Moreover, we assume the asymmetric success probabilities are exogenous rather than determined by the regulator's (strategic) choice of effort. In an alternative specification, the regulator would allocate effort to target different requirements at different intensities (with higher effort increasing the regulator's success probability). With asymmetric cost of effort, such an approach would likely yield asymmetric success probabilities. However, given our goal of examining a firm's compliance under asymmetric regulation by regulators of different capacities, micro-founding the effectiveness of the audit would not enrich our analysis in a substantive way.

Second, detecting *partial* non-compliance (i.e., of just one requirement) is sufficient for the regulator to prevent any adverse societal effects of a firm's activities (by sanctioning the firm, imposing a fine, and possibly compelling a corrective action). For the regulator, the assumption implies that auditing both targets simply increases the probability that the regulator detects at least one non-compliance. This assumption reflects the nature of multi-dimensional regulation. Our objective is to investigate the role of asymmetric enforceability in regulating a single activity subject to multiple requirements. We thus assume that our regulator does not assign different values to the individual requirements but cares about full compliance with respect to the activity itself. It is important to stress this aspect because all requirements in a unified piece of regulation should be understood as aiming toward a common goal: a compliant activity. While not necessarily accurate for all existing examples of regulation, we elect here to abstract from noisy regulatory preferences across different components. In other words, non-compliance in any form undermines the effectiveness of the regulation as a whole and, therefore, generates the same societal loss no matter its specific form.

Third, we take a reduced-form approach to the regulator's budget constraint and the costs of regulation. Enforcing a regulatory target is (symmetrically) costly inasmuch as a constrained regulator (with a binding budget constraint) is not able to enforce both targets (but has to choose), while an unconstrained regulator is able to enforce both.

A more comprehensive model specification would include (symmetric) enforcement costs and a budget constraint. Given enforcement costs, there is a critical capacity threshold at which regulators can enforce both targets; a regulator below that threshold enforces only one target. Our approach is reduced-form, as it assumes a low-capacity regulator with capacity below the threshold and a high-capacity regulator with capacity above the threshold.

Fourth, we assume compliance costs take the form of a reduction in the firm's profitability rather than a one-time fixed cost of compliance. It is natural to wonder how a different specification with sunk compliance costs would affect the results. As it stands, regulatory intervention is modeled as a halt of the non-compliant firm's activities in a one-shot game. A sunk cost does not fit well with this specification, as one would expect an investment cost to be sensible in the context of repeated interactions. Still, the model could incorporate such an alternative by changing the payoff structure and giving a different form to the regulator's intervention. If compliance costs are sunk but the regulator's intervention is unchanged, full non-compliance becomes a much more attractive option mechanically. This would not generate insights of particular interest. Using asymmetric fines to reflect the asymmetric probability of audit success would better fit this alternative environment. In this spirit, it could be a fruitful exercise to compare different kinds of interventions and their relative payoff structures in terms of how they affect compliance when costs are variable (as in our model), fixed (as hypothesized in this paragraph), or both.

Our analysis reveals that a regulator with limited capacity should focus more on the *least* enforceable requirements in its audits if compliance is thought of as a costly choice to incentivize. Therefore, designing regulatory targets without considering enforceability distorts both regulators' incentives to audit and firms' incentives to comply, potentially leading to under-compliance with specific regulatory targets. Increasing the regulatory budget can help mitigate this effect, but it does not guarantee that it will affect compliance with all targets equally. Instead, reducing enforceability asymmetry by providing unambiguous measures to test compliance would dampen the risk that different levels of

ambiguity cannibalize regulatory targets that require regulators' attention.

References

Armstrong, Mark and David E. M. Sappington, "Regulation, Competition, and Liberalization," *Journal of Economic Literature*, 2006, *44* (2), 325–366.

Averch, Harvey and Leland L. Johnson, "Behavior of the Firm Under Regulatory Constraint," *American Economic Review*, 1962, *52* (5), 1052–1069.

Bailey, Elizabeth E. and Roger D. Coleman, "The Effect of Lagged Regulation in an Averch-Johnson Model," *Bell Journal of Economics and Management Science*, 1971, *2* (1), 278–292.

