Monitoring Managers Through Corporate Compliance Programs

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Abstract

Compliance programs entail monitoring of employees' behavior with the claimed objective of fighting corporate crime. (Competition) Authorities promote such intra-firm monitoring. In a three-tier hierarchy model, *authority-shareholder-manager*, we study the impact of monitoring through a compliance program on contracting within the firm and the authority's optimal sanctions and leniency policy. We find that compliance programs are beneficial in the fight against corporate crime if and only if the managerial sanction is low. Moreover, when the shareholder blows the whistle, the authority optimally grants *partial* corporate leniency, while *not* granting individual leniency to the involved employees. Conversely, when the employee blows the whistle, the authority grants individual leniency if and only if the expected managerial sanction is either particularly high or particularly low. Finally, we find that the authority does *not* apply a discount on the corporate sanction for the mere fact of having adopted a compliance program. We discuss our results in the light of the *US* and *EU Corporate Leniency Program, US Individual Leniency Program* and *US Sentencing Guidelines*.

Keywords: compliance programs, leniency programs, enforcement of the law, antitrust
JEL codes: K21, K42, L40

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1 Introduction

A *compliance program* (CP) is a corporate scheme entailing education of employees about illegal activities, monitoring their behavior, and disciplining them in case of illegal conduct.[1] When well-designed, legal scholars advocate such schemes as an effective means to deter corporate crime.[2] However, we argue that, depending on the extent to which the judicial system targets involved employees, CPs can indeed be helpful to deter corporate crime, but can also entail a perverse feature that actually promotes violations of the law. Moreover, we show that in both the US and EU the current sanctions and leniency practice towards corporations and involved individuals may be suboptimal when taking into account the existence of CPs.

This paper focuses on the monitoring and disciplining dimensions of CPs.[3] Examples of monitoring employeess are unannounced inspections of documents, email messages and telephone records, as well as lawyers accompanying managers to business meetings (Stephan, 2009). Authorities may regard such monitoring as an effective means to rely on the firm to prevent employees from engaging in corporate crime. However, a credibility issue arises when the illegal act not only benefits the involved employees, but also the firm to which they belong, i.e. the shareholders. In such cases, the (board of) shareholders may not take (serious) measures against the involved employees when an illegal act is uncovered. They may even use the obtained information to reward employees for engaging in illegal acts, while hiding the evidence from the authority.

To address this credibility issue, we build a three-tier hierarchy, *authority-shareholder-manager* and define a compliance programme as a monitoring technology. The shareholder owns the firm and pays the manager to run it. The manager can unobservably breach the law, resulting in a personal benefit while stochastically increasing the shareholder's profit – this gives rise to the credibility issue of relying on the shareholder to control her manager. The shareholder can adopt a CP to monitor whether the manager breaches the law, which brings about hard evidence of the violation with some probability. The shareholder and the manager both have the opportunity to blow the whistle by reporting evidence to the authority, whose objective is to deter breaches at the lowest possible cost. After a report, the authority imposes sanctions on the shareholder and the manager; otherwise, the authority audits the firm with some costly probability and imposes sanctions if it uncovers a breach.

[1] See 2010 *US Sentencing Guidelines* §8B2.1. Available at <http://www.ussc.gov/Guidelines/Organizational_Guidelines/guidelines_chapter_8.htm>.

[2] See for example Webb and Molo (1993), Calkins (1997), Langevoort (2002), and Wils (2006). If a CP deters illegal conduct, it allows corporations to avoid being exposed to lengthy litigation and costly sanctions. In addition, detection of a violation through a CP allows the corporation to apply for leniency (if available).

[3] We do not consider the educational aspect of CPs. For many serious corporate crimes, such as price fixing by cartels or tax evasion, employees know that such behavior is illegal and need not be educated.

Sanctions are contingent on (i) whether the shareholder or the manager blew the whistle – thus allowing for corporate and individual leniency –, and (ii) whether a CP was adopted – thus allowing for a reduction of the sanction for having implemented a CP.

Our work applies to the field of antitrust law enforcement. We explicitly comment on the impact of the existence of CPs on the sanction policy in the US (*US Sentencing Guidelines*) and Europe, as well as the effectiveness of the US and EU *Corporate Leniency Program* and the US *Individual Leniency Program*. However, our analysis applies more broadly to any type of corporate crime, or non-compliance with a binding standard, that benefits both the organisation and the involved individuals; examples include tax evasion, cooking the books, environmental fraud, and misselling of a product.[4]

In the US, employees involved in antitrust violations are criminally prosecuted, while European competition law does not target individuals.[5] Since our model allows for varying the size of the maximum managerial fine prescribed by the law and endogenously solves for the optimal fine and leniency policy, we are able to derive policy implications for both the US and Europe. Below we summarise our findings from a more general economics perspective, while we discuss the implications for competition policy for both jurisdictions in Section 6.

Desirability of compliance programs. The adoption of a CP reduces information asymmetries within the firm.[6] The shareholder can then at lower cost prevent the manager to breach the law (beneficial for social welfare), but potentially also at lower cost induce managerial violations (detrimental for social welfare). We find that the adoption of a CP is beneficial for social welfare if and only if the managerial sanction is low. The reason is that if the expected managerial sanction is lower than the individual gain from breaching the law, then the shareholder pays a *positive* information rent to prevent a breach, but *no* information rent to induce it. A CP would then reduce the salary to prevent a breach without affecting the salary to induce it, thereby making a breach relatively less profitable for the shareholder. A symmetric reasoning suggests that if the managerial sanction is high, a CP can make corporate crime actually relatively more profitable for the shareholder. Although we do not want to make the claim that firms adopt CPs with the only objective to reduce information asymmetries so as to promote its employees to misbehave, the result does however suggest a

[4]Examples of different interpretations of our three-tier hierarchy are *authority - seller of a product - salesman* (Inderst and Ottaviani, 2009), *authority - seller of a financial product - broker*, or *society - lender - entrepreneur*.

[5]Some EU Member States have however enacted laws to criminally prosecute involved employees on the national level, such as the United Kingdom, Ireland and Estonia. See Wils (2005) p. 130 for an overview of 'criminalisation' of competition law in EU Member States.

[6]In Price Waterhouse Coopers' *2009 Global Economic Crime Survey*, the share of firms responding that they have "suffered" from an economic crime committed by an employee raises with firm size. This may indicate that information asymmetries indeed matter when controlling employees' behavior.

potential perverse effect of increasing the monitoring of harmful activities.

Corporate Leniency Program. The EU *Corporate Leniency Program* allows firms to blow the whistle in exchange for full immunity from legal sanctions aimed at the corporation – in addition, the US *Corporate Leniency Program* also fully protects involved employees from individual legal sanctions.[7] Such a 'blanket' covering the entire corporation as well as its employees has the objective to incentivise employees to report illegal acts to superiors, so as to file for leniency together (Hammond, 2004). In our model, however, we find that the authority optimally grants *partial* leniency to the shareholder when she blows the whistle, while *not* granting leniency to the manager. Three arguments drive this result.

First, corporate leniency increases the effectiveness of CPs to fight corporate crime. A reduction in the corporate sanction incentivises the shareholder to report evidence uncovered through a CP to the authority, resulting in a managerial sanction. Thus, the *combination* of corporate leniency and the adoption of a CP increases the expected managerial sanction, which in turn disincentivises the manager to breach the law, thereby reducing the salary cost to prevent managerial violations while increasing the salary cost to induce such violations. Hence, in the presence of a CP, corporate leniency increases (reduces) the salary cost of inducing (preventing) a breach, thereby making it relatively more profitable for the firm to prevent corporate crime.

Second, although corporate leniency increases the effectiveness of CPs to fight corporate crime, the reduction in the corporate fine also makes a breach less costly to the shareholder. The authority optimally balances this tradeoff by providing 'just enough' leniency to incentivise the shareholder to blow the whistle whenever she possesses evidence. Hence, the authority grants *partial* corporate leniency.

Third, the authority does *not* grant leniency to the manager when the shareholder blows the whistle. The reason is that such leniency would reduce the managerial fine, thereby incentivising the manager to breach the law and thus aligning the manager's incentives with those of a shareholder that wants an infringement to occur.

Individual Leniency Program. Under the US *Individual Leniency Program*, the involved employee receives full immunity from legal sanctions when blowing the whistle.[8] In our model, however, the authority finds it not always optimal to grant individual leniency. The reason is

[7] See *Commission Notice on Immunity from fines and reduction of fines in cartel cases* (2006/C 298/11), available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2006:298:0017:0022:EN:PDF>, and *US Department of Justice Corporate Leniency Policy* (10 August 1993), available at <http://www.justice.gov/atr/public/guidelines/0091.pdf>.

[8] See *US Department of Justice Corporate Leniency Policy* (10 August 1994), available at <http://www.justice.gov/atr/public/guidelines/0092.pdf>.

that individual leniency makes a violation less costly for the manager, because the managerial fine is reduced. Granting individual leniency then entails the tradeoff that (i) it requires a high salary to induce a breach, because the shareholder must compensate (bribe) the manager not to file for leniency, but (ii) it also requires a high salary to prevent a breach, because the shareholder must reward the manager for not 'breaching and blowing the whistle' instead of 'not breaching'. We find that the authority optimally grants individual leniency if and only if the expected managerial fine is either particularly high or particularly low. In addition, whenever individual leniency is granted, the authority fully sanctions the firm.

