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Private and Public Control of Management

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Private and Public Control of Management*

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Abstract

This paper investigates the design of a leniency policy to fight corporate crime. We explicitly take into account the agency problem within the firm. We model this through a three-tier hierarchy: authority, shareholder, and manager. The manager may breach the law and report evidence to the authority. The shareholder writes the manager's incentive scheme, monitors him, and possibly reports evidence to the authority. Finally, the authority designs a sanctioning/leniency policy that deters corporate crime at the lowest possible cost. The authority designs its policy trying to both (i) exacerbate agency problems within non-compliant firms and (ii) alleviate agency problems within compliant firms. We find that depending on the authority's ability to punish the manager, the authority may wish to instigate a "within-firm race to the courthouse". We also provide comparative statics, carry a welfare analysis and discuss policy implications.

Keywords: corporate crime, white-collar crime, leniency, compliance, antitrust
JEL codes: K21, K42, L40

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1 Introduction

Corporate scandals involving serious misconduct by management, such as Enron or Olympus, frequently make the headlines and invariably trigger debates among policy makers, economists, and legal scholars alike. Managerial fraud can include the falsification of financial statements, the violation of environmental or safety rules, price-fixing, bribery, and tax evation. The social and financial consequences can be colossal. To prevent white-collar crime new laws and regulations are regularly designed. The Sarbanes-Oxley act was for instance introduced in 2002 to foster corporate governance rules.[1] Policy makers however often highlight the lack of relevant empirical and theoretical work to inform their choices (see Dyck, Morse and Zingales (2011)). Public control of management (the law) is indeed difficult because of its intricate interaction with the private control of management (within-firm incentives). Yet, when investigating the issue of corporate crime, economics has tended to treat the firm as a single agent. This may explain in part why many existing policies, for instance corporate reporting mechanisms, also ignore the agency problem within the firm. In this paper we provide a simple theoretical framework taking into account this agency problem and aiming at guiding policy prescriptions. We make the case that judicial tools exploiting within-firm dynamics, such as individual leniency programs, may help prevent managerial fraud.

Our work closely relates to a broad literature on self-reporting schemes (see Kaplow and Shavell (1994), Motta and Polo (2003), Spagnolo (2004) and Harrington (2008)) that either considers situations in which a single individual decides whether to breach the law or several firms engage in price-fixing. Our contribution lies in that we investigate leniency programs designed to deter conspiracies implemented by hierarchies of individuals plagued by information asymmetires but linked by employment contracts acting as coordination devices.[2]

We model the interaction between a judicial authority and a vertically separated firm, consisting of a (large) shareholder and a manager.[3] The authority's objective is to deter corporate crime at the lowest possible cost of launching public investigations. To this end, it designs corporate and managerial sanctions contingent on whether the shareholder or the manager brings forward evidence of managerial misconduct. If the authority receives such a report, the relevant sanctions are immediately applied. Otherwise, the authority investigates the firm with some probability and imposes sanctions if it uncovers evidence by itself.

Reacting to the legal environment, the shareholder writes an incentive scheme that either encourages or discourages a breach of the law by the manager. When choosing which action to

[1] See www.sec.gov/about/laws/soa2002.pdf.

[2] Segerson and Tietenberg (1992) already noted this dimension of employment contracts.

[3] We refer to the manager in the male form (he/his), the shareholder in the female form (she/her), and the authority in the neutral form (it/its).

induce, she weights the respective salary costs and possible legal sanctions. Incentive schemes are unobservable to the authority because agreed upon behind closed doors.[4] The shareholder also monitors the manager, and decides whether to report evidence to the authority whenever in possession of evidence. Finally, the manager, responding to the incentives provided both by the shareholder and the authority, decides whether to breach the law (thereby enjoying some private gains) and whether to file for individual leniency.

Our main result is that, whenever its ability to sanction the manager is limited, the authority designs both *corporate* and *individual leniency programs* so as to instigate a "within-firm race to the courthouse". As we discuss below, this is in contrast with current practice in the US and Europe on several dimensions.

Corporate leniency. Granting a sufficiently large reduction in the corporate fine in return for evidence brought forward by the shareholder incentivizes the latter to indeed blow the whistle whenever (i) she finds evidence through internal monitoring and (ii) wishes her manager to abide by the law. This increases the expected managerial fine as the manager is sanctioned by the authority not only in case of a succesful public investigation, but also in case of a succesful internal investigation. This, in turn, reduces the manager's incentives to breach the law and it becomes cheaper for the shareholder to prevent managerial misconduct. The reduction in the corporate sanction is however only *partial* so as to avoid a breach-inducing shareholder from abusing the program by letting breaches occur and systematically filing for leniency.

Individual leniency. An individual leniency program makes corporate crime more attractive to the manager as he may then benefit both from the breach *and* the amnesty. As a result, individual leniency forces the non-compliant shareholder to bribe her manager not to file for leniency to avoid the ensuing corporate sanction, but also increases salary costs for the compliant shareholder to prevent such a lucrative managerial strategy.[5] Such a program is implemented if and only if doing so worsens relatively more the agency problem within the non-compliant firm than within the compliant firm.

The increase in the salary cost to prevent misconduct due to individual leniency occurs only if the cap on the managerial fine is sufficiently high. The intuition is as follows. The

[4]This assumption fits with a literature investigating how incentive schemes can be designed to achieve socially undesirable outcomes (see for instance Fershtman and Judd (1987), Sklivas (1987), Scharfstein (1988), Schmidt (1997), Spagnolo (2000, 2005), and Inderst and Ottaviani (2009). Contrarily to these papers, we explicitly model how the choice of incentive schemes interacts with a judicial authority's policy.

[5]Opening the black box of the firm, but in a price-fixing context, Aubert (2009) also noted the ambiguous impact of individual leniency on the corporation. Unlike us, however, a characterization of the optimal individual leniency program is not provided.

optimal managerial contract to prevent a breach is such that a reward is granted whenever (i) no evidence is uncovered through either the private or public investigations and (ii) the manager does not file for leniency. A manager deviating from the shareholder's wish and breaching the law thus prefers self-reporting rather than remaining silent (and possibly enjoying a reward if the fraud goes undetected) only if the amnesty is very tempting; that is, only if the otherwise faced sanction is high. Thus, granting individual leniency increases salary costs only when the cap on the managerial fine is sufficiently high.

In contrast, the expected cost of inducing a breach always increases in case individual leniency is granted. Indeed, the optimal contract to induce a breach is such that a compensation is granted whenever (i) the authority convicts the manager and (ii) the latter does not file for leniency. The manager may deviate from the shareholder's wish either by "not breaching the law" or by "breaching the law and self-reporting". However, since a conviction (and thus a compensation) never occurs if the manager is innocent, the payoff associated to "breaching the law and self-reporting" is always higher. That is, granting individual leniency always increases the salary costs of a non-compliant shareholder.

When the managerial fine is low, therefore, granting individual leniency is optimal as it leaves unaffected the shareholder's cost of complying with the law but increases that of not complying the law. This better aligns incentives between the shareholder and the authority. When the managerial fine is high, granting individual leniency always hurts the shareholder, whether preventing breaches or letting them occur. We show that whenever internal monitoring is very efficient—and the shareholder does not rely on the authority to deter breaches—it is optimal to grant individual leniency.

Policy Implications. These results concerning corporate and individual leniency programs are in contrast to existing practice in both the US and Europe.[6] Indeed, while self-reporting mechanisms do exist, these tend to be either corporate programs (the application is made on behalf of the firm) or whistleblowing programs (the informant is not directly involved with the misdeed).[7] We argue that in addition to these self-reporting schemes, individual leniency programs—the informant is the individual physically breaching the law—may also constitute powerful policy tools. The distinction between the firm as a legal entity and the manager is relevant because, as our results suggest, amnesty should be granted only to the informant, and not to everyone within the firm. This is also in contrast to existing practice whereby

[6]See for instance the Sarbanes-Oxley act, the Deparment of Justice's *Leniency Program(s)*, the Department of Defense's *Contractor Disclosure Program*, the EPA's *Audit Policy* and the Federal Energy Regulatory Commission's *Self-reporting Scheme*. We discuss at greater length existing practice in Section 4.

[7]Aubert, Rey and Kovacic (2006) consider a set-up in which the firm commits the crime and employees observe it. They argue that it is optimal to reward employees for blowing the whistle in order to worsen the firm's internal incentives.

corporate leniency extends to all employees, even those physically breaching the law.

Relative effectiveness of sanctions. We find that managerial fines tend to be more efficient that corporate fines at decreasing the necessary amount of public investigations. In a nutshell, this is due to (i) leniency programs, (ii) the employment contract linking the shareholder to the manager, and (iii) information asymmetries within the firm. Because of the corporate leniency program, if the shareholder wishes her manager to abide by the law, the latter effectively faces two "watchdogs" and the managerial sanction is then imposed relatively often. In contrast, if the shareholder lets her manager breach the law, through her design of the employment contract, she bribes the latter into remaining silent. This effectively shuts down the manager's temptation to act as a "watchdog" on the shareholder, thereby giving rise to an asymmetry in both sanctions. In addition, moral hazard within the firm leads to detrimental inefficiencies/information rents that are minimized by targetting directly the manager. Overall, therefore, managerial fines tend to be more efficient than corporate fines in our model. As we explain in greater detail in the course of the analysis, these results are somewhat in contrast with those present in Segerson and Tietenberg (1992), Polinsky and Shavell (1993) and Shavell (1997).

Welfare analysis. Whilst most of our analysis is carried out assuming that the authority's objective is to deter breaches at the lowest possible cost of lauching investigations, we also investigate the desirability of leniency programs when the authority maximizes social welfare. We show that the partial corporate leniency program is socially optimal. As we explained above, however, granting individual leniency exacerbates the firm's agency problem—and raises salary costs—regardless of the managerial action induced by the shareholder. An individual leniency program thus amounts to transferring compliance costs from the authority to the shareholder. Our results suggest that granting individual leniency is socially optimal not only when it increases relatively more the salary cost to induce a breach than the one to prevent a breach, but also when the cost of public investigations is relatively high.

We proceed by presenting the model set-up in Section 2. We solve the model in Section 3: we derive the optimal leniency policy and the "within-firm race to the courthouse" effect (3.1–3.2), determine the interaction between leniency and internal monitoring (3.3), present comparative statics (3.4), and study the welfare consequences of leniency programs (3.5). A discussion of the policy implications is provided in Section 4. Section 5 concludes.

2 Set-up of the Model

In this section, we present the set-up of the model. We first introduce the outline and players of the game, then state the player's strategy space as well as information and payoffs, and close this section with the timing of the game.

Outline & players. We consider a three-tier hierarchy (illustrated in Figure 1): a (large) shareholder contracts with a manager who runs the firm and possibly breaches the law.[8] An authority aims at deterring breaches of the law at the lowest investigation cost. The shareholder monitors the manager—through for instance a compliance program[9]—and uncovers hard evidence of a breach having occurred with some probability. Both the manager and the shareholder can blow the whistle by reporting evidence to the authority, which then imposes corporate and managerial fines. If neither the shareholder nor the manager blow the whistle, the authority investigates the firm with some probability and imposes fines when a breach of the law is uncovered.

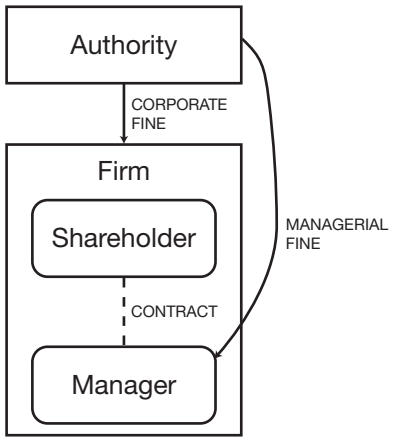

FIGURE 1 – *The players: authority, shareholder, and manager.*

Actions

Manager's actions. The manager takes action $a \in \{b, n\}$, where b is breaching the law and n is not breaching the law. This action is unobservable to both the shareholder and the authority. If the manager breached the law, she may report evidence to the authority.

[8] One may give different interpretations to our hierarchy: *authority - seller of a product - salesman* (Inderst and Ottaviani, 2009), *authority - seller of a financial product - broker*, or *society - lender - entrepreneur*.

[9] A compliance program is a corporate scheme designed to train and monitor employees, as well as discipline them in case of misconduct. See 2010 US Sentencing Guidelines §8B2.1, available at <http://www.ussc.gov/Guidelines/Organizational_Guidelines/guidelines_chapter_8.htm>.

Shareholder's actions. The shareholder offers the manager a take-it-or-leave-it employment contract, which is contingent on all available information; see the upcoming "Employment contract" section. The shareholder also monitors her manager and possibly gathers hard evidence of managerial misconduct.[10] Whether the shareholder finds such evidence is indicated by the signal $\sigma \in \{0, 1\}$, where $\sigma = 1$ means evidence and $\sigma = 0$ means no evidence. The realization of the signal is observed only by the shareholder. Table 2 contains the probability distribution of signal σ, given managerial action a.