Colangelo, Giuseppe and Alba Ribera Martínez, "The Metrics of the DMA's Success," *European Journal of Risk Regulation*, 2025, *16* (1), 1–21.

de Janvry, Alain, Guojun He, Elisabeth Sadoulet, Shaoda Wang, and Qiong Zhang, "Subjective Performance Evaluation, Influence Activities, and Bureaucratic Work Behavior: Evidence from China," *American Economic Review*, 2023, *113* (3), 766–799.

Decarolis, Francesco, Gaétan de Rassenfosse, Leonardo M. Giuffrida, Elisabetta Iossa, Vincenzo Mollisi, Emilio Raiteri, and Giancarlo Spagnolo, "Buyers' Role in Innovation Procurement: Evidence from US Military R&D Contracts," *Journal of Economics & Management Strategy*, 2021, *30* (4), 697–720.

Dresher, Melvin, *A Sampling Inspection Problem in Arms Control Agreements: A Game-Theoretic Analysis*, Santa Monica, Cal.: RAND Corporation, 1962.

Erard, Brian and Jonathan S. Feinstein, "Honesty and Evasion in the Tax Compliance Game," *RAND Journal of Economics*, 1994, *25* (1), 1–19.

Fellingham, John C. and Paul Newman, "Strategic Considerations in Auditing," *Accounting Review*, 1985, *60* (1), 634–650.

Fernández-i Marín, Xavier, Markus Hinterleitner, Christoph Knill, and Yves Steinebach, "Policy Growth, Implementation Capacities, and the Effect on Policy

Performance," *Governance*, 2024, *37* (3), 927–945.

Ganglmair, Bernhard, Julia Krämer, and Jacopo Gambato, "Regulatory Compliance with Limited Enforceability: Evidence from Privacy Policies," CRC Discussion Paper 547, Collaborative Research Center Transregio 224, Bonn and Mannheim 2024.

Graetz, Michael, Jennifer Reinganum, and Louis Wilde, "The Tax Compliance Game: Toward an Interactive Theory of Law Enforcement," *Journal of Law, Economics, and Organization*, 1986, *2* (1), 1–32.

Gulen, Huseyin and Brett W. Myers, "The Selective Enforcement of Government Regulations: Battleground States, State Regulators, and the Environmental Protection Agency," *Journal of Law and Economics*, 2024, *67* (1), 225–263.

Heyes, Anthony G., "Environmental Enforcement when 'Inspectability' is Endogenous: A Model with Overshooting Properties," *Environmental and Resource Economics*, 1994, *4*, 479–494.

Holmstrom, Bengt and Paul Milgrom, "Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design," *Journal of Law, Economics, and Organization*, 1991, *7* (Special Issue), 24–52.

Hong, Fuhai, Tanjim Hossain, John A. List, and Migiwa Tanaka, "Testing the Theory of Multitasking: Evidence From a Natural Field Experiment in Chinese Factories," *International Economic Review*, 2018, *59* (2), 511–536.

Hunter, William J. and Michael A. Nelson, "Tax Enforcement: A Public Choice Perspective," *Public Choice*, 1995, *82* (1/2), 53–67.

Keeler, Andrew, "Regulatory Objectives and Enforcement Behavior," *Environmental and Resource Economics*, 1995, *6* (1), 73–85.

Knutsson, Daniel and Björn Tyrefors, "The Quality and Efficiency of Public and Private Firms: Evidence from Ambulance Services," *Quarterly Journal of Economics*, 2022, *137* (4), 2213–2262.

Laffont, Jean-Jacques and Jean Tirole, *A Theory of Incentives in Procurement and Regulation*, Cambridge, Mass.: MIT Press, 1993.

Macho-Stadler, Ines and David Perez-Castrillo, "Optimal Enforcement Policy and

Firms' Emissions and Compliance with Environmental Taxes," *Journal of Environmental Economics and Management*, 2006, *51* (1), 110–131.

McLaughlin, Patrick A. and Tyler Richards, "On the Design of a Regulatory System," *Journal of Benefit-Cost Analysis*, 2025, *16* (S1), 139–143.

Nissenbaum, Helen, "A Contextual Approach to Privacy Online," *Daedalus (Journal of the American Academy of Arts & Sciences)*, 10 2011, *140* (4), 32–48.