CP and fine reduction. In *Electrical and mechanical carbon and graphite products*, "the [European] Commission considers that it is not appopriate to take the existence of a compliance programme into account as an attenuating circumstance for a cartel infringement".[9] In contrast, according to the *US Sentencing Guidelines*, a firm engaged in illegal activities is legible to receive a reduced sanction if a well-designed CP was in place at the time of the infringement; in some cases the reduction is up to 95% of the original fine.[10] In our model, however, such a policy has a perverse effect. As outlined above, we find that the shareholder optimally receives a reduced sanction (partial leniency) for having adopted a CP *and* blowing the whistle, not for the mere act of adopting a CP. The reason is that a CP can be used to more effectively prevent a breach, but also to induce a breach (see above): the mere act of implementing a CP is therefore not informative of the shareholder's intentions. Thus, our results confirm the European Commission's view.

We proceed by discussing related literature in Section 2. Section 3 presents the model. Section 4 derives conditions under which CPs are helpful in the fight against corporate crime by solving for (i) the impact of a CP on salary costs, (ii) optimal sanctions and corporate leniency policy, and (iii) the authority's equilibrium audit probability. Section 5 extends the model to study the US individual leniency policy. In Section 6, we discuss the policy implications of our model for both the US and the EU. Section 7 concludes.

[9]Decision of 3 December 2003 in Case COMP/E-2/38.359, paragraph 313. The Court of First Instance agrees with this view in its decision on 9 July 2003 in *Archer Daniels Midland v. Commission*, Case T-224/00, paragraph 280. For a detailed legal analysis, see Wils (2006), p. 200-201, and Wils (2007), footnote 119.

[10]Having inplemented an "effective compliance and ethics program" reduces the so-called Culpability Score on which the fine is based – see *US Sentencing Guidelines* §8C2.5(f) and United States Sentencing Commission (2010). See also Wils (2006), p. 200-201.

2 Related Literature

Our work relates to three strands of literature: *managerial incentives with harmful activities*, *leniency programs*, and *optimal liability rules*. To the best of our knowledge, the papers in these literatures consider *two-tier* hierarchy games: either (i) the authority and the black boxed corporation are strategic players, abstracting away from games within the firm, or (ii) the firm owner (principal) and the employee (agent) are strategic players, with the authority assumed to be an exogenous technology.[11] We take a step beyond these models by considering a *three-tier* hierarchy game: the authority, principal and agent are all strategic players.

Managerial incentives with harmful activities. In any model opening the black box of the firm, the nature of the employment contract is central to the analysis. Scharfstein (1988) and Schmidt (1997) study the manager's incentives to exert effort, taking into account the degree of competition in the industry. In Fershtman and Judd (1987), Sklivas (1987) and Spagnolo (2000), an owner offers the manager a publicly observable and binding contract as a commitment device to soften competition or even to sustain tacit collusion. Hiring a manager with strong preferences for income smoothing serves a similar purpose in Spagnolo (2005). These models thus show how an employment contract might be deliberately used by an employer to reach a socially sub-optimal outcome.[12]

From a different perspective, Inderst and Ottaviani (2009) model a seller of a good contracting with an agent to prospect for consumers as well as to provide advice concerning the suitability of the product to the consumer's needs. The consumer is taken to be a fully rational and strategic player. The employment contract, taken to be soft private information as in our model, determines the degree of misselling occurring at equilibrium.

These models however do not consider the authority as a fully-fledged strategic player – if included in the model at all. Aubert (2009) does take into account a strategic authority: she investigates the impact of employment contracts on the incentives for managers to unobservably substitute productive effort with price fixing. In her model, as in ours, the bonus scheme (i) is soft private information to insiders and can be deliberately used by the principal to induce an illegal activity, and (ii) takes into account that cartelisation leads to evidence being created, possibly resulting in public intervention by the authority. In our model, unlike Aubert's, in addition to the authority's intervention, internal contracting is potentially also

[11] A notable exception being Inderst and Ottaviani (2009).

[12] Empirical anecdotes hint in the same direction. Price Waterhouse Coopers' *2009 Global Economic Crime Survey* states that the main motivation driving employees to commit fraud is "incentives and pressure", such as bonuses, financial targets and fear of losing jobs. Also, Khanna (1996) notes that "shareholders can influence the behavior of corporation managers and employees in a number of ways, such as by modifying employment contracts".

affected by the presence of a CP: the principal contracts on profits, evidence generated by the CP and, potentially, evidence brought forward by the employee himself.

Leniency programs. In this paper, both the employee breaching the law and the employer may file for (endogenous) leniency from legal sanctions,[13] where the employer can come into possession of evidence either through a CP, or through a report by the employee. Our paper thus relates to the literature that studies mechanisms incentivising wrongdoers to self report. To our knowledge, most work considering such leniency programs focuses on antitrust and, in particular, on cartels. Motta and Polo (2003) and Chen and Rey (2007), for instance, show that leniency programs can have two opposing effects: they destabilise existing collusion by increasing the incentives to deviate from the collusive agreement, but also make collusion *ex-ante* more profitable by reducing the expected sanction.[14]

In contrast to these papers, we study leniency programs that potentially jeopardise a conspiracy vertically *within* the firm, rather than horizontally *between* firms. The resulting effects are different. On the one hand, granting leniency to an employer reduces the expected corporate sanction, which incentivises the employer to blow the whistle. This in turn increases the expected managerial sanction, which allows for a reduction in salary costs necessary to prevent corporate crime, while increasing salary costs necessary to induce it. On the other hand, granting leniency to an employee reduces the expected managerial sanction, thereby increasing salary costs to ensure that the manager does not blow the whistle. This leads to *vertical* destabilisation, which parallels *horizontal* destabilisation in, for example, Spagnolo (2004) who shows that the authority should grant leniency only to the first horizontal party coming forward with evidence. Similarly, we argue that leniency should apply only to the first vertical party blowing the whistle, i.e. either the employer or the employee.

Aubert, Rey and Kovacic (2006) (ARK) consider a set-up in which the firm (*principal*) itself commits the crime, but employees have information about the crime. They argue that it might be optimal to reward employees for blowing the whistle in order to worsen firms' internal incentives.[15] In contrast, in our model the employee (agent) is the individual possibly breaching the law. The force identified by ARK (2006) is then present, that is, an employer wishing her employee to breach the law must commit to a higher wage to keep him silent. However, there is another side of the coin: granting leniency to an employee increases his incentives to breach the law in the first place, making it more difficult for a firm to deter

[13] See Miller (2009) for recent empirical results concerning the efficacy of leniency programs in the US.

[14] Moreover, Harrington (2008) shows that a third force is present when a time varying probability of conviction is considered: as all players rush to apply for leniency, but only one comes first, overall sanctions may end up being higher.

[15] Such individual rewards also provide incentives to individuals to retain evidence.

misconduct.[16] Thus, we find that individual leniency (or: individual rewards) is not always the optimal policy and depends on the manager's private benefit resulting from the crime.

Optimal liability rules. Our paper also relates to the literature investigating to which extent firms and individuals should be liable for corporate crime.[17] Sykes (1984) and Segerson and Tietenberg (1992), for instance, consider types of corporate crime that hurt the firm; they argue that, in the presence of agency costs, the authority targeting individuals directly is more effective than targeting the firm. We find that if the authority offers corporate leniency, then targeting individuals generally works better at reducing public enforcement costs than targeting the firm, regardless of agency costs. However, since we consider types of corporate crime that actually benefits the corporation, some degree of corporate liability is always needed, which contrasts Segerson and Tietenberg (1992).[18]

Polinsky and Shavell (1993) and Shavell (1997) call for managerial legal sanctions as the firm itself might be limited in its capacity to punish its employees. In our model, where the employer can actually punish its employees in the form of foregone bonuses, it is preferable to have managerial legal sanctions for an additional reason: the employer cannot be trusted to take appropriate measures as the illegal act itself benefits the employer. Focusing on managerial incentives to form cartels, Stephan (2009) argues that CPs may be ineffective if employees bear no liability, because then employees commit the crime anyway. Our results differ; we find that CPs are actually most useful when employees bear no liability, because then employers can use the information obtained through the CP to internally punish employees.

When the probability of conviction increases with the amount of internal monitoring, Arlen (1994) identifies a potentially perverse effect of holding firms liable. Improved internal monitoring would then lead to the firm to expose itself to heavy sanctions. As a result, the firm might be reluctant to disclose evidence and/or to choose the right level of monitoring. Our model eliminates this effect by allowing for corporate leniency, which reduces the expected corporate sanction when the firm monitors *and* reports when evidence is found. In equilibrium, the authority grants *partial* corporate leniency so as to take away Arlen's perverse effect, while not reducing the fine by too much. Such a corporate leniency policy thus incentivises firms to fight corporate crime by monitoring employees through a CP.

[16] Aubert (2009), also considering individual leniency programs, identifies this trade-off as well.