	$a = b$	$a = n$
$\Pr[\sigma = 1 \mid a]$	ρ_σ	0
$\Pr[\sigma = 0 \mid a]$	$1 - \rho_\sigma$	1

TABLE *2 – Probability distribution of signal σ, given managerial action a.*

Both the manager and the shareholder choose whether to report evidence to the authority. We denote the manager's strategy to report evidence to the authority, whenever he breached the law, by $\Re_m \in \{\emptyset, r\}$, where $\Re_m = \emptyset$ means no report and $\Re_m = r$ means report. The shareholder's strategy to report evidence to the authority, whenever she uncovers evidence, is $\Re_s \in \{\emptyset, R\}$, where $\Re_s = \emptyset$ means no report and $\Re_s = R$ means report.

In case both the manager and the shareholder adopt the strategy to report evidence whenever it becomes available, we assume that the manager, being the economic agent physically breaching the law, is able to run faster than the shareholder to the authority.[11] We denote "whether someone reports and who reports first" technically by

$$\Re = \begin{cases} r & \text{if the authority receives a report from the manager first} \\ R & \text{if the authority receives a report from the shareholder first} \\ \emptyset & \text{if the authority receives no report.} \end{cases}$$

Authority's actions. If the authority receives a report, i.e., if $\Re \in \{r, R\}$, the authority imposes corporate fine $F_\Re \leq \overline{F}$ and individual fine $f_\Re \leq \overline{f}$, where $\overline{F}$ and $\overline{f}$ are the legal caps predetermined by the law,[12] the employment contract is executed, and the game ends. For simplicity, we set f_r to be either equal to zero (full amnesty) or equal to $\bar{f}$ (no amnesty).

[10] We assume that evidence is hard so as to allow for a leniency policy as observed in practice. An authority (or a court) requires hard factual evidence in exchange for possible leniency from sanctions. The Department of Defense's *Contractor Disclosure Program* for instance requires "credible evidence of a violation of federal criminal law involving fraud, conflict of interest, bribery, (...)".

[11] This assumption is notationally most convenient. Other rules could have been adopted—for example, a coin is flipped to decide who arrives at the authority first—but results are qualitatively similar.

[12] The maximum fines are either explicitly written in the law or determined by case law (jurisprudence).

If the authority receives no report, i.e., if $\Re = \emptyset$, the authority investigates the firm with probability β, which the authority sets at the start of the game. Through this investigation, the authority either (i) finds hard evidence of a breach, in which case the shareholder-manager pair is convicted ($\tau = 1$) and corporate fine $F_\emptyset \leq \overline{F}$ and individual fine $f_\emptyset \leq \overline{f}$ are imposed, or (ii) finds no evidence, in which case no conviction takes place ($\tau = 0$). Provided that an investigation takes place, Table 3 presents the probabilities of a conviction (evidence) or no conviction (no evidence).

	$a = b$	$a = n$
$\Pr[\tau = 1 \mid a]$	ρ_τ	0
$\Pr[\tau = 0 \mid a]$	$1 - \rho_\tau$	1

TABLE *3 – Probability of conviction* ($\tau = 1$) *after an investigation, given managerial action* a.

Throughout the paper we somewhat abusively denote the event whereby no evidence has been gathered by the authority because no public investigation has been lunched by $\tau = \emptyset$.

Employment contract. Consider now the take-it-or-leave-it employment contract offered by the shareholder to the manager. This contract specifies transfers $t_{\Re,\sigma,\tau}$ contingent on all available information, that is, who (if anybody) reports to the authority $\Re \in \{\emptyset, r, R\}$, the realization of $\sigma \in \{0, 1\}$ and, if the authority investigates, conviction $\tau \in \{0, 1\}$. These transfers $t_{\Re,\sigma,\tau}$ are associated with states of nature $\{\Re, \sigma, \tau\}$, where the probability of each state is denoted $p^a_{\Re,\sigma,\tau}$ and depends on managerial action a as well as reporting strategies $\Re_m$ and $\Re_s$. In the course of the analysis we often refer to the shareholder as being compliant (non compliant) if the employment contract induces action $a = n$ ($a = b$).

When solving the model, we assume that the shareholder can commit to the transfers specified in the employment contract.[13] Since however the realization of evidence through internal monitoring ($\sigma = 1$) is privately observed by the shareholder, for a contract to constitute an equilibrium it must be interim rational. As a result, denoting $\Re_s$ the equilibrium reporting strategy (noting that the manager no longer has the opportunity to self-report, see timing below) we require

$$\begin{aligned} &\beta\left(\rho_\tau t_{\Re_s,0,1} + (1-\rho_\tau)\, t_{\Re_s,0,0}\right) + (1-\beta)\, t_{\Re_s,0,\emptyset} + E_{\emptyset,\Re_s}[F] \geq \\ &\beta\left(\rho_\tau t_{\emptyset,1,1} + (1-\rho_\tau)\, t_{\emptyset,1,0}\right) + (1-\beta)\, t_{\emptyset,1,\emptyset} + E_{\emptyset,\emptyset}[F], \end{aligned} \tag{1}$$

[13]This assumption, capturing the fact that the relationship between the shareholder and the manager is repeated, is in line with the *collusion in hierarchies* literature (see Tirole (1986).

that is, the shareholder finds it optimal to truthfully reveal to the manager that she found evidence and execute the employment contract (and the reporting strategy) accordingly instead of not telling the manager that she found evidence and execute the contract *as if* no evidence was found (and thus not report evidence to the authority). Note that our signal structure is such that this temptation exists only if $\sigma = 1$.

Information. All actions are publicly observable, except (i) whether the manager breaches the law, which is privately observed by the manager and (ii) the employment contract designed by the shareholder, which is known only to the shareholder and the manager, even in case of an investigation by the authority. We thus adopt the conventional wisdom whereby the logic behind bonuses and promotions is opaque to outsiders, but perfectly understandable to insiders.[14] Finally, the realization of the internal investigation σ is known only to the shareholder.

It is worth emphasizing that gathered evidence, either through internal monitoring or through a public investigation, is perfectly informative of the manager having breached the law. Contrarily, not finding evidence does not imply that no breach occurred. This captures the fact that proving innocence typically amounts to failing to establish guilt. We discuss this further in Section 5.

Payoffs. All players are risk neutral. The expected fines depend on the reporting strategy of the manager $\Re_m$ as well as that of the shareholder $\Re_s$. If the manager breaches the law, the shareholder faces expected corporate fine

$$E_{\Re_m,\Re_s}[F] = \begin{cases} F_r & \text{if } \Re_m = r,\ \Re_s \in \{\emptyset, R\} \\ \beta\rho_\tau F_\emptyset & \text{if } \Re_m = \emptyset,\ \Re_s = \emptyset \\ \underbrace{\rho_\sigma F_R}_{A} + \underbrace{(1-\rho_\sigma)\,\beta\rho_\tau F_\emptyset}_{B} & \text{if } \Re_m = \emptyset,\ \Re_s = R, \end{cases} \tag{2}$$

and the manager faces expected managerial fine

$$E_{\Re_m,\Re_s}[f] = \begin{cases} f_r & \text{if } \Re_m = r,\ \Re_s \in \{\emptyset, R\} \\ \beta\rho_\tau f_\emptyset & \text{if } \Re_m = \emptyset,\ \Re_s = \emptyset \\ \underbrace{\rho_\sigma f_R}_{A} + \underbrace{(1-\rho_\sigma)\,\beta\rho_\tau f_\emptyset}_{B} & \text{if } \Re_m = \emptyset,\ \Re_s = R. \end{cases} \tag{3}$$

[14] This captures the idea that in many cases it is difficult for the judicial system to establish the set of incentives in place at the time of the infringement. Thus, whenever we find that the optimal policy is to sanction the shareholder, this is not based on factual evidence of culpability, but on efficiency grounds. We thank Michael Riordan for pointing this out.

The expected fines when the shareholder reports evidence, whenever she finds it, consists of two parts: (A) with probability ρ_σ the shareholder finds evidence and blows the whistle, in which case the authority imposes fines F_R and f_R, and (B) with probability $(1-\rho_\sigma)$ the shareholder finds no evidence, in which case the authority investigates the firm with probability β and finds evidence with probability ρ_τ, after which fines $F_\emptyset$ and $f_\emptyset$ are imposed.

Given managerial action a and reporting strategies $\Re_m$ and $\Re_s$, the expected transfer to the manager by the shareholder is

$$E_{\Re_m,\Re_s}\left[t^a\right] = \sum_{\Re\in\{\emptyset,r,R\}} \sum_{\sigma\in\{0,1\}} \sum_{\tau\in\{\emptyset,0,1\}} p^a_{\Re,\sigma,\tau} t_{\Re,\sigma,\tau}.$$

Shareholder's payoff. The shareholder pays out managerial salary $t_{\Re,\sigma,\tau}$. The shareholder's expected payoff $\Pi^a_{\Re_m,\Re_s}$ is then

$$\Pi^a_{\Re_m,\Re_s} = \begin{cases} -E_{\Re_m,\Re_s}\left[t^n\right] & \text{if } a=n \\ -E_{\Re_m,\Re_s}\left[t^b\right] - E_{\Re_m,\Re_s}\left[F\right] & \text{if } a=b. \end{cases} \tag{4}$$

To limit the number of cases we do not model the firm's profits (which could very well depend on the manager's action) as these do not modify importantly employment contracts and simply shift up or down the authority's investigation probability. We discuss this further in Section 5. Importantly, even without a profit motive, the shareholder may still prefer her manager to breach the law if deterring it is too expensive.

Managerial payoff. The manager receives his salary $t_{\Re,\sigma,\tau}$. When breaching the law, he also receives private gain $G \geq 0$, which can be interpreted as a benefit either directly or indirectly resulting from the breach, such as the possibility to work less hard or good reputation on the job market.[15] The manager's expected payoff $U^a_{\Re_m,\Re_s}$ is then

$$U^a_{\Re_m,\Re_s} = \begin{cases} E_{\Re_m,\Re_s}\left[t^n\right] & \text{if } a=n \\ E_{\Re_m,\Re_s}\left[t^b\right] - E_{\Re_m,\Re_s}\left[f\right] + G & \text{if } a=b. \end{cases}$$

The manager is protected by limited liability with respect to salary, but not with respect to the managerial fine.

Authority's payoff. The authority's cost of investigating firms $C(\beta)$ is increasing in the investigation probability, i.e., $C'(\beta) > 0$. Fines are costless to impose and collect.

[15] In Aubert (2009), for example, managerial effort and cartelization are strategic substitutes: forming a cartel allows the manager to exert less costly effort, which is an indirect benefit.

We assume that the authority executes a pre-written law:[16] its objective is to minimize investigation cost $C(\beta)$ subject to breaches being deterred, i.e.,

$$\begin{aligned} \min_{\beta, F_{\Re}, f_{\Re}, \ \forall \Re} \ & C(\beta) && \text{subject to} \\ & F_{\Re} \leq \overline{F}, && \forall \Re, \\ & f_{\Re} \leq \overline{f}, && \forall \Re, \\ & \max\left\{\Pi^{n}_{\Re_m,\emptyset}, \Pi^{n}_{\Re_m,R}\right\} \geq \max\left\{\Pi^{b}_{\Re_m,\emptyset}, \Pi^{b}_{\Re_m,R}\right\}. && (5) \end{aligned}$$

Constraint (5) ensures that the shareholder writes an employment contract that prevents her manager to breach the law, that is, the shareholder's expected payoff when inducing a breach (RHS) must not be higher than her payoff when preventing a breach (LHS).

In section 3.5, we carry a welfare analysis in which the authority's objective is to deter breaches while taking into account the shareholder's and manager's payoffs.

Timing. The timing of the game is as follows and schematically depicted in Figure 2.[17][18]

1. The authority sets its policy parameters $\beta, \{F_\emptyset, F_r, F_R\}, \{f_\emptyset, f_r, f_R\}$.
2. The shareholder offers a take-it-or-leave-it contract specifying transfers $t_{\Re,\sigma,\tau}$ to the manager, which the manager accepts or rejects.
3. The manager breaches the law or not: $a \in \{b, n\}$.
4. The manager (i) blows the whistle ($\Re_m = r$), after which sanctions are imposed, the contract is executed, and the game ends, or (ii) does not blow the whistle ($\Re_m = \emptyset$).
5. Signal $\sigma \in \{0, 1\}$ is realized. If evidence of a breach materializes ($\sigma = 1$), the shareholder (i) blows the whistle ($\Re_s = R$), after which sanctions are imposed, the contract is executed, and the game ends, or (ii) does not blow the whistle ($\Re_s = \emptyset$).
6. The authority investigates the firm with probability β. If a breach occurred, the authority finds evidence $\tau = 1$ with probability ρ_τ.

[16] Equivalently, we could have assumed that breaches are very detrimental to society.

[17] We consider reporting to (possibly) happen *before* the authority's investigation so as to study the impact of leniency programs on practices that are not yet under investigation. Motta and Polo (2003) show that it can be efficient to reduce fines even when the authority has already started an investigation, but has not yet obtained evidence of misbehavior.