Sherman, Roger, "Capital Waste in the Rate-of-Return Regulated Firm," *Journal of Regulatory Economics*, 1992, *4*, 197–204.

Stern, Jon, "Electricity and Telecommunications Regulatory Institutions in Small and Developing Countries," *Utilities Policy*, 2000, *9* (3), 131–157.

Sweeney, George, "Adoption of Cost-Saving Innovations by a Regulated Firm," *American Economic Review*, 1981, *71* (3), 437–447.

Viscusi, W. Kip, Jr. Joseph E. Harrington, and John M. Vernon, *Economics of Regulation and Antitrust*, Cambridge, Mass.: MIT Press, 2005.

Zhang, Ruohao, Huan Li, and Neha Khanna, "Monitoring and Enforcement and Environmental Compliance: Power Plant Emissions During the 2018–19 Federal Government Shutdown," *Journal of the Association of Environmental and Resource Economists*, 2025, *12* (5), 1355–1388.

A Proof of Proposition 2

We look for mixed strategy equilibria. The regulator is indifferent between i_a and i_b if the firm plays $(a, 0)$ with probability p_a; $(0, b)$ with probability p_b; and $(0, 0)$ with probability $1 - p_a - p_b$. These probabilities satisfy:

$$\begin{aligned}(1 - p_a - p_b)(1 - \pi_a)(-\gamma) - p_a\gamma - p_b(1 - \pi_a)\gamma \\ = (1 - p_a - p_b)(1 - \pi_b) \quad (-\gamma) - p_a(1 - \pi_b)\gamma - p_b\gamma.\end{aligned}$$

Rearranging yields:

$$p_b \in \left[0, \frac{\pi_b}{\pi_a + \pi_b}\right], \quad p_a = \frac{\pi_a - (1 - p_b)\pi_b}{\pi_a} > 0, \quad \text{and} \quad 1 - p_a - p_b = (1 - p_b)\frac{\pi_b}{\pi_a} - p_b.$$

The firm is indifferent between $(a,0)$ and $(0,b)$ or $(a,0)$ and $(0,0)$ if i_a is played with probabilities $q_{a|b}$ or $q_{a|0}$. These probabilities solve:

$$q_{a|b}\,(v-c)+\left(1-q_{a|b}\right)(1-\pi_b)\,(v-c)=q_{a|b}\,(1-\pi_a)\,(v-c)+\left(1-q_{a|b}\right)(v-c)$$

and

$$q_{a|0}\,(v-c)+\left(1-q_{a|0}\right)(1-\pi_b)\,(v-c)=q_{a|0}\,(1-\pi_a)\,v+\left(1-q_{a|0}\right)(1-\pi_b)\,v$$

so that

$$q_{a|b}=\frac{\pi_b}{\pi_a+\pi_b},\quad q_{a|0}=\frac{(1-\pi_b)\,c}{\pi_a v-\pi_b c}.$$

We check for profitable deviations. In the equilibrium with the firm mixing between $(a,0)$ and $(0,b)$, it holds:

$$\begin{aligned}
E[(a,0)]|_{q_{a|b}}=E[(0,b)]|_{q_{a|b}} &= \frac{\pi_b}{\pi_a+\pi_b}\,(v-c)+\left(1-\frac{\pi_b}{\pi_a+\pi_b}\right)(1-\pi_b)\,(v-c)\\
&= \frac{(v-c)[\pi_a(1-\pi_b)+\pi_b]}{\pi_a+\pi_b}\\
E[(0,0)]|_{q_{a|b}} &= \frac{\pi_b}{\pi_a+\pi_b}\,(1-\pi_a)\,v+\left(1-\frac{\pi_b}{\pi_a+\pi_b}\right)(1-\pi_b)\,v\\
&= \frac{v[\pi_a+\pi_b-2\pi_a\pi_b]}{\pi_a+\pi_b}
\end{aligned}$$

By direct comparison, $E[(a,0)]|_{q_{a|b}}=E[(0,b)]|_{q_{a|b}}>\max\{E[(0,0)]|_{q_{a|b}},v-2c\}$ if, and only if,

$$\begin{aligned}
\frac{1}{2}<\pi_b<\min\left(\pi_a,\frac{\pi_a}{3\pi_a-1}\right)\leq\frac{2}{3} \quad\wedge\quad c<\frac{\pi_b\pi_a}{\pi_b+\pi_a-\pi_b\pi_a}v,\\
\frac{\pi_a}{3\pi_a-1}<\pi_b<\pi_a<1 \quad\wedge\quad c<\frac{v}{2},\\
c<\frac{\pi_b\pi_a}{\pi_b+\pi_a+\pi_b\pi_a}v.
\end{aligned}$$