[17] See Khanna (1996) for an exposition of the various liability regimes.

[18] The threat of corporate sanctions effectively forces firms to internalise the potential social harm caused by their employees, thereby (at least partially) delegating the task of fighting corporate crime to the firm. Firms may thus choose to monitor employees by adopting a CP.

3 Set-up of the Model

In this section, we present the set-up of the model.

Outline & players. Consider the following three-tier hierarchy: an owner or shareholder of the firm (principal) contracts with a manager (agent) who runs the firm and possibly breaches the law. An authority aims at deterring breaches of the law. The manager does not (Section 4) or does (Section 5) possess evidence of the violation, while the shareholder may receive hard evidence either directly through the manager or through monitoring the manager with a CP. The manager and/or the shareholder can blow the whistle and report evidence to the authority, which then imposes corporate and managerial fines. If neither the shareholder nor the manager blows the whistle, the authority audits the firm with probability β and imposes fines when a breach of the law is uncovered. Figure 1 illustrates this set-up. All players are risk neutral. We refer to the manager in the male form (he/his), the owner in the female form (she/her), and the authority in the neutral form (it/its).

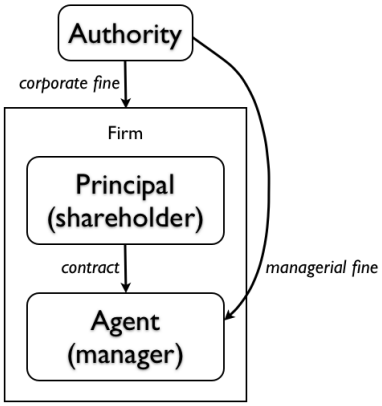

Figure 1. The players: authority, principal (shareholder) and agent (manager).

Actions

Manager. The manager unobservably takes action $a \in \{b, n\}$, where b is breaching the law and n is not breaching the law. The manager's action stochastically affects the realisation of firm profit $\pi \in \{0, 1\}$. The following table contains the probability distribution over firm profit π given action a, where $\rho_\pi > \frac{1}{2}$, that is, breaching the law increases the firm's expected profit:

	$a = b$	$a = n$
$\pi = 1$	ρ_π	$1 - \rho_\pi$
$\pi = 0$	$1 - \rho_\pi$	ρ_π

In Section 4 we consider the case in which the manager does *not* possess evidence when he breached the law. Section 5 solves the case when the manager *does* possess evidence, which he may report to her shareholder and/or the authority. This allows to study the US *Individual Leniency Program*; details about this adapted set-up are outlined in Section 5.

Shareholder. The shareholder takes three possible actions: (i) she offers the manager a take-it-or-leave-it employment contract, (ii) she chooses whether or not to adopt a CP,[19] and (iii) she chooses whether or not to report evidence to the authority if she comes into possession of such evidence. Regarding the latter two actions, the shareholder has the following three strategies 'reporting strategies': she either does not adopt a CP and has nothing to report ($i = N$), adopts a CP and reports whenever possible ($i = R$), or adopts a CP and never blows the whistle ($i = C$).

Adopting a CP allows the shareholder to uncover perfectly informative hard evidence of a breach with probability $\rho_\sigma > 0$. Whether she indeed finds evidence is indicated by the signal $\sigma \in \{0, 1\}$, where $\sigma = 1$ means evidence and $\sigma = 0$ means no evidence. The following table contains the probability distribution over signal σ, given action a taken by the manager:[20]

	$a = b$	$a = n$
$\sigma = 1$	ρ_σ	0
$\sigma = 0$	$1 - \rho_\sigma$	1

Consider now the employment contract. The shareholder offers the manager a take-it-or-leave-it contract, which defines transfers $t_{\pi,\sigma}$ contingent on the realisation of profit $\pi \in \{0, 1\}$ as well as the signal $\sigma \in \{0, 1\}$ (if a CP is in place).[21] The shareholder may thus use the contract to either induce or to prevent her manager to breach the law.

[19] For simplicity, we assume that a CP is costless to implement. Based on an earlier version of the model, we discuss in the concluding remarkts that the results remain qualitatively unchanged when a CP is costly.

[20] See Tirole (1986) for the same signal structure. For simplification, we assume that a CP possibly gives rise to *hard* information. If the shareholder were to possess *soft* information and transmit it to the authority, then an investigation would still be needed as judges and courts are reluctant to rely on testimonies which are not backed by factual evidence. The possibility of soft information is left for future work.

[21] We asssume that the shareholder cannot contract on the outcome of the authority's audit. By introducing such an incompleteness we replicate the results that we would obtain in a frictionless contracting environment in which the authority commits type (not too frequent) type I/II errors. If completeness was restored in the current framework, most results would qualitatively hold but less 'forces' would be at play.

The employment contract is assumed to be soft private information. The shareholder can credibly commit to making the transfers as stated in the employment contract, while she cannot credibly commit to a specific reporting strategy, though she would prefer to.[22] In the concluding remarks, we discuss the results we would obtain if she could commit on that dimension as well.

The transfers $t_{\pi,\sigma}$ are associated with four possible states of nature $\{\pi, \sigma\}$. The following table states the probabilities $p^{a,i}_{\pi,\sigma}$ of these states of nature occurring, given the manager's action $a \in \{b, n\}$ and the shareholder's choice $i \in \{N, C, R\}$,

State of nature $\{\pi, \sigma\}$ and associated transfer $t_{\pi,\sigma}$	Probability if $a = n$	Probability if $a = b$
$\{\pi = 1, \sigma = 1\}, t_{11}$	$p^{n,i}_{11} = 0$	$p^{b,i}_{11} = \rho_\pi \rho^i_\sigma$
$\{\pi = 1, \sigma = 0\}, t_{10}$	$p^{n,i}_{10} = 1 - \rho_\pi$	$p^{b,i}_{10} = \rho_\pi (1 - \rho^i_\sigma)$
$\{\pi = 0, \sigma = 1\}, t_{01}$	$p^{n,i}_{01} = 0$	$p^{b,i}_{01} = (1 - \rho_\pi) \rho^i_\sigma$
$\{\pi = 0, \sigma = 0\}, t_{00}$	$p^{n,i}_{00} = \rho_\pi$	$p^{b,i}_{00} = (1 - \rho_\pi)(1 - \rho^i_\sigma)$

where $\rho^i_\sigma = \rho_\sigma$ if $i \in \{C, R\}$ and $\rho^i_\sigma = 0$ if $i = N$.

Authority. The authority imposes corporate fine F^i on the shareholder and individual fine f^i on the manager, subject to legal caps $\overline{F}$ and $\overline{f}$, respectively. Varying the legal cap $\overline{f}$ allows to interpret the results in light of US policy (positive managerial sanctions, i.e. $\overline{f} > 0$) and EU policy (no managerial sanctions, i.e.$\overline{f} = 0$).

If the shareholder blows the whistle, the authority imposes sanctions F^R and f^R. If instead no report is made, the authority commits[23] to audit the firm with probability β, in which case it always uncovers the beach if it occurred.[24] The authority then imposes sanctions F^C and f^C when a CP was in place, or sanctions F^N and f^N when a CP was not in place.[25]

[22] We thus adopt the conventional wisdom that the logic behind bonuses is opaque to outsiders, but perfectly understandable to insiders. We also assume that such bonuses are credible as they involve relatively small amounts of money. Committing whether or not to report, however, may involve colossal amounts of money and is only credible only if it is *ex-post* rational to do so.

[23] If the authority cannot credibly commit to a probability of investigation, the equilibrium is in mixed strategies – see for instance Khalil (1997).

[24] Aubert, Rey and Kovacic (2006) and Aubert (2009) also make the assumption that an audit always leads to conviction if a breach occurred.

[25] We do not consider signalling games in which the authority tries to 'separate' the behavior of a shareholder preventing a breach from that of a shareholder inducing a breach.

Information. All actions are publicly observable, except whether the manager breaches the law or not, which is unobservable to both the shareholder and the authority. When the shareholder and the manager contract with each other, the manager knows whether the shareholder has adopted a CP.

Whether the shareholder uncovers evidence through the adoption of a CP is observable to the manager, but unobservable to the authority; only if the shareholder blows the whistle then the authority knows that the shareholder has found evidence.