[18] In addition to stage 4, we could have allowed the manager to blow the whistle anywhere between stages 4 and 6. Results would however be identical, while notation would be mathematically more involved. Second, we left out the possibility for the manager to report evidence directly to the shareholder. Once again, results would be qualitatively similar. We discuss this further in Section 5.

7. The employment contract is executed.

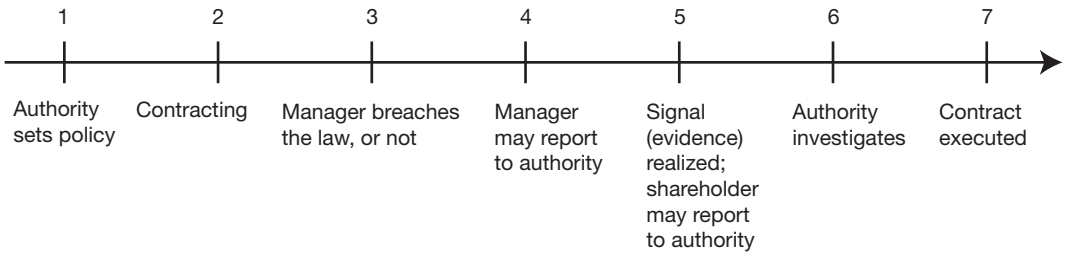

FIGURE 2 – *Timing of the game.*

3 Solving the Model

In Subsection 3.1, we determine the expected transfers associated with the optimal employment contracts. Subsection 3.2 determines the authority's optimal sanctions and leniency policy. Subsection 3.3 determines the interaction between the optimal leniency policy and internal monitoring activities. Subsection 3.4 determines the impact of internal monitoring and other parameters of the model on the optimal level of investigations necessary to deter corporate crime. Finally, Subsection 3.5 carries a welfare analysis.

3.1 Optimal Expected Transfers

In this subsection, we present the expected transfers associated with the optimal employment contract when the shareholder (i) prevents or (ii) induces the manager to breach the law. We proceed by disregarding constraint (1) and assume that the shareholder is not tempted to deviate from the contract after she found evidence, regardless of the action induced. We show this anticipation to be correct in Appendix A.2.

Lemma 1 (Expected transfers) *To prevent a breach, the shareholder rewards the manager if and only if* $\Re = \emptyset$, $\sigma = 0$, *and* $\tau = \emptyset$, *yielding expected transfer*

$$E_{\emptyset,\Re_s}[t^n] = \max\left\{\underbrace{\gamma\left(G - E_{\emptyset,\Re_s}[f]\right)}_{A}, \underbrace{G - f_r}_{B}, 0\right\}.$$

To induce a breach, the shareholder rewards the manager if and only if the manager is convicted and $\Re_m = \emptyset$, yielding expected transfer

$$E_{\emptyset,\Re_s}\left[t^b\right] = \max\left\{\underbrace{E_{\emptyset,\Re_s}\left[f\right] - G}_{C}, \underbrace{E_{\emptyset,\Re_s}\left[f\right] - f_r}_{D}, 0\right\},$$

where

$$E_{\emptyset,\Re_s}\left[f\right] = \begin{cases} \beta\rho_\tau f_\emptyset & \text{if } \Re_s = \emptyset \\ \rho_\sigma f_R + (1-\rho_\sigma)\,\beta\rho_\tau f_\emptyset & \text{if } \Re_s = R \end{cases}$$

is the expected managerial fine, given the shareholder's reporting strategy $\Re_s \in \{\emptyset, R\}$, and

$$\gamma = \frac{1}{1-(1-\rho_\sigma)\,(1-\rho_\tau)} > 1$$

is the measure of information asymmetry between the manager and the shareholder when preventing a breach.

Proof. See Appendix A.1. ∎

When the shareholder wishes her manager to abide by the law, she faces two incentive compatibility constraints (A and B):

(A) She needs to ensure that the manager does not "breach and remain silent". The shareholder most cheaply prevents such behavior by paying a positive transfer if and only if all available information is indicative of no breach having occurred, that is, if and only if $\Re = \emptyset$, $\sigma = 0$, and $\tau = \emptyset$. This amounts to paying the difference between managerial gain G from breaching the law and the expected managerial fine, inflated by the measure of information asymmetries γ.

(B) She needs to ensure that the manager does not "breach and self-report". The optimal way of preventing such behavior is once again to pay a positive transfer if and only if $\Re = \emptyset$, $\sigma = 0$, and $\tau = \emptyset$. The shareholder needs to pay the difference between managerial gain G from breaching and the fine f_r that the manager receives after applying for leniency. There is here no information rent since $\Re = \emptyset$ is perfectly informative of the manager not having blown the whistle.

When the shareholder wishes her manager to breach the law, she also faces two incentive compatibility constraints (C and D):

(C) She needs to ensure that the manager "breaches the law". One (optimal) way of achieving this objective is to pay a positive transfer if and only if a public investigation uncovers evidence $\tau = 1$. That is, she optimally compensates the manager for being convicted. She needs to pay the difference between the expected managerial fine and the gain G from breaching. There is no information rent as $\tau = 1$ is perfectly informative of a breach having occurred.

(D) She needs to ensure that the manager does not "breach the law and self-report". One (optimal) way of preventing such behavior is again to pay a positive transfer if and only if the manager is convicted by the authority, i.e. $\tau = 1$. The shareholder needs to pay the difference between the expected managerial fine and the fine f_r that the manager receives after applying for leniency. There is no information rent, because $\Re = \emptyset$ is perfectly informative of the manager not having blown the whistle and $\tau = 1$ is perfectly informative of a breach having occurred.

Before moving on, we comment on the impact of individual leniency on the expected transfers.

Lemma 2 (Impact IL on transfers) *Individual leniency weakly increases both the expected transfer to induce a breach and the expected transfer to prevent a breach.*

Proof. Both $E_{\emptyset,\Re_s}[t^n]$ and $E_{\emptyset,\Re_s}\left[t^b\right]$ in Lemma 1 are weakly increasing as f_r decreases. ■

Lemma 2 highlights that the authority faces a tradeoff when granting leniency to the manager: individual leniency (i) weakly increases the expected transfer to induce a breach as the manager must be compensated for staying silent, but (ii) also weakly increases the expected transfer to prevent a breach as she must compensate the manager for not breaching the law and subsequently self-reporting.

3.2 Sanctions and Leniency Policy: Within-Firm Race to the Courthouse

The authority's objective is to implement a policy that deters breaches at the lowest possible cost $C(\beta)$, i.e., with the lowest possible investigation probability β. Before determining this optimal β in the next subsection, we solve for the optimal schedules of fines, both managerial and corporate, and determine whether and when the authority grants leniency to the shareholder and/or the manager.

Recall that constraint (5) ensures that the shareholder finds it profitable to design an employment contract preventing managerial misconduct. We rewrite (5) as

$$\begin{aligned}&\min\left\{E_{\Re_m,\emptyset}\left[t^b\right]+E_{\Re_m,\emptyset}\left[F\right],E_{\Re_m,R}\left[t^b\right]+E_{\Re_m,R}\left[F\right]\right\}\geq\\&\min\left\{E_{\Re_m,\emptyset}\left[t^n\right],E_{\Re_m,R}\left[t^n\right]\right\},\end{aligned}\tag{6}$$

which allows us to determine the schedules of fines $\{F_{\Re}, f_{\Re}\}$ ensuring that (6) is satisfied for the lowest possible investigation probability β. We do this in the following three propositions.

The first proposition states the optimal sanction for the player who does not bring evidence to the authority (in case the authority comes into possession of evidence, either through an investigation or a report by the other player).

Proposition 1 (Punish when no report) *If the shareholder (manager) does not blow the whistle, the authority maximally punishes her (him) when in possession of evidence. Fines are set to the legal cap, i.e.,*

$$F_{\emptyset}=F_r=\overline{F}\ \textit{and}\ f_{\emptyset}=f_R=\overline{f}.$$

Proof. From Lemma 1, increasing either $f_{\emptyset}$ or f_R weakly increases (respectively) $E_{\Re_m,\emptyset}\left[t^b\right]$ and $E_{\Re_m,R}\left[t^b\right]$, while weakly decreasing (again respectively) $E_{\Re_m,\emptyset}\left[t^n\right]$ and $E_{\Re_m,R}\left[t^n\right]$; this relaxes constraint (6), which is optimal as it allows for a lower investigation probability β. By (2), increasing either $F_{\emptyset}$ or F_r increases $E_{\Re_m,\Re_s}\left[F\right]$, thereby relaxing constraint (6). ■

Whoever did *not* report evidence to the authority is fully punished by the authority in case it uncovers a breach. The intuition is straightforward: economic agents who misbehave are punished in the Beckerian way of setting the sanction as high as possible.

The second proposition states the corporate sanction if the shareholder blows the whistle.

Proposition 2 (Corporate leniency) *If the shareholder reports evidence to the authority, the authority grants partial corporate leniency, i.e.,*

$$F_R\in\left[\tilde{F},\tilde{\tilde{F}}\right],$$

where

$$\tilde{F}=\beta\rho_\tau\bar{F}+E_{\emptyset,\emptyset}\left[t^b\right]-E_{\emptyset,R}\left[t^b\right],$$

and

$$\tilde{\tilde{F}}=(1-\rho_\tau)\max\left\{\frac{G-\left[\rho_\sigma\bar{f}+(1-\rho_\sigma)\,\beta\rho_\tau\bar{f}\right]}{1-(1-\rho_\sigma)\,(1-\rho_\tau)},G-f_r,0\right\}+\beta\rho_\tau\bar{F}.$$

Proof. See Appendix A.2. ■

The proposition states that the authority optimally grants a reduction in the corporate fine when the shareholder brings forward evidence of managerial misconduct, but that this reduction is only *partial*. The intuition is as follows. It is optimal, from both the authority's and the shareholder's viewpoints, to have the shareholder credibly commit to systematically blowing the whistle (that is, whenever $\sigma = 1$), since it raises the expected managerial fine ($E_{\emptyset,R}[f] > E_{\emptyset,\emptyset}[f]$), thereby reducing the manager's temptation to breach the law, thus relaxing (6) and allowing for a lower $C(\beta)$.

However, even if the shareholder wishes to prevent managerial misconduct, because the outcome of the internal monitoring is private information, she might be reluctant to actually blow the whistle if a heavy corporate sanction is subsequently imposed. To solve this issue, the authority helps the shareholder by setting the corporate sanction low enough, i.e. $F_R < \tilde{\tilde{F}}$.[19] On the other hand, the authority also needs to ensure that the non-compliant shareholder does not abuse the corporate leniency program by systematically blowing the whistle so as to enjoy a *certain but low corporate sanction* (though such a strategy implies also a higher compensation for the manager). The authority prevents such a strategy by setting the corporate fine high enough, i.e. $F_R > \tilde{F}$.

In the remainder of the analysis we take into account the fact that a compliant shareholder sets $\Re_s = R$ while a non-compliant shareholder sets $\Re_s = \emptyset$. The third proposition states the managerial sanction in case the manager blows the whistle.

Proposition 3 (Individual leniency) *Whether the authority finds it optimal to grant individual leniency to a self-reporting manager depends on caps $\bar{f}$ and $\bar{F}$. In particular,*

1. *if $\bar{f} \in \left[0, \frac{(\gamma-1)G}{\gamma\rho_\sigma}\right]$, then it is strictly optimal to grant individual leniency for (i) $\bar{F} > F_1$ if $\rho_\sigma < \frac{(1-\rho_\tau)}{(2-\rho_\tau)}$ and (ii) $\forall \bar{F}$ if $\rho_\sigma > \frac{(1-\rho_\tau)}{(2-\rho_\tau)}$,*
2. *if $\bar{f} \in \left(\frac{(\gamma-1)G}{\gamma\rho_\sigma}, \frac{G}{\rho_\sigma}\right)$, then it is strictly optimal to grant individual leniency if and only if both $\bar{F} < F_1$ and $\rho_\sigma > \frac{(1-\rho_\tau)}{(2-\rho_\tau)}$, and*
3. *if $\bar{f} \in \left(\frac{G}{\rho_\sigma}, \infty\right)$, then it is never optimal to grant individual leniency,*

where $F_1 = \frac{\bar{f}\left[\gamma\rho_\sigma\left(\bar{f}-G\right)\right]}{(\gamma-1)G-\gamma\rho_\sigma\bar{f}}$.

[19] Formally, the authority sets F_R low enough to ensure that (1) is slack, thereby validating our earlier anticipation.