In the equilibrium in which the firm mixes between $(d,0)$ and $(0,0)$, it holds:

$$\begin{aligned}
E[(a,0)]|_{q_{a|0}}=E[(0,0)]|_{q_{a|0}} &= \frac{(1-\pi_b)\,c}{\pi_a v-\pi_b c}\,(1-\pi_a)\,v+\left(1-\frac{(1-\pi_b)\,c}{\pi_a v-\pi_b c}\right)(1-\pi_b)\,v\\
&= \frac{(v-c)v\pi_a(1-\pi_b)}{\pi_a v-\pi_b c},
\end{aligned}$$

and

$$\begin{aligned} E[(0,b)]|_{q_{a|0}} &= \frac{(1-\pi_b)\,c}{\pi_a v - \pi_b c}(1-\pi_a)(v-c) + \left(1 - \frac{(1-\pi_b)\,c}{\pi_a v - \pi_b c}\right)(v-c) \\ &= \frac{(v-c)[v\pi_a - c\pi_b - c\pi_b(1-\pi_a)]}{\pi_a v - \pi_b c}. \end{aligned}$$

Again, by direct comparison, $E[(a,0)]|_{q_{a|0}} = E[(0,0)]|_{q_{a|0}} > \max\{E[(0,b)]|_{q_{a|0}}, v-2c\}$ if, and only if,

$$\frac{1}{2} < \pi_b < \min\left(\pi_a, \frac{\pi_a}{3\pi_a - 1}\right) \leq \frac{2}{3} \quad \wedge \quad c > \frac{\pi_b \pi_a}{\pi_b + \pi_a - \pi_b \pi_a} v.$$

No other equilibria can exist for $c > \underline{c}_l = \frac{\pi_b \pi_a}{\pi_b + \pi_a + \pi_b \pi_a} v$.

For $c < \underline{c}_l$, the firm never plays $(0,0)$ with positive probability. We compare (a,b) and mixing between $(a,0)$, $(0,b)$. First, (a,b) dominates for $c < \underline{c}_l = \frac{\pi_b \pi_a}{\pi_b + \pi_a + \pi_b \pi_a} v$, and infinite payoff equivalent equilibria exist for $c < \underline{c}_l$. In these equilibria, the firm plays (a,b) with probability one; the regulator mixes between i_a and i_b. Recall that:

$$\begin{aligned} E[(a,0)]|_{q_{a|b}} &= q_{a|b}(v-c) + \left(1 - q_{a|b}\right)(1-\pi_b)(v-c) \\ E[(0,b)]|_{q_{a|b}} &= q_{a|b}(1-\pi_a)(v-c) + \left(1 - q_{a|b}\right)(v-c) \end{aligned}$$

We are interested in values q that make the firm weakly better off selecting (a,b) than $(a,0)$ or $(0,b)$. The former case arises when

$$v - 2c > q(v-c) + (1-q)(1-\pi_b)(v-c),$$

which is equivalent to:

$$q \leq \overline{q}^b := \frac{(v-c)\pi_b - c}{(v-c)\pi_b}.$$

The latter arises when $v - 2c \geq q(1-\pi_a)(v-c) + (1-q)(v-c)$, which is equivalent to:

$$q \geq \underline{q}^b := \frac{c}{(v-c)\pi_a}.$$

For all $c \in (0, \underline{c}_l)$, any strategy in which the regulator plays i_a with probability $q_{a|b} \in [\underline{q}^b, \overline{q}^b]$ induces the firm to play (a,b) with probability one. Notice that $c \in (0, \underline{c}_l)$ is a necessary condition for it holds $\underline{q}^b < \overline{q}^b$ to hold.

No other equilibria exist. Suppose a mixed-strategy equilibrium exists that involves

the firm playing (a, b) with some positive probability different from one. Then, the regulator will optimally play the best response to the other action with probability one, to which the firm's best response is something different from (a, b).