Payoffs

Shareholder. The shareholder receives realised profit $\pi \in \{0, 1\}$ and pays managerial salary $t_{\pi,\sigma}$. If the manager breaches the law, the firm faces expected corporate fine

$$E_i[F] = \begin{cases} \beta F^N & \text{if } i = N, \\ \beta F^C & \text{if } i = C, \\ \underbrace{\rho_\sigma F^R}_{A} + \underbrace{(1-\rho_\sigma)\beta F^C}_{B} & \text{if } i = R, \end{cases} \tag{1}$$

where the expected corporate fine when the shareholder adopts a CP and reports evidence ($i = R$) consists of two parts: (A) with probability ρ_σ the shareholder finds evidence and blows the whistle in which case the authority imposes fine 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 imposes fine F^C. Given the expected corporate fine $E_i[F]$ and the expected transfer $E_i[t^a] = \sum_{\pi=0}^{1} \sum_{\rho=0}^{1} p_{\pi,\sigma}^{a,i} t_{\pi,\sigma}$, the shareholder's expected payoff Π_i^a is then

$$\Pi_i^a = \begin{cases} 1 - \rho_\pi - E_i[t^n] & \text{if } a = n, \\ \rho_\pi - E_i\left[t^b\right] - E_i[F] & \text{if } a = b. \end{cases} \tag{2}$$

Manager. The manager receives his salary $t_{\pi,\sigma}$. When breaching the law, he also receives private gain G, which can be interpreted as a benefit either directly or indirectly resulting from the breach, such as the possibility to work less hard.[26] Moreover, the manager then faces expected managerial fine

$$E_i[f] = \begin{cases} \beta f^N & \text{if } i = N, \\ \beta f^C & \text{if } i = C, \\ \rho_\sigma f^R + (1-\rho_\sigma)\beta f^C & \text{if } i = R. \end{cases} \tag{3}$$

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

Given this expected managerial fine $E_i[f]$ and the expected transfer $E_i[t^a]$, the manager's expected payoff M_i^a then boils down to

$$M_i^a = \begin{cases} E_i[t^n] & \text{if } a = n, \\ E_i\left[t^b\right] - E_i[f] + G & \text{if } a = b. \end{cases}$$

The manager has a zero outside option and is protected by limited liability with respect to salary, but not with respect to the managerial fine.

Authority. The authority's cost of auditing firms is $K(\beta)$, where $K'(\beta) > 0$. Fines are costless to impose and collect. We assume that breaches are so detrimental to society that the authority's objective is to minimise audit cost $K(\beta)$ subject to breaches being deterred,

$$\min_{\beta,\{F^N,F^C,F^R\},\{f^N,f^C,f^R\}} K(\beta) \text{ s.t.}$$
$$\max\left\{\Pi_N^n, \Pi_C^n, \Pi_R^n\right\} \geq \max\left\{\Pi_N^b, \Pi_C^b, \Pi_R^b\right\}, \tag{4}$$

where constraint (4) ensures that the shareholder writes an employment contract that prevents her manager to breach, that is, the shareholder's expected payoff when inducing a breach (RHS) must not be higher than her payoff when preventing a breach (LHS). Another interpretation of this minimisation problem is that the authority executes a pre-written law at the least possible costs.

Timing. The timing of the game is as follows and schematically depicted in Figure 2:

1. The authority sets its policy parameters $\beta, \left\{F^N, F^C, F^R\right\}, \left\{f^N, f^C, f^R\right\}$;
2. The shareholder chooses her reporting strategy, $i \in \{N, C, R\}$;
3. The shareholder offers a take-it-or-leave-it contract to the manager, which the manager accepts or rejects;
4. The manager breaches the law or not, $a \in \{n, b\}$;
5. Firm profit $\pi \in \{0, 1\}$ and signal $\sigma \in \{0, 1\}$ are realised;
6. If evidence of a breach becomes available through the CP ($\sigma = 1$), the shareholder blows the whistle if and only if $i = R$;[27]

[27] 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.

7. If the authority receives a report, the authority imposes sanctions. If the authority receives no report, the authority audits the firm with probability β and imposes sanctions when a violation indeed occurred.

8. The employment contract is executed.[28]

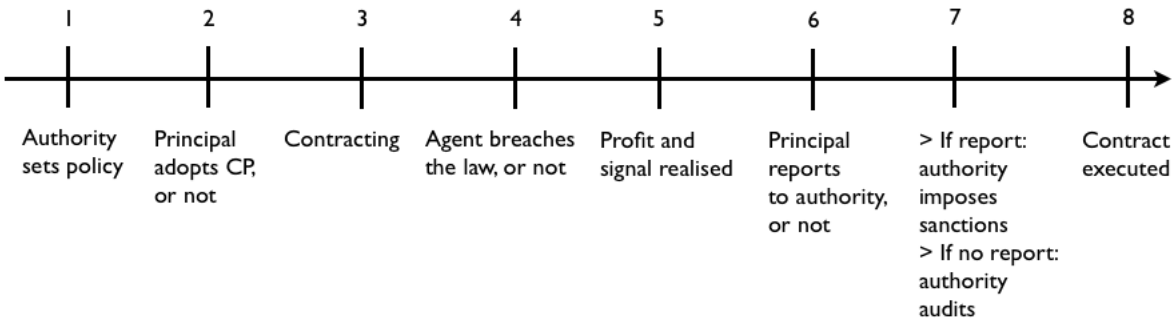

Figure 2. Timing of the game.

4 The Impact of Compliance Programs on Optimal Policy

This section solves the model for the case in which the manager does *not* possess evidence when he breached the law. In subsection 4.1, we solve for the expected transfers associated with the optimal employment contracts. Subsection 4.2 determines the authority's optimal sanctions and leniency policy. Subsection 4.3 derives the impact of compliance programs on the optimal level of auditing necessary to deter corporate crime.

4.1 Optimal Expected Transfers

In this subsection, we present the expected transfers associated with the manager's employment contract when the shareholder either induces or prevents the manager to breach the law. We define $\gamma^N = \frac{\rho_\pi}{2\rho_\pi - 1} > 1$ and $\gamma^C = \frac{\rho_\pi}{\rho_\pi - (1-\rho_\pi)(1-\rho_\sigma)} > 1$ as measures of information asymmetries, where $\gamma^N > \gamma^C$, because $\rho_\pi > \frac{1}{2}$.

[28]While the employment contract is executed *after* the possible audit, the contract is not contingent on the outcome of the audit. This assumption is similar in effect to Aubert (2009) who instead assumes that the contract is executed *before* a possible audit, but managerial whistle blowing (Section 5 of our paper) cannot take place after the contract is executed.

Lemma 1 [No compliance program] *If a compliance program is not adopted ($i = N$), the expected transfer to induce or to prevent a breach, respectively, is*

$$E_N\left[t^b\right] = \max\left\{\gamma^N\left(\beta f^N - G\right), 0\right\},$$
$$E_N\left[t^n\right] = \max\left\{\gamma^N\left(G - \beta f^N\right), 0\right\}.$$

Proof. See Appendix A.1. ■

When the shareholder wants to prevent (induce) a breach, she pays a positive expected transfer if and only if the manager's gain G from breaching is higher (lower) than the expected managerial fine βf^N, i.e. if and only if the incentives of the shareholder and the manager are not aligned. The resulting expected transfer is the difference between G and βf^N, inflated by the measure of information asymmetries γ^N, caused by the fact that the only (imperfect) information that the shareholder has about managerial behavior is the realisation of profit.

Lemma 2 [Compliance program] *If a compliance program is adopted ($i \in \{C, R\}$), the expected transfer to induce or to prevent a breach, respectively, is*

$$E_i\left[t^b\right] = \max\left\{E_i\left[f\right] - G, 0\right\},$$
$$E_i\left[t^n\right] = \max\left\{\gamma^C\left(G - E_i\left[f\right]\right), 0\right\}.$$

Proof. See Appendix A.1. ■

The adoption of a CP reduces the moral hazard problem, because the shareholder receives informative signal σ. As a result, the measure of information asymmetries decreases from γ^N to γ^C when the shareholder prevents her manager to breach, while information rents disappear altogether when the shareholder induces her manager to breach as evidence ($\sigma = 1$) is a perfectly informative signal about a breach having occurred.

We again have that the shareholder pays a positive expected transfer if and only if the incentives of the shareholder and the manager are not aligned. This expected transfer is the difference between G and $E_i\left[f\right]$, which is inflated by the measure of information asymmetries γ^C when the shareholder prevents a breach.

4.2 Optimal Sanctions and Leniency Policy

The authority's objective is to implement a policy that deters breaches at the lowest possible cost, i.e. with the lowest possible audit probability β. Before determining this optimal β in

the next subsection, we solve for the optimal schedule of fines and determine whether and when the authority optimally grants leniency to the shareholder and/or the manager.

Recall that constraint (4) ensures that the shareholder does not find it profitable to induce a managerial violation. Substituting for the shareholder's expected payoffs (equation (2)) and subsequently for the expected corporate fines (equation (1)) yields

$$\begin{aligned} &1-\rho_\pi-\min\left\{E_N\left[t^n\right],E_C\left[t^n\right],E_R\left[t^n\right]\right\}\geq \\ &\rho_\pi-\min\left\{E_N\left[t^b\right]+\beta F^N,E_C\left[t^b\right]+\beta F^C,E_R\left[t^b\right]+\rho_\sigma F^R+\left(1-\rho_\sigma\right)\beta F^C\right\}, \end{aligned} \tag{5}$$

which allows to determine the schedule of fines $\left\{F^N,F^C,F^R\right\}$ and $\left\{f^N,f^C,f^R\right\}$ that ensures that the constraint can be satisfied for the lowest possible audit probability β.

Proposition 1 *The authority's optimal policy is to set all fines to their legal maximum, but to provide partial corporate leniency when the shareholder blows the whistle, that is,*

$$\begin{aligned} &(i)\ \ f^N=\overline{f},\ F^N=\overline{F}, \\ &(ii)\ \ f^C=\overline{f},\ F^C=\overline{F}, \\ &(iii)\ \ f^R=\overline{f},\ F^R=\beta\overline{F}-\left|\epsilon\right|, \end{aligned}$$

where ϵ is arbitrarily small.[29]

The manager receives no individual leniency when the shareholder blows the whistle and there is no reduction on the corporate fine for having adopted a compliance program.