Proof. See Appendix A.3. ∎

To gain intuition for these results it is useful to make the following remarks. Recall first that, as was stated in Lemma 2, granting individual leniency increases both the expected transfer to induce a breach $E_{\emptyset,\emptyset}\left[t^b\right]$ and the expected transfer to prevent a breach $E_{\emptyset,R}\left[t^n\right]$. This follows directly from the fact that the the strategy "breaching the law and self-reporting" becomes more lucrative to the manager, thereby hurting the shareholder regardless of the action induced in the employment contract. Since the authority's objective is to relax (6) as much as possible so as to reduce $C(\beta)$, granting individual leniency is optimal only if the increase in $E_{\emptyset,\emptyset}\left[t^b\right]$ (denoted $\triangle E_{\emptyset,\emptyset}\left[t^b\right]$) offsets that in $E_{\emptyset,R}\left[t^n\right]$ (denoted $\triangle E_{\emptyset,R}\left[t^n\right]$).

Second, it is also helpful to observe that the higher the cap on the corporate fine $\bar{F}$ the lower $\beta^* \bar{f}$ is. Indeed, an increase in the cap on corporate fine $\bar{F}$ relaxes (6), and thus lowers the necessary investigation probability β^*. This is stated more formally in Corollary 3.

Finally, from Lemma 1, we know that

$$\triangle E_{\emptyset,R}\left[t^n\right] = \max\left\{\underbrace{\gamma\left(G - E_{\emptyset,R}\left[f\right]\right)}_{A}, \underbrace{G}_{B}\right\} - \max\left\{\underbrace{\gamma\left(G - E_{\emptyset,R}\left[f\right]\right)}_{A}, 0\right\}, \tag{7}$$

where

$$E_{\emptyset,R}\left[f\right] = \rho_\sigma \overline{f} + \left(1 - \rho_\sigma\right)\beta\rho_\tau \overline{f},$$

whereas

$$\triangle E_{\emptyset,\emptyset}\left[t^b\right] = \max\left\{\underbrace{\beta^*\rho_\tau \bar{f}}_{D}\right\} - \max\left\{\underbrace{\beta^*\rho_\tau \bar{f} - G}_{C}, 0\right\}. \tag{8}$$

While $\triangle E_{\emptyset,R}\left[t^n\right]$ may be equal to zero (if $A > B$), $\triangle E_{\emptyset,\emptyset}\left[t^b\right]$ is always positive. Indeed, the optimal contract to induce a breach is such that a manager is compensated only if (i) a conviction occurs ($\tau = 1$; which can happen only if the manager is guilty) and (ii) neither the manager nor the shareholder files for leniency ($\Re = \emptyset$). The manager can deviate from the shareholder's wish either by "not breaching the law" or by "breaching and self-reporting". The second strategy, with payoff G, is however always more tempting than the first one, with payoff equal to zero. Thus whenever an individual leniency program is in place, inducing a breach of the law is costly to the shareholder.

Low Managerial Fine. Suppose $\bar{f} \in \left[0, \frac{(\gamma-1)G}{\gamma\rho_\sigma}\right]$. Recall that a shareholder wishing to prevent misconduct rewards a manager if and only if (i) both private and public investigations

fail to uncover evidence ($\sigma = 0$ and $\tau = 0$) and (ii) neither the manager nor the shareholder files for leniency ($\Re = \emptyset$). The associated reward $t_{\emptyset,0,\emptyset}$ is here large because $\bar{f}$ is low, implying that component A is also large. Preventing misconduct is very costly because the manager has strong private incentives to breach the law.

A manager deviating from the shareholder's wish may prefer the strategy "breaching the law and remaining silent" to the strategy "breaching the law and self-reporting" even if individual leniency is granted, precisely so as to pocket the high reward $t_{\emptyset,0,\emptyset}$ granted in case the fraud goes undetected. This happens whenever $\bar{f}$ is particularly low (and $A > B$). In these cases, we have that $\triangle E_{\emptyset,R}[t^n] = 0$ because individual leniency does not change the compliant shareholder's problem, and thus granting leniency is optimal since in contrast $\triangle E_{\emptyset,\emptyset}\left[t^b\right] > 0$ always.

In case $\bar{f}$ is slightly higher, however, "breaching the law and self-reporting" may become the most interesting strategy to the manager (and $B > A$). Here granting individual leniency leads to

$$\begin{aligned} \triangle E(t^n) &= G - \gamma\left(G - \rho_\sigma \bar{f} - (1-\rho_\sigma)\beta^* \rho_\tau \bar{f}\right) \\ &= \gamma\rho_\sigma \bar{f} - (\gamma - 1)G + \gamma(1-\rho_\sigma)\beta^* \rho_\tau \bar{f}, \end{aligned} \tag{9}$$

where $\gamma\rho_\sigma \bar{f} - (\gamma - 1)G < 0$, which captures the fact that the net increase $\triangle E_{\emptyset,R}[t^n]$ is somewhat limited because $E_{\emptyset,R}[t^n]$ is high *even absent leniency* (due to $\bar{f}$ being low).[20]

Whether $\triangle E_{\emptyset,\emptyset}\left[t^b\right] > \triangle E_{\emptyset,R}[t^n]$ depends on the extent to which the compliant shareholder relies on the frequency β^* of public investigations to deter misbehavior; where this reliance is captured by the efficiency ρ_σ of internal monitoring. As can be seen from (8) and (9), increases in $\beta^* \rho_\tau \bar{f}$ have an ambiguous impact since they increase both $\triangle E_{\emptyset,R}[t^n]$ and $\triangle E_{\emptyset,\emptyset}\left[t^b\right]$.[21] When ρ_σ is low, changes in β^* tend to have a larger impact on $\triangle E_{\emptyset,R}[t^n]$ than $\triangle E_{\emptyset,\emptyset}\left[t^b\right]$ because of information asymmetries (measured by γ) plaguing only the compliant firm and inefficiently inflating $E_{\emptyset,R}[t^n]$.[22] When $\bar{F}$ is low (high), and thus β^* high (low), granting leniency leads to $\triangle E_{\emptyset,R}[t^n] > (<) \triangle E_{\emptyset,\emptyset}\left[t^b\right]$ and is suboptimal (optimal).

In contrast, when ρ_σ is high, public investigations do not impact $\triangle E_{\emptyset,R}[t^n]$ much because internal monitoring is very efficient in deterring breaches of the law. In these instances, granting leniency is always optimal.

[20] We have that $\gamma\rho_\sigma \bar{f} - (\gamma - 1)G < 0$ because $\bar{f} \in \left[0, \frac{(\gamma-1)G}{\gamma\rho_\sigma}\right]$.

[21] $\triangle E(t^n)$ is increasing in $\beta^* \rho_\tau \bar{f}$ because increases in $\beta^* \rho_\tau \bar{f}$ make the strategy "breaching and self-reporting" relatively more lucrative to the manager than the strategy "breaching and remaining silent".

[22] By ρ_σ low we mean $\gamma(1-\rho_\sigma) > 1$, which is equivalent to condition $\rho_\sigma < \frac{(1-\rho_\tau)}{(2-\rho_\tau)}$ stated in Proposition 3.

Intermediate Managerial Fine. Suppose now that $\bar{f} \in \left(\frac{(\gamma-1)G}{\gamma\rho_\sigma}, \frac{G}{\rho_\sigma}\right)$. The managerial fine is now high enough that the strategy "breaching the law and self-reporting" is the most interesting one to the manager when individual leniency is granted. We then have that $\triangle E_{\emptyset,R}[t^n] > 0$ and is equal to (9), where however now $\gamma\rho_\sigma\bar{f} - (\gamma-1)G > 0$; this captures the fact that individual leniency increases $E_{\emptyset,R}[t^n]$ by a large amount since, when $\bar{f} \in \left(\frac{(\gamma-1)G}{\gamma\rho_\sigma}, \frac{G}{\rho_\sigma}\right)$, the manager has little private incentives to misbehave absent leniency.

As above, granting leniency depends on the extent to which the shareholder relies on public investigations to discipline her manager. If ρ_σ is low, $\triangle E_{\emptyset,R}[t^n] > \triangle E_{\emptyset,\emptyset}[t^b]$ always and it is not optimal to grant individual leniency. If instead ρ_σ is high, we have that $\triangle E_{\emptyset,R}[t^n] < \triangle E_{\emptyset,\emptyset}[t^b]$ only if β^* is large enough, that is only if $\bar{F}$ is low enough.

High Managerial Fine. Suppose finally that $\bar{f} \in \left(\frac{G}{\rho_\sigma}, \infty\right)$. The managerial fine is now potentially so high that the manager has no incentives whatsoever to breach the law. Internal monitoring (which is successful with probability ρ_σ in case of a breach), combined with the corporate leniency program, are sufficient to discipline the manager. Consequently, $E_{\emptyset,R}[t^n] = 0$ and the authority does not launch any public investigation. Granting individual leniency in such cases is unnecessary.

Having now derived Propositions 2 and 3, we are in a better position to relate to existing literature on self-reporting schemes. If the breach of the law involves only one individual, self-reporting schemes play no deterrence effect and aim only at extracting information so as to save on enforcement costs. Because self-reporting schemes have no deterrence effect, the amnesty is typically partial and set so that the individual is just indifferent between "remaining silent" or "self-reporting" (see Kaplow and Shavell (1994)). Granting more than "just enough" leniency might in fact raise the incentives to breach the law in the first place. In our model, and in all models involving conspiracies organized collectively (e.g. price-fixing), self-reporting schemes also possess a deterrence dimension because they make it more difficult for agents to coordinate. In the context of cartels, Motta and Polo (2003) and Spagnolo (2004), for instance, show that corporate leniency programs entail two opposing forces: they destabilize existing horizontal collusion by increasing the incentives to deviate from the agreement, but also make collusion *ex-ante* more profitable by reducing the expected sanction. In our model, things differ in that shareholder and manager are linked by an employment contract acting as a powerful coordination device, have different information, and may have misaligned incentives. This makes the design of effective leniency programs a particularly delicate issue. The partial corporate leniency program contributes to aligning incentives between (i) the shareholder and the authority, (ii) the manager and the authority, and (iii) the manager and the shareholder in case the shareholder wishes to prevent misbehavior. Only a partial

reduction is granted as otherwise the authority may induce the shareholder to let breaches happen and file for leniency to enjoy the amnesty. Individual leniency operates differently. It (i) misaligns incentives between the manager and *both* the shareholder and the authority and (ii) either aligns or misaligns incentives between the shareholder and the authority.

Corollary 1 (Effects of a CP on expected transfers) *Increasing the amount of internal monitoring ρ_σ reduces the optimal expected transfer to prevent a breach, and has no effect on the optimal expected transfer to induce a breach.*

Proof. Substituting the optimal fines from Propositions 1–3 in the expressions for the optimal transfers from Lemma 1, yields

$$\begin{aligned} E_{\emptyset,R}\left[t^n\right] &= \max\left\{\underbrace{\gamma\left(G - E_{\emptyset,R}\left[f\right]\right)}_{A}, \underbrace{G - f_r}_{B}, 0\right\}, \\ E_{\emptyset,\emptyset}\left[t^b\right] &= \max\left\{\underbrace{\beta\rho_\tau\overline{f} - G}_{C}, \underbrace{\beta\rho_\tau\overline{f} - f_r}_{D}, 0\right\}, \end{aligned} \tag{10}$$

whereas

$$\begin{aligned} E_{\emptyset,R}\left[f\right] &= \rho_\sigma\overline{f} + \left(1-\rho_\sigma\right)\beta\rho_\tau\overline{f} \\ &= \rho_\sigma\left(1-\beta\rho_\tau\right)\overline{f} + \beta\rho_\tau\overline{f}. \end{aligned}$$

We have that $E_{\emptyset,\emptyset}\left[t^b\right]$ does not depend on ρ_σ, while since $\frac{\partial E_{\emptyset,R}[f]}{\partial\rho_\sigma} > 0$ and $\frac{\partial\gamma}{\partial\rho_\sigma} < 0$, we have that $\frac{E_{\emptyset,R}[t^n]}{\partial\rho_\sigma} \leq 0$. ∎

The intuition is two-fold. First, increasing the amount of internal monitoring ρ_σ reduces the information asymmetry within the firm, thus (i) reducing the information rent necessary to prevent a breach when the strategy "breaching the law and remaining silent" is the most profitable one to the manager, while (ii) leaving unaffected the transfer necessary to induce a breach (a conviction by the authority is already a perfectly informative signal).

Second, increasing the amount of internal monitoring ρ_σ increases the probability that the shareholder uncovers evidence, which she reports to the authority in case she wishes her manager to abide by the law. By proposition 2, this increases the expected managerial fine $\left(\rho_\sigma\overline{f} + \left(1-\rho_\sigma\right)\beta\rho_\tau\overline{f}\right)$ when the shareholder wishes her manager to abide by the law. Because the shareholder inducing a breach instead never blows the whistle, increases in the quality of internal auditing do not impact transfers.

3.3 Interaction Between Leniency Policy and Internal Monitoring

The following corollary states the interaction between the internal monitoring activities within the firm and the leniency programs designed by the authority and stated in Propositions 2 and 3.