Proof. See Appendix A.2. ■

The authority optimally sets all managerial fines to their legal maximum and provides no individual leniency when the shareholder blows the whistle. The intuition is that increasing the managerial fines leads to (i) a better alignment of the manager's incentives with those of the shareholder aiming to prevent a breach, resulting in a weakly lower expected transfer, and (ii) more misalignment between the manager's incentives and those of the shareholder aiming to induce a breach, resulting in a weakly higher expected transfer. Setting all managerial fines to their legal maximum thus optimally relaxes constraint (5): it becomes cheaper for the shareholder to prevent a breach, but more expensive to induce a breach.

The authority sets corporate fines to their legal maximum, but grants partial leniency to the shareholder when she blows the whistle. Consider first the case in which the shareholder

[29] We realise that 'ϵ is arbitrarily small' violates the equilibrium concept, because all variables are continuous. The same results would however be obtained when rewriting the proofs with corporate fines defined in a discrete grid. This makes practical sense: monetary values cannot be splitted at some point.

does not adopt a CP and thus never comes into possession of evidence. We then have the Beckerian results that the authority sets the corporate fine to its legal maximum so as to maximally deter the shareholder from inducing her manager to breach, i.e. $f^N = \overline{F}$.

Suppose now the shareholder adopts a CP, which possibly provides her with evidence of a breach. Substituting the optimal managerial fines $f^N = f^C = f^R = \overline{f}$ into $E_C[f]$ and $E_R[f]$ gives expected managerial fines

$$E_R[f] = (\rho_\sigma + (1 - \rho_\sigma)\beta)\bar{f} > E_C[f] = \beta\bar{f},$$

that is, the expected managerial fine is higher when the shareholder blows the whistle than if she does not blow the whistle, because the manager is convicted for sure after a report by the shareholder. Blowing the whistle thus weakly reduces the expected salary cost to prevent a breach, but weakly increases the expected salary cost to induce a breach. Therefore, a shareholder aiming to prevent a breach would like to commit *vis-à-vis* her manager to blow the whistle whenever she finds evidence, while a shareholder aiming to induce a breach would like to commit not to blow the whistle.

Whether such commitments are credible depends on the relative sizes of the corporate fines: blowing the whistle is *ex-post* rational for the shareholder if and only if reporting leads to a lower corporate fine than not reporting, i.e. if and only if $F^R < \beta F^C$. To maximally deter the shareholder from inducing a breach, the authority sets F^C and F^R as high as possible, with the restriction that $F^R < \beta F^C$ so as to (i) provide the breach-preventing shareholder with the commitment to report, while (ii) destroying the breach-inducing shareholder's commitment to not report. When the shareholder implements a CP, the authority thus optimally sets the corporate fine when no report is made to the legal maximum, i.e. $F^C = \overline{F}$, while granting partial leniency to the shareholder when she reports, i.e. $F^R = \beta\overline{F} - |\epsilon|$, where ϵ is arbitrarily small. Hence, the authority does not reduce the corporate fine for the mere fact of having adopted a CP.

Combining the results regarding optimal transfers (Lemmas 1 and 2) with the authority's optimal sanctions and leniency policy (Proposition 1), we state the impact of the adoption of a CP on expected transfers in the following Proposition.

Proposition 2 *Monitoring managers through a compliance program*

(i) *reduces information asymmetries within the firm, and*

(ii) *increases the expected managerial fine.*

The former effect entails a downward pressure on the transfer to prevent breaches as well as on the transfer to induce breaches. The latter effect entails a downward pressure on the

transfer to prevent breaches and an upward pressure on the transfer to induce breaches.

Proof. The former effect directly follows from Lemmas 1 and 2. The latter effect follows from Lemmas 1 and 2 and Proposition 1 by noting that the managerial fine is (i) $E_N[f] = \beta\overline{f}$ when no CP is adopted, and (ii) $E_R[f] = \rho_\sigma\overline{f} + (1-\rho_\sigma)\beta\overline{f} > E_N[f]$ when a CP is adopted, because the authority's optimal policy makes it ex-post rational for the shareholder to blow the whistle whenever she finds evidence through the CP. ■

Adopting a CP affects expected transfers through two channels. First, since a CP reduces information asymmetries within the firm, it decreases information rents (if any), thereby weakly reducing expected salary costs. This effect is beneficial in the fight against corporate crime when the shareholder aims to prevent managerial violations, but entails a perverse effect when the shareholder uses the information obtained through the CP to promote such violations. Second, given the authority's optimal sanctions and leniency policy, adopting a CP increases the expected managerial fine from $E_N[f] = \beta\overline{f}$ to $E_R[f] = \rho_\sigma\overline{f} + (1-\rho_\sigma)\beta\overline{f}$, because the shareholder finds it *ex-post* rational to blow the whistle whenever she finds evidence, which results in a sure conviction of the manager. This effect helps to deter violations as it increases the manager's expected cost of breaching, thereby reducing the expected transfer needed to prevent a breach and increasing the expected transfer needed to induce a breach. We then arrive at the following Corollary.

Corollary 1 *A shareholder that prevents breaches optimally adopts a compliance program.*

Proof. The result follows directly by noting that Proposition 2's effects both entail a downward pressure on the expected transfer to prevent breaches. ■

Adopting a CP thus unambiguously helps the shareholder to prevent managerial violations: a CP reduces information asymmetries and increases the expected managerial fine, which both entail a downward pressure on the optimal expected transfer.

4.3 Social Desirability of Compliance Programs

Given the authority's optimal sanctions and leniency policy, we now determine the net impact of the CP – i.e. the monitoring technology – on the authority's costly audit probability. We do so by comparing the minimum audit probability β^* that satisfies constraint (5) with the minimum audit probability $\tilde{\beta}^*$ in a hypothetical scenario in which the monitoring technology is *not* available.[30] Proposition 3 then states the conditions under which monitoring managers

[30]Such a situation could be due to very high implementation costs, but also to cultural or legal reasons.

through CPs is socially desirable ($\beta^* < \tilde{\beta}^*$) or undesirable ($\beta^* > \tilde{\beta}^*$); we graphically illustrate the results in Figure 3. Denote by F' and F'' thresholds on the corporate fine, where $F' < F''$. We assume that the corporate fine $\overline{F}$ is high enough for $\beta^* < 1$ to exist.

Proposition 3 *If the managerial fine is lower than the manager's private benefit from the breach* $\left(\overline{f} \leq G\right)$*, monitoring the manager through a compliance program is welfare enhancing.*

If the managerial fine is higher than the manager's private benefit from the breach $\left(\overline{f} > G\right)$*, monitoring the manager through a compliance program is*

1. *detrimental for welfare if the corporate fine is low* $\left(\overline{F} < F'\right)$*,*
2. *welfare neutral if the corporate fine is intermediate* $\left(F' \leq \overline{F} < F''\right)$*, and*
3. *welfare enhancing if the corporate fine is high* $\left(\overline{F} > F''\right)$*.*

Proof. See Appendix A.3. ■

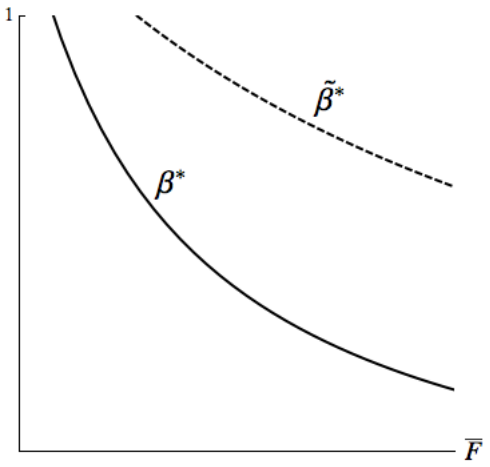

Figure 3a. Low managerial fine: $\overline{f} \leq G$.

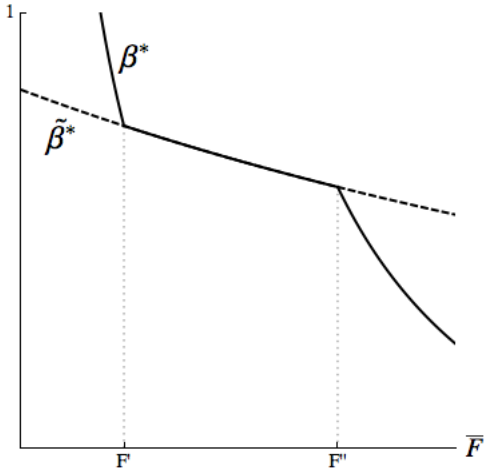

Figure 3b. High managerial fine: $\overline{f} > G$.

Optimal audit probability when CPs are available (β^*) and CPs are not available ($\tilde{\beta}^*$).