Corollary 2 (Interaction monitoring and leniency) *Corporate leniency raises the usefulness of internal monitoring activities. Individual leniency lowers the usefulness of internal monitoring activities.*

Proof. By Proposition 2, we now that it is optimal to set $F_R \in \left[\tilde{F}, \tilde{\tilde{F}}\right]$. By doing so expected transfer A in Lemma *1* (plugging in the fines stated in Propositions 1-3) decreases as (i) it becomes interim rational for the shareholder to systematically blow the whistle (when preventing breaches) and (ii) $\rho_\sigma \overline{f} + (1 - \rho_\sigma)\, \beta \rho_\tau \overline{f} > \beta \rho_\tau \overline{f}$. Thus, although expected transfer A is less likely to be relevant, it decreases because of the corporate leniency program. In contrast, expected transfers B, C, and D are left unaffected by F_r. The first claim of the corollary thus follows.

To continue, expected transfers B and D are relevant whenever the reporting constraint is binding in the shareholder's problem when, respectively, preventing and inducing a breach. As can be seen from (10), expected transfers B and D are independent of ρ_σ. By setting $f_r = 0$, constraints B and D are more likely to be relevant and, inversely, expected transfer A (which decreases with ρ_σ) is less likely to be relevant. In addition the expected transfer A is unaffected by f_r. The second claim of the corollary thus follows. ■

Internal monitoring is useful in two ways in the fight against corporate crime: it both reduces information asymmetries and increases the expected managerial fine within compliant firms. The reason for the second effect is that corporate leniency incentivizes the shareholder to report evidence uncovered through internal monitoring to the authority. This makes deterring corporate crime less costly to the shareholder and better aligns incentives with the authority. In this sense, therefore, corporate leniency and internal monitoring work hand in hand towards deterring breaches of the law.

Individual leniency, however, works differently. When granted, it (often) makes the strategy "breaching the law and self-reporting" the most profitable one at the disposal of the manager. However, because the manager is able to run faster than the shareholder to the authority, the shareholder cannot use the threat of reporting evidence uncovered through internal monitoring to deter breaches of the law, unlike a situation in which "breaching the law and remaining silent" is the most profitable managerial strategy. In this sense, therefore,

the implementation of an individual leniency program tends to decrease the usefulness of internal monitoring activities.[23]

The finding that the welfare enhancing effect of internal audits is reduced by individual leniency does *not* mean that individual leniency has a perverse effect on deterring corporate crime. After all, in our model, the authority chooses whether to grant individual leniency and thus does so only if optimal. The result rather implies that individual leniency and within firm monitoring activities such as compliance programs are competing tools to decrease the shareholder's relative profitability of not preventing breaches of the law.

3.4 Comparative Statics

Given the authority's optimal sanctions and leniency policy, we compute the optimal investigation probability. This probability is determined by binding constraint (6). Substituting for the optimal fines we rewrite constraint (6) as

$$\beta\rho_\tau\overline{F} \geq E_{\emptyset,R}\left[t^n\right] - E_{\emptyset,\emptyset}\left[t^b\right], \tag{11}$$

that is, in equilibrium, the expected corporate fine must exceed the net salary cost of preventing breaches of the law. The expression for the optimal investigation probability is stated in Appendix A.3.

In this subsection, we comment on how the authority's optimal investigation probability is affected by the different parameters of the model.

Proposition 4 (Comparative statics) *The authority's optimal investigation probability* β^*

1. *decreases in the amount of internal monitoring* ρ_σ*;*
2. *decreases in the size of the legal cap on the corporate fine* $\bar{F}$*;*
3. *decreases in the size of the legal cap on the managerial fine* $\bar{f}$*; and*
4. *increases in the size of the managerial gain from breaching the law* G*.*

Proof. See Appendix A.4. ∎

The intuition runs as follows. As we stated in Corollary 1, increasing the amount of internal monitoring ρ_σ—say by the adoption of a compliance program—(weakly) decreases

[23]The second statement would hold even if the shareholder were able to arrive first at the authority's doorstep with some probability (lower than one).

the expected transfer to prevent a breach $E_{\emptyset,R}[t^n]$ and leaves the expected transfer to induce one $E_{\emptyset,R}[t^b]$ unaffected. This better aligns incentives between the authority and the shareholder (i.e. it relaxes (11)) and thus calls for a lower probability of public investigations β^*. This comparative static sheds some light on the current debate regarding the usefulness of compliance programs. What our model suggests is that if judicial authorities are limited in their capacity to punish individuals, then compliance programs may be useful to firms, despite the risk of these programs being entirely cosmetic (a feature captured in our model).

To continue, not surprisingly, punishing more severely the shareholder leads her to internalize better the consequences of managerial misconduct, thereby relaxing (11) and allowing for a lower probability of public investigations. Similarly, punishing more severely the manager for breaching the law dicentivizes him from breaching the law (and/or makes it more expensive for a shareholder to induce him to), and thus allows for a lower investigation probability. Finally, for the opposite reasons, increases in the private gains G from breaching the law incentivizes the manager into breaching the law (and/or makes it cheaper for the shareholder to induce a breach), and thus calls for a higher probability of investigations.

We now formally state a result mentioned (and made use of) when commenting on Proposition 3 regarding the manager's propensity to misbehave as a function of $\bar{F}$.

Corollary 3 (Propensity to Misbehave) *The equilibrium expected managerial sanction* $E_{\emptyset,\Re_s}[f]$ *is decreasing in the cap on the corporate fine* $\bar{F}$*, where* $\Re_s \in \{\emptyset, R\}$*.*

Proof. This is easily demonstrated by deriving β^* stated in (26) in Appendix A.3 by $\bar{F}$. ■

The intuition for this result is straightforward. Increases in $\bar{F}$ relaxes (11) and allows for a lower probability of public investigations β^*, as stated in Proposition (4). This in turn implies that $\beta^* \bar{f}$ is decreasing in the cap on the corporate sanction. In words, whenever the authority is able to punish more harshly a shareholder for failing to prevent managerial misconduct, incentives between them become better aligned and less public investigations are needed. What this result suggets is that although raising F (except in case of a corporate report) is always optimal, it nevertheless implies a *second-order* negative effect: a manager unilaterally breaching the law (that is, without the shareholder's consent) faces a lower probability of being caught.

In this paper, the authority is limited in its capacity to impose sanctions by caps on both corporate fines ($\bar{F}$) and managerial fine ($\bar{f}$). We now comment on the effectiveness, within the scope of our model, of one cap relative to the other in decreasing the probability of investigations β^*.

Proposition 5 (Managerial versus Corporate Sanctions) *Increases in the cap on the managerial fine $\bar{f}$ is (weakly) more efficient at reducing the necessary amount of public investigations β^* than increases in the cap on the corporate fine $\bar{F}$.*

Proof. Follows immediately from deriving the optimal probability of investigation β^* stated in (26) in Appendix A.3 with respect to $\bar{f}$ and $\bar{F}$ and comparing. ∎

To gain intuition for this result it is useful to plug into (11) the optimal transfers (**??**), yielding

$$\beta\rho_\tau\overline{F} \geq \max\left\{\underbrace{\gamma\left(G-\rho_\sigma\bar{f}-(1-\rho_\sigma)\,\beta_\tau\bar{f}\right)}_{A},\underbrace{G}_{B}\right\}-\underbrace{\beta\rho_\tau\overline{f}}_{D}, \tag{12}$$

in case individual leniency is granted ($f_r = 0$), and

$$\beta\rho_\tau\overline{F} \geq \max\left\{\underbrace{\gamma\left(G-\rho_\sigma\bar{f}-(1-\rho_\sigma)\,\beta_\tau\bar{f}\right)}_{A},0\right\}-\max\left\{\underbrace{\beta\rho_\tau\overline{f}-G}_{C},0\right\}, \tag{13}$$

in case individual leniency is not granted ($f_r = \bar{f}$). We do not work with the optimal probability β^* directly as the intuition is most easily conveyed looking directly at the shareholder's incentive compatibility constraint.

Two forces are at play here: the implications of leniency programs and information asymmetries. To begin with, observe that an increase of one dollar in $\bar{F}$ relaxes either (12) or (13) by $\beta\rho_\tau$ dollars. Indeed, the only case in which the shareholder is imposed a sanction is when the authority launches an investigation and uncovers evidence of misbehavior. This is because, when the shareholder lets her manager breach the law, she is able to bribe her into remaining silent, essentially killing the manager's potential role as a "watchdog" and the associated additional deterrent effect of the corporate fine.[24] We now argue that increases of the same magnitude in $\bar{f}$ always lead to the incentive compatibility constraint being relaxed by more than $\beta\rho_\tau$ dollars.

Because of the corporate leniency program, it is optimal for the shareholder (when wishing to prevent breaches) to systematically report the manager in case evidence is uncovered. This implies that when the strategy "breaching the law and remaining silent" is relevant (i.e. component A matters), an increase of one dollar in $\bar{f}$ relaxes either (12) or (13) by $\gamma\left(\rho_\sigma+(1-\rho_\sigma)\,\beta\rho_\tau\right)+\beta\rho_\tau > \beta\rho_\tau$ dollars.[25] When incentives between the shareholder and

[24] The assumption, common in this literature, of the shareholder having "deep pockets" is here crucial.

[25] Except if $G > \beta\rho_\tau\bar{f}$, in which case it relaxes (13) by $\gamma\left(\rho_\sigma+(1-\rho_\sigma)\,\beta\rho_\tau\right) > \beta\rho_\tau$ dollars.

the authority are aligned—which is the case in equilibrium—the manager is being monitored by two "watchdogs": both the shareholder and the authority. The managerial fine is thus imposed relatively often in case of a breach. Observe also that the expected transfers to induce a breach (either C or D) also (weakly) increase proportionally with $\beta\rho_\tau\bar{f}$, thereby further reinforcing the effectiveness of the managerial fine. In addition, because the shareholder wishing her manager to abide by the law must give up an *information rent,* every one dollar change in the manager's payoff leads to a greater than one dollar change in the shareholder's payoff (measured by γ). This reinforces once again the usefulness of increasing $\bar{f}$ relative to $\bar{F}$.

To finish, in case an individual leniency program is implemented, and the strategy "breaching the law and self-reporting" matters (i.e. component B matters), an increase of one dollar in $\bar{f}$ relaxes (12) by $\beta\rho_\tau$ dollars. Overall, therefore, leniency programs and information asymmetries imply, in our model, that targetting individuals directly may be more efficient than targetting firms and relying on them to discipline managers.

In the context of environmental accidents, Segerson and Tietenberg (1992) show that managerial and corporate fines are substitutes as long as information asymmetries are either absent or irrelevant (because for instance fines perfectly reveal managerial actions).[26] When introducing contractual frictions within the firm they show that either fine may be more efficient. Our contribution in this debate lies in that we show that leniency programs tend to make managerial fines very efficient compared to corporate fines. Polinsky and Shavell (1993) and Shavell (1997) argue in favor of managerial sanctions as the firm itself might be limited in its capacity to punish its employees. In our model, where the shareholder can actually punish her manager in the form of foregone bonuses and/or reports to the authority, it is preferable to have managerial sanctions for an additional reason: the shareholder cannot be trusted to take appropriate measures (thereby also calling for corporate sanctions to align incentives between the shareholder and the authority).

3.5 Social Welfare Analysis

The analysis carried up to section 3.4 assumed that the authority's objective was to deter breaches at the lowest possible (public) cost of launching investigations $C(\beta)$. We now proceed by analysing the case in which the authority's objective is to maximize social welfare, subject to deterring breaches (we still thus implicitly assume that the harm associated to a breach is sufficiently high that it needs to be deterred with almost certainty). In particular, we now suppose that the authority's problem takes the form

[26] We thank David Martimort for pointing this out.

$$\max_{\beta, F_{\Re}, f_{\Re},\ \forall \Re} \left\{ \max \left\{ \Pi^n_{\emptyset,\emptyset}, \Pi^n_{\emptyset,R} \right\} + \lambda U^n_{\emptyset,\Re^*_s} - c\beta^2 \right\} \qquad \text{subject to}$$

$$\begin{aligned} F_{\Re} &\leq \overline{F}, \qquad \forall \Re, \\ f_{\Re} &\leq \overline{f}, \qquad \forall \Re, \\ \max \left\{ \Pi^n_{\Re_m,\emptyset}, \Pi^n_{\Re_m,R} \right\} &\geq \max \left\{ \Pi^b_{\Re_m,\emptyset}, \Pi^b_{\Re_m,R} \right\}, \end{aligned} \tag{14}$$

where we have set $C(\beta) = c\beta^2$ and where $\lambda \leq 1$ is the weight given to the manager's payoff. Observe that we already set $\Re_m = \emptyset$ as it cannot be the case, in equilibrium, that the manager files for individual leniency (this would be contradict the authority's objective). The max conditions in (14) capture the fact that the shareholder may set $\Re_s = \emptyset$ or $\Re_s = R$. Finally, $\Re^*_s$ denote the shareholder's equilibrium reporting strategy.

The following proposition builds upon Lemma 2 and Propositions 2 and 3 to briefly analyse the circumstances under which corporate and individual leniency programs are socially desirable.

Proposition 6 (Welfare Analysis of Leniency) *First, a partial corporate leniency program is socially optimal. Second, since individual leniency amounts to a transfer of compliance costs from the authority to the shareholder, for it to be socially optimal, it must be the case that both c and λ are sufficiently high.*

Proof. To begin with, note that the shareholder's problem is left unchanged. Expected transfers stated in Lemma 1 continue to prevail.

As was shown in Proposition 2, granting a partial reduction in the corporate sanction imposed on the shareholder when reporting evidence is optimal since it allows for a reduced $E_{\emptyset,\Re^*_s}(t^n)$, without affecting the other dimensions of the problem. When the social welfare criterion is the relevant one, it is still optimal to grant this partial reduction as a lower $E_{\emptyset,\Re^*_s}(t^n)$ both (i) increases the objective function and (ii) relaxes (14). This proves the first statement.

To continue, recall from Lemma 2 that granting individual leniency increases the expected transfer to induce $a = n$, that is, *increases the equilibrium expected transfer.* If $\lambda = 1$ this transfer drops out as $\max \left\{ \Pi^n_{\emptyset,\emptyset}, \Pi^n_{\emptyset,R} \right\} + U^n_{\emptyset,\Re^*_s} = 0$, i.e. it simply amounts to a transfer of utility between the shareholder and her manager. In such instances the socially optimal individual leniency program coincides with that stated in Proposition 3 since the optimization problem is identical. Suppose instead that $\lambda < 1$, then the authority's objective function becomes

$$-(1-\lambda)\,E_{\emptyset,\Re_s^*}(t^n) - c\frac{\beta^2}{2},$$

while the rest of its problem is unchanged.

When deciding whether to grant individual leniency, the authority must weight the resulting detrimental increase in $E_{\emptyset,\Re_s^*}(t^n)$ against the beneficial decrease in β^*, *when* β^* *is determined by* (14). Clearly, if c is sufficiently small the solution to this problem is such that (14) is slack, and thus it cannot be optimal to grant individual leniency. If instead c is sufficiently high then (14) binds as the authority's concern is that of minimizing β subject to deterring breaches of the law. In these instances, it is optimal to grant leniency if and only if λ is sufficiently close to one, that is, if not too much weight is given to the increase in $E_{\emptyset,\Re_s^*}(t^n)$. This concludes the proof. ■

Proposition 6 is useful in that it highlights both the robustness of the corporate leniency program derived in Proposition 2 and the new relevant trade-offs associated to an individual leniency program when maximizing social welfare. From Lemma 2, we already noted that granting individual leniency decreases the equilibrium payoff of the shareholder and increases the equilibrium payoff of the manager. Since, as seems reasonable given the context, we give less weight to the manager's payoff, we are not surprised that this force tends to reduce the attractiveness of individual leniency programs.[27] The authority thus finds it optimal to grant individual leniency, despite these drawbacks, only when its cost of launching investigations are very high, i.e. only when its operating budget is very tight. In these instances, the authority effectively reacts by relying more on the shareholder to prevent her own manager from misbehaving so as to save on public costs. Intuitively, the more weight is given to the manager, the lower the social cost of granting individual leniency as the increased salary simply amounts to a transfer of money between the shareholder and the manager.

4 Policy Discussion

Self reporting mechanisms at the corporate level abound. To deter price-fixing, in both the U.S. and the E.U., the *corporate leniency program* (CLP) allows firms to blow the whistle in exchange for *full* immunity from corporate legal sanctions.[28] While our model suggests that *partial* immunity is sufficient (see Proposition 2), these differences may be due to the fact that our corporate program is not designed to deter a horizontal conspiracy, but a vertical one

[27] This is meant to capture the fact that money spent deterring breaches of the law involves some inefficiencies or an opportunity cost.

[28] See *Commission Notice on Immunity from fines and reduction of fines in cartel cases*, Official Journal C298/17 (2006); and the U.S. Department of Justice's *Corporate Leniency Policy* (10 August 1993).

instead. If we were to add this horizontal aspect we should thus expect a downward pressure on corporate sanctions imposed on firms filing for corporate leniency.[29] Other corporate self-reporting mechanisms deterring white-collar crime not involving the coordination amongst firms (see for instance the EPA's *Audit Policy*, the DOD's *Contractor Disclosure Program* and the FERC's *Self-reporting Scheme*) involve, as in our model, only a partial reduction in the corporate sanction imposed on an applicant firm filing for leniency.[30]

These corporate self-reporting mechanisms are however such that all employees within the firm are granted amnesty when the firm files for leniency.[31] Hammond (2004) argues, at least in the contest of price-fixing, that such a "blanket" covering the entire corporation and its employees incentivizes employees to report illegal acts to their superiors so as to file for leniency together (thereby avoiding internal retaliation). This practice is in contrast with our results. Our model instead suggests that while it is optimal to reduce the sanction imposed on the firm (when blowing the whistle), it is also optimal to fully punish the manager carrying out the illegal activity (see Proposition 1). This is done to increase the expected managerial fine and essentially transform the shareholder into a second "watchdog".

A striking feature, in our view, of current practice is the almost complete absence of individual leniency programs to deter white-collar crime. Although the Sarbanes-Oxley act did foster the protection of individual informants (whistle blowers), it did not explicitly address the issue of individual informants self-reporting their own illegal activities. In addition, while the U.S. do have in place an individual leniency program to deter price-fixing, this program is almost never made use of. This is probably the case because of the argument put forward by Hammond (see first paragraph): since corporate leniency applies to everyone within the firm, the individual, eager to retain his job, may prefer not to engage in actions leading to sanctions being imposed on his firm and instead file for leniency through the firm. What our model suggests is that individual leniency programs may be useful, especially when judicial authority are only imperfectly capable of punishing individuals (as is for instance the case in E.U. Competition Law) and have tight operating budgets (see Proposition 6).

Another prediction of our model is that raising managerial fines/sanctions is more effective than raising corporate fines/sanctions because of information asymmetries within the firm and the leniency programs (see Proposition 5). While it is difficult and lengthy in practice to

[29] We thank Giancarlo Spagnolo for pointing this out.

[30] For a description of the DOD's *Contractor Disclosure Program* go to www.dodig.mil/Inspections/IPO/ContractorDisclosure/Contractor%20Disclosure%20Program%20Guide%20030509.

For a description of the EPA's *Audit Policy* go to www.epa.gov/oecaerth/resources/policies/incentives/auditing/auditpolicy

Finally, for a description of the FERC's policy go to www.ferc.org/whats-new/comm-meet/2008/051508/M-1.pdf.

[31] Or at least have no systematic approach to dealing with the issue of individual sanctions. As we know from the literature on cartels, however, predictability of the law is crucial if leniency programs are to work effectively.

punish directly individuals for economic crimes, it should be said that there has been a recent increase in the penalties (including jail time) imposed on managers (see the Sarbanes-Oxley act or the U.S. Sentencing Guidelines).

Finally, it is worth emphasizing that our predictions—especially those regarding the individual leniency program—suppose a clear distinction within the firm between employees potentially breaching the law and employees in charge of monitoring their peers (compliance officers). While this dichotomy seems reasonable when it comes to middle-management, it becomes more blurry regarding senior management (often responsible for compliance matters). Current practice acknowledges the problem since, for instance, the possible reductions in the corporate sanction stated in the U.S. Sentencing Guidelines do not apply in case senior management is involved in the mischief. Bearing this in mind, the recent trend of appointing compliance officers in charge exclusively of compliance matters (sometimes imposed by regulators) seems desirable.

5 Concluding Remarks

We have constructed a three-tier hierarchy framework, *authority-shareholder-manager*, to investigate the issue of corporate crime and guide policy prescriptions. Our model contributes to existing work because of the emphasis put on the firm's internal agency problem and the scope for sophisticated reporting mechanisms.

Our results suggest that granting a partial reduction in the corporate sanction in return for evidence of managerial misbehavior is optimal, but that in these instances the manager should be fully punished. This is in contrast to existing practice in the US, where partial corporate leniency programs do exist but either grant amnesty also to management or at least provide no systematic guidelines as to subsequent managerial sanctions.

We have also investigated individual leniency programs and shown that these are a delicate tool in so far as they increase private compliance costs regardless of the intention of the firm vis-à-vis managerial conduct. Said differently, when a judicial authority implements an individual leniency program, it effectively transfers a share of the burden of deterring corporate crime to shareholders. We find that it is optimal to grant amnesty to the self-reporting manager whenever the authority's ability to punish management is limited (e.g. E.U. Competition Law). In these instances, however, the authority finds it optimal to punish fully the firm. Since in practice such individual self-reporting schemes rarely exist, this paper makes the case that these should instead be considered by judicial authorities.

Our paper also contributes to the current debate concerning compliance programs. In our model, these tend to be useful, despite the risk of them being cosmetic. We have argued that,

on the one hand, corporate leniency programs raise the usefulness of within-firm monitoring activities/compliance programs while, on the other, individual leniency programs diminish it. Finally, we have analysed the relative effectiveness of managerial versus corporate fines and have concluded in favor of the former ones, suggesting that the recent move (e.g. the Sarbanes-Oxley act) towards harsher managerial punishments is desirable

These results were obtained from a rather parsimonious framework. We however now comment on several modelling choices. To begin with, the shareholder was not affected directly by the behavior of her manager. Her sole concern was instead that of minimizing salary expenditures. This is of course simplistic as in practice firm owners may directly benefit (e.g. antitrust or environmental violations) or suffer (e.g. accounting fraud) from corporate crime. If we were to introduce such a dimension to the model most of the analysis would be left unaffected and the gains or losses would simply act as a shifter on the optimal probability of investigation by the authority, much like the manager's private gains.

To continue, when investigating the design of leniency programs, we assumed that the manager was able to run faster to the authority than the shareholder. Though this is a reasonable first approximation—the manager is after all the person physically breaching the law—this assumption is nevertheless stark. Assuming instead that the authority, with some probability, could arrive first at the authority's doorstep would however only little affect the analysis as the shareholder would still be concerned about the manager filing for leniency and the manager would still be concerned about the shareholder filing for leniency (in fact, even more so). It would nevertheless give a greater importance to internal monitoring activities. In addition, we also shut down the possibility for each party to (i) have several opportunities to blow the whistle and (ii) have an opportunity to report despite the other party having already blown the whistle. These restrictions, made mostly for notational purpose, can be shown to have no consequences as, respectively, (i) parties wishing to report have strong incentives to do so as soon as possible and (ii) there is no additional informational gain to the authority of having a second report. If the authority could further save on public costs by having additional information, as may well be the case in practice, there is an even greater need for reporting mechanisms.

Our model allows for evidence to be brought from either the shareholder or the manager to the authority, yet not from the manager to the shareholder. In our framework there is however very little scope for effective internal self reporting mechanisms. On the one hand, a compliant shareholder would find it impossible to incentivize her manager into internally self-reporting without raising the latter's incentives to breach the law in the first place. On the other hand, a non-compliant shareholder prefers remaining ignorant as the authority's conviction already provides her with enough information.

Internal monitoring activities were taken as exogenous in the analysis, where a parameter capturing the ability for the shareholder to uncover managerial misbehavior allowed us to derive several comparative statics. A more general approach (but much more complex) would have the shareholder, much like the authority, choose with which probability to launch costly private investigations. In such a variant of the model, we would expect only the compliant shareholder to monitor and the intensity of private monitoring to be decreasing in the intensity of public investigations. We also expect the comparative statics derived in this paper to hold if one replaces the precision of the internal audit by the inverse of the marginal cost of launching private investigations.

Finally, the framework was such that both the authority and the shareholder were capable of finding perfectly informative evidence of a breach having occurred. While it is reasonable to suppose that it is easier to prove someone's guilt than someone's innocence (in fact, establishing someone's innocence typically amounts to failing to prove guiltiness), it is nevertheless strong to assume evidence to be perfectly informative. If we were to relax this assumption, information asymmetries would play a role also within non-compliant firms: an information rent would have to be given up to induce the manager into breaching the law. While this would leave unaffected the shape of the leniency programs derived in the paper it would reinforce the greater effectiveness of managerial fines compared to corporate fines in reducing the optimal probability of investigation. It would however also imply that the internal monitoring activities are no longer unambiguously beneficial as reduced info asymmetries could serve the purpose of better coordinating shareholder and manager within non-compliant firms.

Appendix

A.1 Proof of Lemma 1

This appendix derives the expected transfers stated in Lemma 1.

Prevent breach. The shareholder most cheaply prevents her manager to breach the law by paying him a positive transfer if and only all available information is informative of no breach having occurred, i.e., if and only if $\Re = \emptyset$, $\sigma = 0$, and $\tau = \emptyset$.

Given the shareholder's reporting strategy $\Re_s \in \{\emptyset, R\}$, she minimizes $t_{\emptyset,0,\emptyset} \geq 0$, s.t.

$$\beta t_{\emptyset,0,\emptyset} \geq (1-\rho_\sigma)\,\beta\,(1-\rho_\tau)\,t_{\emptyset,0,\emptyset} + G - E_{\emptyset,\Re_s}[f], \tag{15}$$

$$\beta t_{\emptyset,0,\emptyset} \geq G - f_r, \tag{16}$$

$$\beta t_{\emptyset,0,\emptyset} \geq 0, \tag{17}$$

where (15) ensures that the manager does not "breach and remain silent", (16) ensures that the manager does not "breach and self-report", and (17) is the participation constraint.