When the managerial fine is lower than the manager's private benefit from the breach $\left(\overline{f} < G\right)$, the manager has private incentives to breach the law when a CP is *not* adopted. The shareholder then pays a zero salary to induce a breach, but a positive expected salary, including an information rent, to prevent a breach. As discussed in the previous two subsections, adopting a CP has two effects: it decreases information rents and increases the expected managerial fine. The former effect thus decreases the expected transfer to prevent a breach, while not affecting the zero transfer to induce a breach. The latter effect has a disincentivising effect on the manager to breach, thereby reducing the positive transfer to

prevent a breach and (weakly) increasing the zero transfer to induce a breach. Altogether, the adoption of a CP thus reduces the salary cost of preventing a breach, while (weakly) increasing the salary cost of inducing a breach. This makes corporate crime relatively less profitable for the shareholder, which allows the authority to reduce its costly audit probability.

Consider now the case in which the managerial fine is higher than the manager's private benefit from the breach $\left(\overline{f} \geq G\right)$. In such cases, the manager has private incentives to breach if $\beta\overline{f} < G$, but has no private incentives to breach if $\beta\overline{f} \geq G$. For the following argumentation, we note that the corporate fine $\overline{F}$ and the audit probability β are substitutes in deterring corporate crime, that is, a high corporate fine allows for a low audit probability.

Suppose the corporate fine is high $\left(\overline{F} \geq F''\right)$. By substitutability of $\overline{F}$ and β, the authority can set the audit probability β relatively low. In particular, the audit probability is so low that $\beta\overline{f} < G$, that is, the manager has private incentives to breach. Without a CP, the shareholder then pays a zero salary to induce a breach, but a positive expected salary, including an information rent, to prevent a breach. By the same arguments as above ('low managerial fine'), a CP reduces the salary cost of preventing a breach, while (weakly) increasing the salary cost of inducing a breach. This makes corporate crime relatively less profitable for the shareholder, which allows the authority to reduce its costly audit probability.

Suppose now the corporate fine is not so high $\left(\overline{F} < F''\right)$. By substitutability of $\overline{F}$ and β, the authority needs to set the audit probability β relatively high, resulting in $\beta\overline{f} > G$, that is, the manager has no private incentives to breach. Without a CP, the shareholder then pays a zero salary to prevent a breach, but a positive expected salary, including an information rent, to induce a breach. Then, adopting a CP by the shareholder that aims to prevent a breach has no effect on the expected transfer as it is zero anyway.

However, the shareholder inducing a breach faces a tradeoff: adopting a CP (i) reduces the information rent, which gives a *downward pressure* on the expected transfer, but (ii) if the shareholder finds evidence she cannot help reporting it to the authority so as to receive partial leniency, which gives an *upward pressure* on the expected transfer. When the corporate fine is low $\left(\overline{F} < F'\right)$, the former effect outweighs the latter[31]: adopting a CP then allows the shareholder to reduce the salary cost of inducing breach, which pushes the authority to increase its costly audit probability to be able to deter corporate crime. Conversely, when the corporate fine is intermediate $\left(F' \leq \overline{F} < F''\right)$, the latter effect outweighs the former: the shareholder inducing a breach would not adopt a CP. As a result, the availability of CPs

[31]The intuition runs as follows. The latter effect (i.e. the difference in the expected managerial fine with and without a CP, $\rho_\sigma \bar{f} + (1-\rho_\sigma)\beta\bar{f} - \beta\bar{f}$) is less pronounced the higher the audit probability is. The reason is that with a high audit probability, the expected managerial fine is relatively high already *without* a CP. Now, if the corporate fine is low $\left(\overline{F} < F'\right)$, then the audit probability β needs to be relatively high by substitutability of the corporate fine and the audit probability. This reduces the scope of the latter effect.

then has no impact on the authority's audit probability.

5 Individual Leniency

In this section, we study how managerial leniency interacts with the effects of a CP. To that end, we extend our set-up by assuming that if the manager breaches the law he comes into possession of a piece of verifiable evidence, which he can (i) report to the shareholder ($r_p = 1$) or not ($r_p = 0$), and (ii) report to the authority ($r_a = 1$) or not ($r_a = 0$), where a report to the authority is observed by the shareholder. This set-up allows the shareholder to condition transfers on such reports. Similarly, the authority conditions fines on the manager blowing the whistle, which we denote by F^r and f^r.

The timing of the game is adapted by taking into account that the manager can make reports either immediately after breaching the law, or after (possibly) payoff relevant information comes available. Figure 4 indicates those stages by 4' and 5', respectively, which we refer to as the 'ex-ante' and 'interim' reporting stages.

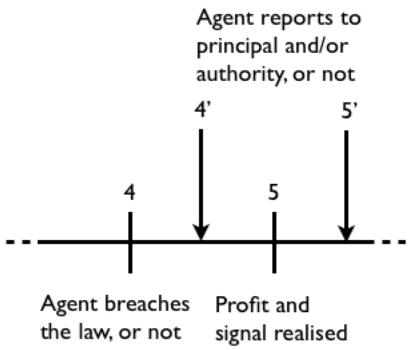

Figure 4. Revised timing: the manager can report immediately after he breaches (ex-ante stage: 4') or after the realisation of information (interim stage: 5').

As the derivation of the equilibrium is tedious and replicates many of the steps taken in the previous section, we focus on the results that differ from the previous section. Subsection 5.1 deals with the impact of the adapted set-up on optimal transfers, subsection 5.2 discusses the optimal individual leniency policy, and subsection 5.3 states the impact of the individual leniency policy on the effectiveness of CPs.

5.1 Optimal Expected Transfers: Reporting Constraints

Since the manager now holds verifiable evidence of his breach, the shareholder faces an additional incentive compatibility constraint when offering the employment contract. She must

ensure that her manager does not blow the whistle so as to receive managerial leniency. We coin this constraint the *reporting constraint* and show how it affects the expected transfers.[32]

By the same reasoning as in the previous section, the authority optimally (i) sets the managerial fines f^N, f^C and f^R to their legal maximum $\overline{f}$; (ii) sets the corporate fines F^N and F^C to their legal maximum $\overline{F}$; and (iii) grants partial corporate leniency when the shareholder reports evidence to the authority, i.e. $F^R = \beta\overline{F} - |\epsilon|$, thereby ensuring that the shareholder always reports when she has evidence of a breach. The formal proof is delegated to Appendix B and is simultaneously derived with the optimal transfers.

If the authority grants managerial leniency, the reporting constraint turns up in the contracting problem of the shareholder inducing a breach, but also in the contracting problem of the shareholder preventing a breach, thus introducing a tradeoff. The following Lemma's state the optimal expected transfers.

Lemma 3 [Preventing a breach] *If the shareholder prevents a breach, she adopts a compliance program, resulting in expected transfer*

$$E_R\left[t^n\right] = \max\left\{\gamma^C\left(G - E_R\left[f\right]\right), G - f^r, 0\right\}.$$

Proof. See Appendix B.1. ■

If the shareholder prevents a breach she adopts a CP, because that (i) decreases the information asymmetry, while (ii) increasing the expected managerial fine. The shareholder now faces two ICs: she must not only make sure that the manager does not breach, but also that he does not 'breach and blow the whistle' so as to possibly receive individual leniency.[33] This introduces the additional restriction $E_R\left[t^n\right] \geq G - f^r$, that is, the expected payment when the manager does not breach must be at least as large as the managerial gain G when he breaches minus the managerial fine when he blows the whistle f^r.

Lemma 4 [Inducing a breach] *If the shareholder induces a breach without adopting a compliance program, the expected transfer is*

$$E_N\left[t^b\right] = \underbrace{\max\left\{\gamma^N\left(\beta\bar{f} - G\right), 0\right\}}_{A} + \underbrace{\max\left\{\beta\overline{f} - f^r, 0\right\}}_{B}.$$

[32]Technically, there are several *reporting constraints*, because the manager may report to the authority at several points in time during the game. However, these *reporting constraints* boil down to one relevant constraint that dominates all others - see Appendix B.

[33]Managerial strategy 'breach and report to the shareholder' is irrelevant as it is weakly dominated by the strategy 'breach and report to the authority', because $f^r \leq f^R = \bar{f}$.

while if she instead adopts a compliance program and respectively requests or does not request evidence from the manager, the expected transfer is

$$E_R\left[t^b\right] = \max\left\{\underbrace{\overline{f} - G}_{E}, \underbrace{(1-\rho_\sigma)(1-\beta)\overline{f}}_{F}, \underbrace{\overline{f} - f^r}_{H}, 0\right\},$$

$$E_R\left[t^b\right] = \max\left\{\underbrace{E_R[f] - G + \max\left\{\beta\overline{f} - f^r, 0\right\}}_{C}, \underbrace{E_R[f] - f^r}_{D}, 0\right\}.$$

Proof. See Appendix B.2. ■

When the shareholder induces a breach, she must ensure that the manager (i) breaches the law, (ii) does not blow the whistle immediately after having breached, and (iii) does not blow the whistle after the realisation of payoff relevant information, i.e. profit π or signal σ.