Solving for $t_{\emptyset,0,\emptyset}$ yields

$$t_{\emptyset,0,0} = \max\left\{\frac{G - E_{\emptyset,\Re_s}[f]}{\beta - (1-\rho_\sigma)\,\beta\,(1-\rho_\tau)}, \frac{G-f_r}{\beta}, 0\right\},$$

which gives expected transfer

$$\begin{aligned} E_{\emptyset,\Re_s}[t^n] &= \beta t_{\emptyset,0,\emptyset} \\ &= \max\left\{\gamma\left(G - E_{\emptyset,\Re_s}[f]\right), G - f_r, 0\right\}, \end{aligned} \tag{18}$$

where $\Re_s \in \{\emptyset, R\}$.

Induce breach. There are multiple optimal contracts to induce a breach, because both $\sigma = 1$ and $\tau = 1$ are perfectly informative signals of the manager having breached the law.

To save on space, we neglect analyzing the possibility for the shareholder to induce the manager to file for individual leniency in equilibrium. This strategy, involving the corporate fine being imposed with certainty, can easily be demonstrated to be dominated.

Without loss of generality, consider the optimal contract in which the shareholder pays a positive transfer if and only if $\sigma = 1$ and $\Re \neq r$, regardless of other available information and for a given reporting strategy $\Re_s \in \{\emptyset, R\}$.

Given the shareholder's reporting strategy $\Re_s \in \{\emptyset, R\}$, she minimizes $t_{\Re_s,1,\tau} \geq 0$, subject to

$$\rho_\sigma t_{\Re_s,1,\tau} + G - E_{\emptyset,\Re_s}[f] \geq 0, \tag{19}$$
$$\rho_\sigma t_{\Re_s,1,\tau} + G - E_{\emptyset,\Re_s}[f] \geq G - f_r, \tag{20}$$
$$\rho_\sigma t_{\Re_s,1,\tau} + G - E_{\emptyset,\Re_s}[f] \geq 0, \tag{21}$$

where (19) ensures that the manager does not "not breach", (20) ensures that the manager does not "breach and self-report", and (21) is the participation constraint.

Solving for $t_{\Re_s,1,\tau}$ yields

$$t_{\Re_s,1,\tau} = \max\left\{\frac{E_{\emptyset,\Re_s}[f] - G}{\rho_\sigma}, \frac{E_{\emptyset,\Re_s}[f] - f_r}{\rho_\sigma}, 0\right\},$$

which gives expected transfer

$$\begin{aligned} E_{\emptyset,\Re_s}[t_{\Re_s,1,\tau}] &= \rho_\sigma \bar{t} \\ &= \max\{E_{\emptyset,\Re_s}[f] - G, E_{\emptyset,\Re_s}[f] - f_r, 0\}, \end{aligned} \tag{22}$$

where $\Re_s \in \{\emptyset, R\}$. □

A.2 Proof of Proposition 2

We proceed as follows. We first show that there exists an $\tilde{\tilde{F}}$ such that the LHS of (6), $\max\left\{\Pi^n_{\emptyset,\emptyset}, \Pi^n_{\emptyset,R}\right\}$, reaches its highest level for $\forall F_R$ such that $F_R \leq \tilde{\tilde{F}}$. Second, we establish that there exists an $\tilde{F}$ such that the RHS of (6), $\max\left\{\Pi^b_{\emptyset,\emptyset}, \Pi^b_{\emptyset,R}\right\}$, reaches its lowest level for $\forall F_R$ such that $F_R \geq \tilde{F}$. Finally, we show that $\tilde{F} < \tilde{\tilde{F}}$.

We substitute into all relevant formulae the sanctions stated in Proposition 1.

Prevent breach. Recall that the expected transfers stated in Lemma 1 were computed under the anticipation that (1) was slack. Ignoring for now the RHS of (6), since (i) the shareholder can only be better off when solving an optimization problem with less constraints and since (ii) the authority wishes to raise as much as possible the LHS of (6), it must be optimal, from the authority's perspective, to set F_R so that (1) is slack (recall also that F_R does not enter directly the LHS, see (4)) and the LHS of (6) is as high as possible. We now seek this condition.

By Lemma 1, we see that it is optimal for the shareholder to have $\Re_s = R$ since $E_{\emptyset,\emptyset}[t^n] > E_{\emptyset,R}[t^n]$ (because $\rho_\sigma \bar{f} + (1-\rho_\sigma)\beta\rho_\tau \bar{f} > \beta\rho_\tau \bar{f}$). We now substitute the optimal employment contract to induce $a = n$ when $\Re_s = R$ stated in Lemma1 and Appendix A.1 into (1). Recall from Appendix A.1 that this optimal contract involves setting all transfers to zero, except possibly for

$$t_{\emptyset,0,\emptyset} = \max\left\{\frac{G - E_{\emptyset,\Re_s}[f]}{\beta - (1-\rho_\sigma)\beta(1-\rho_\tau)}, \frac{G - f_r}{\beta}, 0\right\}.$$

Substituting these transfers into (1) yields

$$0 + F_R < \beta(1-\rho_\tau)\max\left\{\frac{\left(G - \left(\rho_\sigma \bar{f} + (1-\rho_\sigma)\beta\rho_\tau \bar{f}\right)\right)}{\beta - (1-\rho_\sigma)\beta(1-\rho_\tau)}, \frac{G - f_r,}{\beta} 0\right\} + \beta\rho_\tau \overline{F}, \tag{23}$$

that is, the interim condition holds if and only if

$$F_R \leq \tilde{\tilde{F}} = (1-\rho_\tau)\max\left\{\frac{\left(G - \left(\rho_\sigma \bar{f} + (1-\rho_\sigma)\beta\rho_\tau \bar{f}\right)\right)}{1 - (1-\rho_\sigma)(1-\rho_\tau)}, G - f_r, 0\right\} + \beta\rho_\tau \bar{F}.$$

By looking at (4) we see that there is no further gain in setting $F_R < \tilde{\tilde{F}}$: the LHS of (6), $\max\left\{\Pi^n_{\emptyset,\emptyset}, \Pi^n_{\emptyset,R}\right\}$, reaches its highest level for $\forall F_R$ such that $F_R \leq \tilde{\tilde{F}}$.

Induce breach. The optimal contract to induce $a = b$ was also computed anticipating that (1) would not be an issue. This anticipation was w.l.o.g. for the following reason. By Lemma 1, if $\Re_s = \emptyset$, the shareholder pays in the induced equilibrium a positive transfer if and only if (i) $\sigma = 1$ and (ii) $\Re_s = \Re_m = \emptyset$. The shareholder can *costlessly* make this contract interim rational, simply by committing to a large enough transfer in case she deviates and plays $\Re_s = R$ instead (this deviation being observable, the associated transfer is enforceable). Note that one can interpret this as the shareholder simply not monitoring the manager. Thus, the authority is unable to influence the interim rationality of the optimal employment contract to induce $a = b$ under $\Re_s = \emptyset$. Consequently, and regardless of the value of F_R, the shareholder can always guarantee herself $\Pi^b_{\emptyset,\emptyset}$. We now show that by setting F_R high enough, this is the best she can do.

By Lemma 1 we have that $E_{\emptyset,\emptyset}\left[t^b\right] < E_{\emptyset,R}\left[t^b\right]$. Thus, given (4), a shareholder inducing a breach wishes to set $\Re_s = R$ if and only if $\Pi^b_{\emptyset,\emptyset} < \Pi^b_{\emptyset,R}$, i.e. if and only if F_R is sufficiently low. Substituting $E_{\emptyset,\emptyset}\left[t^b\right]$ and $E_{\emptyset,R}\left[t^b\right]$ into, respectively, $\Pi^b_{\emptyset,\emptyset}$ and $\Pi^b_{\emptyset,R}$, we have that $\Pi^b_{\emptyset,\emptyset} < \Pi^b_{\emptyset,R}$ if and only if

$$F_R < \tilde{F} = \beta\rho_\tau \bar{F} + E_{\emptyset,\emptyset}\left[t^b\right] - E_{\emptyset,R}\left[t^b\right].$$

Ignoring for now the LHS of (6), it is optimal for the authority to set $F_R \geq \tilde{F}$, so as to decrease as much as possible the RHS of (6). Since if $F_R > \tilde{F}$ the shareholder simply switches strategy (that is, adopts $\Re_s = \emptyset$), it must be the case that the RHS of (6), $\max\left\{\Pi^b_{\emptyset,\emptyset}, \Pi^b_{\emptyset,R}\right\}$, reaches its lowest level for $\forall F_R$ such that $F_R \geq \tilde{F}$.

Ranking thresholds. The inequality $\tilde{F} < \tilde{\tilde{F}}$ follows immediately from the fact that $E_{\emptyset,\emptyset}\left[t^b\right] < E_{\emptyset,R}\left[t^b\right]$. It is thus *stricty* optimal to set $F_R \in \left[\tilde{F}, \tilde{\tilde{F}}\right]$. □

A.3 Proof of Propositions 3

From Appendix A.2, we know that the corporate fine F_R is set such that it is (i) optimal for the breach-preventing shareholder to report whenever she uncovers evidence and (ii) not optimal for the breach-inducing shareholder to report evidence.

Constraint (6) becomes

$$\begin{aligned} &- E_{\emptyset,R}\left[t^n\right] \geq \\ &- E_{\emptyset,\emptyset}\left[t^b\right] - \beta\rho_\tau \overline{F}, \end{aligned}$$

which is relaxed when the wedge

$$E_{\emptyset,\emptyset}\left[t^b\right] - E_{\emptyset,R}\left[t^n\right]$$

is maximized, where

$$\begin{aligned} E_{\emptyset,R}\left[t^n\right] &= \max\left\{\gamma\left(G - E_{\emptyset,R}\left[f\right]\right), G - f_r, 0\right\}, \\ E_{\emptyset,\emptyset}\left[t^b\right] &= \max\left\{\beta\rho_\tau \overline{f} - G, \beta\rho_\tau \overline{f} - f_r, 0\right\}, \end{aligned}$$

with $E_{\emptyset,R}\left[f\right] = \rho_\sigma \overline{f} + \left(1 - \rho_\sigma\right)\beta\rho_\tau \overline{f}$.

We (i) derive the wedge without managerial leniency $\left(f_r = \overline{f}\right)$ in Section A.3.1, (ii) derive the wedge with managerial leniency $(f_r = 0)$ in Section A.3.2, (iii) compare them to determine the optimal f_r in Secion A.3.3, and (iv) derive the optimal β in Section A.3.4 so as to characterize the equilibrium thresholds determining the optimal individual leniency program.

A.3.1 Wedge without managerial leniency: $f_r = \overline{f}$

Suppose the authority provides no managerial leniency, that is, $f_r = \overline{f}$.

Preventing a breach. If $f_r = \overline{f}$ the expected transfer to prevent a breach becomes

$$E_{\emptyset,R}\left[t^n\right] = \max\left\{\gamma\left(G - E_{\emptyset,R}\left[f\right]\right), 0\right\},$$

where we have that

$$\begin{aligned}\gamma\left(G - E_{\emptyset,R}\left[f\right]\right) &\geq 0 \\ \text{iff. } \overline{f} &\leq \frac{G}{\rho_\sigma + \left(1-\rho_\sigma\right)\beta\rho_\tau}.\end{aligned}$$

Inducing a breach. If $f_r = \overline{f}$ the expected transfer to induce a breach becomes

$$E_{\emptyset,\emptyset}\left[t^b\right] = \max\left\{\beta\rho_\tau\overline{f} - G, 0\right\},$$

where we have that

$$\begin{aligned}\beta\rho_\tau\overline{f} - G &\geq 0 \\ \text{iff. } \overline{f} &\geq \frac{G}{\beta\rho_\tau}.\end{aligned}$$

The wedge. Combining these results, we get the following table with the wedge.

	$E_{\emptyset,\emptyset}\left[t^b\right]$	$E_{\emptyset,R}\left[t^n\right]$	WEDGE: $E_{\emptyset,\emptyset}\left[t^b\right] - E_{\emptyset,R}\left[t^n\right]$
$\overline{f} \in \left[0, \frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau}\right)$	0	$\gamma\left(G - E_{\emptyset,R}\left[f\right]\right)$	$\gamma\left(E_{\emptyset,R}\left[f\right] - G\right)$
$\overline{f} \in \left[\frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau}, \frac{G}{\beta\rho_\tau}\right)$	0	0	0
$\overline{f} \in \left[\frac{G}{\beta\rho_\tau}, \infty\right)$	$\beta\rho_\tau\overline{f} - G$	0	$\beta\rho_\tau\overline{f} - G$

A.3.2 Wedge with managerial leniency

Suppose the authority provides managerial leniency, that is, $f_r = 0$.

Preventing a breach. If $f_r = 0$ the expected transfer to prevent a breach becomes

$$E_{\emptyset,R}\left[t^n\right] = \max\left\{\gamma\left(G - E_{\emptyset,R}\left[f\right]\right), G, 0\right\},$$

where we have that

$$\gamma\left(G - E_{\emptyset,R}\left[f\right]\right) \geq G$$
$$\text{iff. } \overline{f} \leq \frac{\gamma - 1}{\gamma} \frac{G}{\rho_\sigma + (1 - \rho_\sigma)\beta\rho_\tau}.$$

Inducing a breach. If $f_r = 0$ the expected transfer to induce a breach becomes

$$\begin{aligned} E_{\emptyset,\emptyset}\left[t^b\right] &= \max\left\{\beta\rho_\tau\overline{f}, 0\right\}, \\ &= \beta\rho_\tau\overline{f}. \end{aligned}$$

The wedge. Combining these results, we get the following table.

	$E_{\emptyset,\emptyset}\left[t^b\right]$	$E_{\emptyset,R}\left[t^n\right]$	WEDGE: $E_{\emptyset,R}\left[t^b\right] - E_{\emptyset,R}\left[t^n\right]$
$\overline{f} \in \left[0, \frac{\gamma-1}{\gamma}\frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau}\right)$	$\beta\rho_\tau\overline{f}$	$\gamma\left(G - E_{\emptyset,R}\left[f\right]\right)$	$\beta\rho_\tau\overline{f} + \gamma\left(E_{\emptyset,R}\left[f\right] - G\right)$
$\overline{f} \in \left[\frac{\gamma-1}{\gamma}\frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau}, \infty\right)$	$\beta\rho_\tau\overline{f}$	G	$\beta\rho_\tau\overline{f} - G$

A.3.3 Comparing wedges: deriving the optimal f_r

Combining the tables from subsection A.3.1. and A.3.2, we get the following table with optimal f_r as a function of $\overline{f}$, where $f' = \frac{(\gamma-1)G}{\gamma[\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau]-\beta\rho_\tau}$.

FINE $\bar{f}$	WEDGE IF $f_r = 0$	WEDGE IF $f_r = \overline{f}$	IND. LEN.?
$\bar{f} \in \left[0, \frac{\gamma-1}{\gamma}\frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau}\right)$	$\gamma\left(E_{\emptyset,R}\left[f\right] - G\right) + \beta\rho_\tau\overline{f}$	$\gamma\left(E_{\emptyset,R}\left[f\right] - G\right)$	IL: $f_r = 0$
$\bar{f} \in \left[\frac{\gamma-1}{\gamma}\frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau}, \frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau}\right)$	$\beta\rho_\tau\overline{f} - G$	$\gamma\left(E_{\emptyset,R}\left[f\right] - G\right)$	$\overline{f} < f' \Rightarrow$ IL: $f_r = 0$ $\overline{f} \geq f' \Rightarrow$ NO IL: $f_r = \overline{f}$
$\bar{f} \in \left[\frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau}, \frac{G}{\beta\rho_\tau}\right)$	$\beta\rho_\tau\overline{f} - G$	0	NO IL: $f_r = \overline{f}$
$\bar{f} \in \left[\frac{G}{\beta\rho_\tau}, \infty\right)$	$\beta\rho_\tau\overline{f} - G$	$\beta\rho_\tau\overline{f} - G$	DOES NOT MATTER: $f_r \in \left\{0, \overline{f}\right\}$

A.3.4 Optimal investigation probability

We solve for the optimal investigation probability β by binding constraint (24), i.e., by binding

$$E_{\emptyset,R}\left[t^b\right] - E_{\emptyset,R}\left[t^n\right] \geq -\beta\rho_\tau\overline{F},$$

which we conveniently express as

$$\beta\rho_\tau\overline{F} = \max\left(-\left(E_{\emptyset,R}\left[t^b\right] - E_{\emptyset,R}\left[t^n\right]\right), 0\right) \tag{24}$$

where the wedge $E_{\emptyset,R}\left[t^b\right] - E_{\emptyset,R}\left[t^n\right]$ is determined in the last table of Appendix A.3.3 as

$$E_{\emptyset,R}\left[t^b\right] - E_{\emptyset,R}\left[t^n\right] = \begin{cases} \gamma\left(E_{\emptyset,R}\left[f\right] - G\right) + \beta\rho_\tau\overline{f} & \text{if } \bar{f} \in [0, f_1) \\ \beta\rho_\tau\overline{f} - G & \text{if } \bar{f} \in [f_1, f_2) \\ \gamma\left(E_{\emptyset,R}\left[f\right] - G\right) & \text{if } \bar{f} \in [f_2, f_3) \\ 0 & \text{if } \bar{f} \in [f_3, f_4) \\ \beta\rho_\tau\overline{f} - G & \text{if } \bar{f} \in [f_4, \infty), \end{cases} \tag{25}$$

where $f_1 = \frac{\gamma-1}{\gamma}\frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau} < f_2 = f' = \frac{(\gamma-1)G}{\gamma[\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau]-\beta\rho_\tau} < f_3 = \frac{G}{\rho_\sigma+(1-\rho_\sigma)\beta\rho_\tau} < f_4 = \frac{G}{\beta\rho_\tau}$,

$$\begin{aligned} E_{\emptyset,R}\left[f\right] &= \rho_\sigma\overline{f} + (1-\rho_\sigma)\beta\rho_\tau\overline{f} \\ &= \rho_\sigma\left(1-\beta\rho_\tau\right)\overline{f} + \beta\rho_\tau\overline{f}. \end{aligned}$$

By straightforward algebra, binding (24) yields

$$\beta^* = \begin{cases} \beta_1 = \frac{\gamma\left(G-\rho_\sigma\bar{f}\right)}{\rho_\tau\left[\bar{F}+(1+\gamma(1-\rho_\sigma))\bar{f}\right]} & \text{if } \bar{f} \in [0, f_1) \\ \beta_2 = \frac{G}{\rho_\tau\left(\bar{F}+\bar{f}\right)} & \text{if } \bar{f} \in [f_1, f_2) \\ \beta_3 = \frac{\gamma\left(G-\rho_\sigma\bar{f}\right)}{\rho_\tau\left[\bar{F}+\gamma(1-\rho_\sigma)\bar{f}\right]} & \text{if } \bar{f} \in [f_2, f_3) \\ \beta_4 = 0 & \text{if } \bar{f} \in [f_3, f_4) \\ \beta_4 = 0 & \text{if } \bar{f} \in [f_4, \infty), \end{cases} \tag{26}$$

Recall from A.3.3 that it is (i) strictly optimal for the authority to grant individual leniency whenever $\bar{f} < f_2\left(\beta^*\left(\bar{f}, \bar{F}, G, \rho_\tau, \rho_\sigma\right)\right)$ and (ii) weakly optimal to do so when $\bar{f} \geq f_4\left(\beta^*\left(\bar{f}, \bar{F}, G, \rho_\tau, \rho_\sigma\right)\right)$. We fix the endogeneity problem by rewriting the thresholds determining the relevant formulae for the wedge in terms of $\overline{F}$ by substituting β^* in f_1–f_4 and solving for $\overline{F}$. We also add the conditions ensuring that $\beta^* < 1$, i.e. ensuring that a solution to the optimization problem exists.

After some tedious algebra we see that two cases are relevant depending on $\rho_\sigma \lessgtr \frac{1-\rho_\pi}{2-\rho_\pi}$. In particular, if $\rho_\sigma < \frac{1-\rho_\pi}{2-\rho_\pi}$, we have that

$$\text{If } \bar{f} \in \left[0, \frac{(\gamma-1)\,G}{\gamma\rho_\sigma}\right]: \ \beta^* = \begin{cases} \beta_3 & \text{if } \underline{F}_3 \leq \bar{F} \leq F_1, \\ \beta_2 & \text{if } \max\left(\underline{F}_2, F_1\right) \leq \bar{F} \leq F_2, \\ \beta_1 & \text{if } \max\left(\underline{F}_1, F_2\right) \leq \bar{F}, \end{cases} \tag{27}$$

$$\text{If } \bar{f} \in \left(\frac{(\gamma-1)\,G}{\gamma\rho_\sigma}, \frac{G}{\rho_\sigma}\right): \ \beta^* = \beta_3 \text{ if } \underline{F}_3 \leq \bar{F}, \tag{28}$$

$$\text{If } \bar{f} \in \left[\frac{G}{\rho_\sigma}, \infty\right): \ \beta^* = 0 \text{ if } 0 \leq \overline{F}, \tag{29}$$

If instead $\rho_\sigma > \frac{1-\rho_\pi}{2-\rho_\pi}$, then

$$\text{If } \bar{f} \in \left[0, \frac{(\gamma-1)\,G}{\gamma\rho_\sigma}\right]: \ \beta^* = \begin{cases} \beta_2 & \text{if } \underline{F}_2 \leq \bar{F} \leq F_2, \\ \beta_1 & \text{if } \max\left(\underline{F}_1, F_2\right) \leq \bar{F}, \end{cases} \tag{30}$$

$$\text{If } \bar{f} \in \left(\frac{(\gamma-1)\,G}{\gamma\rho_\sigma}, \frac{G}{\rho_\sigma}\right): \ \beta^* = \begin{cases} \beta_3 & \text{if } \max\left(\underline{F}_3, F_1\right) \leq \bar{F}, \\ \beta_2 & \text{if } \underline{F}_2 \leq \bar{F} \leq F_1, \end{cases} \tag{31}$$

$$\text{If } \bar{f} \in \left[\frac{G}{\rho_\sigma}, \infty\right): \ \beta^* = 0 \text{ if } 0 \leq \overline{F}, \tag{32}$$

where $F_1 = \frac{\bar{f}\left[\gamma\rho_\sigma\left(\bar{f}-G\right)\right]}{(\gamma-1)G-\gamma\rho_\sigma\bar{f}} < F_2 = \frac{\bar{f}\left[\gamma\rho_\sigma\left(\bar{f}-G\right)+G\right]}{(\gamma-1)G-\gamma\rho_\sigma\bar{f}}$, and where $\underline{F}_i$, for $i = 1, 2, 3$, is the condition ensuring that $\beta_i^* < 1$. To save on space we do not write the conditions on ρ_τ (if these exist) ensuring that (i) $\underline{F}_3 < F_1$, (ii) $\underline{F}_2 < F_2$ and (iii) $\underline{F}_2 < F_1$. If these conditions are not met a solution to the optimization problem may not exist, i.e. if sanctions are too low the authority may not be able to deter breaches of the law.

Individual Leniency In terms of individual leniency, the condition $\bar{f} < f_1\left(\beta^*\left(\bar{f}, \bar{F}, G, \rho_\sigma, \rho_\tau\right)\right)$ computed above, when expressed in terms of $\bar{F}$, becomes (i) "$\bar{f} \in \left[0, \frac{(\gamma-1)G}{\gamma\rho_\sigma}\right]$ and $\bar{F} > F_1$" if $\rho_\sigma < \frac{1-\rho_\pi}{2-\rho_\pi}$ and (ii) either "$\bar{F} > 0$ and $\bar{f} \in \left[0, \frac{(\gamma-1)G}{\gamma\rho_\sigma}\right]$" or "$\bar{F} \leq F_1$ and $\bar{f} \in \left(\frac{(\gamma-1)G}{\gamma\rho_\sigma}, \frac{G}{\rho_\sigma}\right)$" if $\rho_\sigma > \frac{1-\rho_\pi}{2-\rho_\pi}$. Finally, the condition $\bar{f} \geq f_4\left(\beta^*\left(\bar{f}, \bar{F}, G, \rho_\sigma, \rho_\tau\right)\right)$ is never satisfied. This yields Proposition 3 in Section A.3.3.

A.4 Proof of Proposition 4

Claim 1: β^* decreases in the amount of internal monitoring

By Corollary (1) and its proof, we have that $E_{\emptyset,R}\left[t^b\right] - E_{\emptyset,R}\left[t^n\right]$ increases in ρ_σ, thereby relaxing constraint (24), which allows for a lower equilibrium investigation probability β^*.

Claim 2: β^* decreases in the size of the legal cap on the corporate fine

The legal cap on the corporate fine $\overline{F}$ appears only in the denominator of β^* (see (26)). Thus, $\frac{\partial \beta^*}{\partial \overline{F}} < 0$.

Claim 3: β^* decreases in the size of the legal cap on the managerial fine Expression (25) shows that the wedge $E_{\emptyset,R}\left[t^b\right] - E_{\emptyset,R}\left[t^n\right]$ is increasing in the managerial fine $\overline{f}$, thereby relaxing constraint (24), which allows for a lower equilibrium investigation probability β^*.

Claim 4: β^* decreases in the size of the managerial gain of breaching the law

The managerial gain from a breach G appears only in the numerator of β^* (see (26)). Thus, $\frac{\partial \beta^*}{\partial G} > 0$.

□

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