Suppose the shareholder does not adopt a CP. She then induces a breach by rewarding the manager if profit is high ($\pi = 1$), resulting in payment A. She must also reward the manager for not blowing the whistle at any time, resulting in additional payment B. Payment B comes in *addition* to A as it is paid to the manager for being silent, that is, it is being paid to the manager if he breaches the law and stays silent, but also if he does not breach the law as he then has nothing to confess and thus stays silent automatically.[34]

Suppose now the shareholder adopts a CP. If she does *not* request evidence from the manager, payment C ensures that the manager breaches the law and does not blow the whistle immediately, while payment D ensures that the manager does not blow the whistle after the realisation of signal $\sigma = 0$. If the shareholder *does* request to see evidence, she rewards the manager if and only if he hands in evidence and does not blow the whistle. Noting that the shareholder cannot help to blow the whistle when she possesses evidence, the expected transfer must ensure that the manager does not (i) 'not breach' (E), (ii) 'breach and report no evidence to the shareholder' (F), and (iii) 'breach and blow the whistle' (H).

The following Lemma qualitatively summarises the findings from Lemmas 3 and 4.

Lemma 5 *Individual leniency weakly increases the expected transfer to induce a breach as well as the expected transfer to prevent a breach.*

Proof. Comparing Lemmas 1 - 4 straightforwardly shows that the introduction of the reporting constraints weakly increases the expected transfers. ■

[34]The strategy 'adopt no CP and request evidence' is irrelevant as it entails a weakly higher expected transfer than the strategy 'adopt a CP and request evidence' – see Appendix B.2.5.

The authority faces a tradeoff when granting leniency to the manager: the reporting constraint weakly increases the expected transfer both to induce and to prevent a breach. Indeed, by Lemmas 3 and 4, individual leniency (i) weakly increases the expected transfer to induce a breach as the shareholder must compensate the manager to stay silent in stages 4' and 5', but (ii) also weakly increases the expected transfer to prevent a breach as the shareholder must compensate the manager to not 'breach the law and blow the whistle'.

5.2 Optimal Individual Leniency Policy

Provided the tradeoff faced by the authority, the following Proposition states the optimal individual leniency policy when the manager blows the whistle. For sake of brevity, we focus on the case in which monitoring through a CP is relatively precise, i.e. $\rho_\sigma > (1-\rho_\pi)/\rho_\pi$.[35]

Proposition 4 *There exist thresholds $\tilde{f} < G$, $\tilde{F}$ and $\tilde{\tilde{F}}$, such that if the cap on the managerial fine $\bar{f}$ is*

1. *lower than $\tilde{f}$ then the authority grants individual leniency, regardless of $\bar{F}$,*
2. *between $\tilde{f}$ and G then the authority grants individual leniency if and only if $\bar{F} < \tilde{F}$,*
3. *higher than G then the authority grants individual leniency if and only if $\bar{F} < \tilde{\tilde{F}}$.*

Proof. See Appendix C. ■

First, suppose $\bar{f} < \tilde{f}$. For such low values of the managerial fine, the manager's private incentive to breach the law $G - \beta\overline{f}$ is relatively large. Therefore, absent individual leniency, it is very costly for the shareholder to prevent a breach, while it is costless to induce one. As a result, introducing the reporting constraint has either no impact or a small impact on the expected transfer to prevent a breach, while it increases the expected transfer to induce a breach by a lot as the reporting constraint becomes binding. Therefore, the authority optimally grants individual leniency when the manager blows the whistle.

Second, suppose $\tilde{f} < \bar{f} < \tilde{\tilde{f}}$. Absent individual leniency, it is still costless to induce a breach but now also relatively cheap to prevent one. Consequently, granting individual leniency *strictly* increases both transfers. We further note that the magnitude of both increases is larger the higher is β. Since we have here taken the CP to be relatively precise, an increase in β raises the expected transfer to induce a breach by more than the expected to prevent one. The intuition is that the more precise is the CP, the less important becomes the authority's audit with respect to the expected managerial punishment when preventing a breach.

[35] Results concerning the other cases are very similar and can be provided upon request.

Thus, the greater is β the more likely it is that the introduction of the reporting constraint increases the expected transfer to induce a breach by more than the expected transfer to prevent one. Since a large cap on the corporate fine $\bar{F}$ allows for a lower equilibrium audit probability β, we have that it is optimal to grant individual leniency only if and only if $\bar{F}$ is sufficiently low, i.e. only if and only if $\bar{F} < \tilde{F}$.

Finally, suppose $\bar{f} > \tilde{\tilde{f}}$. Absent individual leniency, it is now either very cheap or costless to prevent a breach. In contrast, the greater is β, the more costly it becomes to induce a breach. Granting individual leniency *strictly* increases both expected transfers. We note that the attractiveness to the manager of the strategy "breach and blow the whistle" increases with β only if the shareholder induces a breach. Thus, when $\bar{F} > \tilde{\tilde{F}}$, then the audit probability β is relatively low, and consequently the attractiveness of the strategy "breach and blow the whistle" is also very low to the manager. As a result, granting leniency leads to an increase in the expected transfer to induce a breach that is smaller by the increase in the expected transfer to prevent a breach: the authority does not grant individual leniency. When $\bar{F} < \tilde{\tilde{F}}$, then the audit probability β is relatively high and granting individual leniency makes it very costly for the shareholder to induce a breach, while keeping her manager silent. The increase in the expected transfer to induce a breach is larger than the increase in the expected transfer to prevent a breach: granting individual leniency is optimal.

5.3 Individual Leniency and Compliance Programs

The following Proposition states the interaction between individual leniency and CPs.

Proposition 5 *Individual leniency reduces the scope of the welfare detrimental as well as the welfare enhancing effect of compliance programs.*

Proof. By Lemmas 3 and 4 and their proofs in Appendix B, granting individual leniency introduces reporting constraints. If such a reporting constraint becomes binding, CPs are ineffective at reducing the expected transfer, because information asymmetries have become irrelevant. ■

As the proof indicates, the intuition is straightforward. If the authority grants individual leniency, then the reporting constraint may become binding, thereby determining the expected transfer. As a result, adopting a CP would not decrease the expected transfer, since it does not affect the reporting constraint. That is, adopting a CP does not affect the shareholder's employment cost whenever the reporting constraint binds. Therefore, both the welfare detrimental and welfare enhancing effect of CPs is reduced.

The finding that the welfare enhancing effect of CP is reduced by individual leniency does *not* mean that individual leniency has a perverse effect on deterring corporate crime. After all, the authority chooses whether or not to grant individual leniency and would therefore only do so if it helps the authority to deter illegal activities. The result rather implies that individual leniency and CPs are substitute tools to decrease the shareholder's relative profitability of inducing a breach. Without individual leniency, a CP would be used by the shareholder to reduce the expected transfer needed to prevent corporate crime, thereby reducing the (costly) audit probability. However, implementing an optimal individual leniency policy reduces the audit probability by more through changing the shareholder's contracting problem.

6 Policy Implications and Discussion

The set-up of our model accommodates for a discussion of the US as well as the EU practice. Under EU Competition Law individuals are *not* sanctioned and thus individual leniency policy is non-existent: the model of Section 4 applies with a zero cap on the managerial fine $\left(\overline{f}=0\right)$. In contrast, US Antitrust Law targets individuals and encompasses individual leniency policy: the models of both Sections 4 and 5 apply with a positive cap on the managerial fine $\left(\overline{f}>0\right)$. In this Section, we discuss the relevance of our work for (competition) policy in both jurisdictions.

Corporate Leniency Program I (US and EU)

In both the US and the EU, the *Corporate Leniency Program* (*CLP*) allows firms to blow the whistle in exchange for *full* immunity from corporate legal sanctions. In contrast, our results suggest that *partial* corporate leniency is more effective, because that would still incentivise the corporation to come forward, while not reducing the corporate sanction to zero. However, in practice it may be extremely difficult to determine the optimal amount of leniency, because the authority needs to estimate the corporation's benefit from the breach, which is different for each (type of) breach. The danger is then that the authority implements a policy granting too little leniency, which makes the *CLP* ineffective altogether. Therefore, although we find partial leniency to be optimal in theory, full leniency may be a practical second-best solution.[36] Again, we note that for violations involving strategic interaction, optimal policy should weigh our 'partial leniency result' against *ex-ante* strategic deterrence

[36]Spagnolo (2008) states that the number of leniency applications increased twentyfold after revisions in the leniency policy, which included *automatic* full immunity for the first corporation to self-report. This may suggest that an *inappropriate* level of partial immunity does not have the desired reporting and deterrence effect.

considerations of full leniency.

Corporate Leniency Program II (US)

The US *CLP* not only protects the corporation, but also provides involved employees with full immunity from legal sanctions. Hammond (2004) argues that such a 'blanket' covering the entire corporation and its employees has the objective to incentivise employees to report illegal acts to their superiors so as to file for leniency together. However, we show that such a policy has a perverse effect: breaching the law becomes cheaper for the economic agent executing the illegal act, i.e. the employee. This makes corporate crime more attractive to the corporation as the employee does not need to be heavily compensated (indemnified) by its superiors to breach the law.

This result is particularly relevant for types of corporate crime that do not involve strategic interaction with other conspirators. The blanket covering employees then results in a lower expected cost of breaching the law for the entire corporation. However, when the illegal act involves coordination with others, which is the case in cartels, then our result should be balanced with the impact of the blanket on strategic considerations. Co-conspirators anticipate that the blanket reduces the corporation's expected cost of corporate crime, which results in the fear that a rival corporation files for leniency, thereby *ex-ante* destabilising the conspiracy. Thus, it is important that competition policy carefully balances the blanket's *indirect* destabilising effect through strategic interaction with our *direct* corporate crime stabilising effect through reducing the expected indemnification costs.

Individual Leniency Program (US)

The US *Individual Leniency Program* (*ILP*) grants the involved employee full immunity from legal sanctions when coming forward with incriminating evidence. When the breach involves strategic interaction with a co-conspirator, such a policy destabilises criminal cooperation as each conspirator fears that the other files for individual leniency.[37] We show that individual leniency not only entails such 'horizontal destabilisation', but also 'vertical destabilisation'. Individual leniency makes breaching the law more expensive for the employee's superior (the cooperation), as the employee needs to be bribed not to file for individual leniency. This makes breaching the law relatively more expensive for the entire cooperation as a vertical structure.

However, we also show that individual leniency entails a perverse effect. Individual leniency not only increases the cost of a breach for the corporation (through the cost of bribing

[37]See, for example, Motta and Polo (2003) and Chen and Rey (2007).

the employee not to file for leniency), it also increases the cost of *preventing* a breach for the corporation, because the employee must be compensated not to 'breach the law and file for leniency' instead of not breaching the law.

Our results suggest that authorities should only grant individual leniency if the expected managerial fine is either particularly low or particularly high. In practice, however, it may be very difficult to determine the managerial fine *perceived* by the manager. Providing individual leniency for all types of corporate crime may then be a practical second-best solution, although it entails the perverse effect outlined above and may thus increase the profitability of some types of corporate crime.

Interaction Corporate and Individual Leniency Program (US)

The *ILP* has been used rarely in practice (Spagnolo, 2008). Hammond (2004) argues that this is not a sign that the *ILP* is ineffective: an employee that considers to blow the whistle through the *ILP* can tell its superior who then has an incentive to file for leniency on behalf of the entire corporation as a 'vertical structure' through the *CLP*. The mere *existence* of the *ILP* thus promotes the usage of the *CLP*.

However, the leniency policy as outlined in our paper entails another effect by disaligning the incentives of the corporation and the employees. Our results suggest that it is optimal *not* to provide the employee (corporation) immunity when the corporation (employee) files for corporate (individual) leniency. Such a policy effectively introduces a 'vertical race to the courthouse' between the corporation and the employee: the corporation and the employee cannot trust each other to stay silent.

Compliance Programs and Fine Reductions (US and EU)

While "the [European] Commission considers that it is not appopriate to take the existence of a compliance programme into account as an attenuating circumstance for a cartel infringement", the *US Sentencing Guidelines* allows for a mitigation of the corporate fine when the corporation had a well-designed CP in place at the time of the infringement, in some cases up to 95%.[38] Our results suggest that it is not optimal to apply such a fine reduction. The reason is that monitoring through a CP can be used to indeed prevent corporate crime, but also to promote it. Our results thus confirm the European Commission's view.

However, we do realise that our model is based on the monitoring aspect of CPs and leaves out practicalities of how exactly the CP is implemented. Therefore, the potentially perverse effect of reducing information asymmetries may not always be present. In particular,

[38] See footnotes 9 and 10.

the perverse effect is less relevant when the shareholder delegates the implementation and execution of the CP to a third party like an in-house or external lawyer that can credibly live up to its reputation. However, such delegation may suffer from collusion (bribing) between the lawyer and the employee; these considerations are work-in-progress.

Desirability of Compliance Programs (US and EU)

Focusing on the monitoring aspect of CPs, we argue that CPs may be beneficial in the fight against corporate crime when individual sanctions are low, but detrimental when individual sanctions are high. Although we do not want to make the claim that firms adopt CPs with the only objective to reduce information asymmetries so as to promote its employees to misbehave, the result does however suggest a potential perverse effect of increasing the monitoring of harmful activities. Since individual sanctions are non-existent[39] in the EU and relatively high in the US, our results suggest that monitoring behavior through CPs is more desirable in the EU than in the US.

7 Concluding Remarks

In this paper, we have examined the desirability of the firm's monitoring effort and its impact on optimal (competition) policy. We have stressed that the information obtained by monitoring employees through a CP may be used to prevent corporate crime, but also to promote corporate crime. Thus, we have argued that corporations having adopted a CP should not automatically qualify for a discount on the corporate fine, which contradict the *US Sentencing Guidelines*. Also, we have provided arguments that the *Corporate Leniency Program* may be improved upon by granting partial immunity instead of full immunity to the corporation, while granting no immunity to the involved individuals. Finally, we showed that for some types of corporate crime the *Individual Leniency Program* entails the perverse effect of actually promoting breaches of the law.

We assumed that a CP is costless to implement so as to not complicate the analysis with exogenous fixed costs, which would not have an impact on 'marginal behavior'. If the adoption of a CP entails a fixed cost, then the qualitative results remain unchanged; the only difference would be that, in equilibrium, a CP is adopted for less parameter values, because the shareholder would compare its cost with the reduction in salary cost caused by the CP.

Details of the contract between the shareholder and the manager are unobservable to the authority. In contrast, one may think of a set-up in which the details of this contract

[39]Some EU Member have however criminal laws on the national level – see footnote 5.

are revealed when the authority audits the firm. This would not change our results as the authority finds out whether a breach has occurred anyway when the firm is audited; additional information about the employment contract would then be irrelevant.

Our model takes the manager's private benefit from breaching the law (G) to be a fixed observable variable. An interesting extension would be to take the manager's private benefit as a random variable, which is unobservable to the shareholder. The resulting equilibrium may then entail some breaches occurring, because managers with a very high private benefit would not be deterred from breaching the law in equilibrium.

An extension of the model presented in this paper is work in progress. We consider a *third party* in charge of the CP, such as an in-house or external lawyer, who cannot credibly commit to reporting evidence to the authority. This introduces a new tradeoff: (i) the lawyer has reputational concerns, which makes monitoring by the lawyer *a priori* more credible than monitoring by the shareholder, but (ii) the shareholder must now control two players, i.e. the manager *and* the lawyer, who may collude against the shareholder.

A Appendix: Proof Lemma 1 and 2 and Propositions 1 and 3

A.1 Proof Lemmas 1 and 2

We determine the expected transfers by solving for the schedule of transfers associated with the optimal contract that induces or prevents breaches, respectively.

Contract inducing breaches. If the principal wants to induce breaches of the law, then the optimal contract, given action $i \in \{N, C, R\}$ is defined as the solution of

$$\max_{t_{\pi,\sigma}} \left\{ \rho_\pi - \sum_{\pi=0}^{1} \sum_{\sigma=0}^{1} p_{\pi,\sigma}^{b,i} t_{\pi,\sigma} - E_i[F] \right\} \quad \text{s.t.}$$

$$t_{\pi,\sigma} \geq 0, \qquad \forall \{\pi, \sigma\}, \tag{LL_b}$$

$$\sum_{\pi=0}^{1} \sum_{\sigma=0}^{1} p_{\pi,\sigma}^{b,i} t_{\pi,\sigma} - E_i[f] + G \geq 0, \tag{PC_b}$$

$$\sum_{\pi=0}^{1} \sum_{\sigma=0}^{1} \left(p_{\pi,\sigma}^{b,i} - p_{\pi,\sigma}^{n,i} \right) t_{\pi,\sigma} - E_i[f] + G \geq 0. \tag{IC_b}$$

By limited liability (LL_b), the participation constraint (PC_b) is satisfied whenever the incentive compatibility constraint (IC_b) is satisfied. Now, if $E_i[f] \leq G$, then (IC_b) is satisfied by setting $t_{\pi,\sigma} = 0$, $\forall \{\pi, \sigma\}$, and thus $E_i\left[t^b\right] = 0$ for $i \in \{N, C, R\}$.

If $E_i[f] > G$, the cheapest way to satisfy (IC_b) is to make a positive transfer only in

(i) state $\{\pi, \sigma\} = \{1, 0\}$ if $i = N$ (there is no CP, so evidence never comes available and profit realisation $\pi = 1$ is most informative of a breach having occurred), and

(ii) any state in which $\sigma = 1$ if $i \in \{C, R\}$ (signal $\sigma = 1$ is a sufficient statistic), for example state $\{\pi, \sigma\} = \{1, 1\}$.

Consider first the case in which $i = N$. Then, setting $t_{\pi,\sigma} = 0$ for every state of the world $\{\pi, \sigma\} \neq \{1, 0\}$, while setting t_{10} to bind the incentive compatibility constraint, gives $t_{10} = \frac{E_N[f]-G}{\rho_\pi-(1-\rho_\pi)}$,which is paid out with probability ρ_π in equilibrium and thus $E_N\left[t^b\right] = \gamma^N\left(\beta f^N - G\right)$, where $\gamma^N = \frac{\rho_\pi}{2\rho_\pi-1}$.

Consider now the cases in which $i \in \{C, R\}$. Then, setting $t_{\pi,\sigma} = 0$ for every state of the world $\{\pi, \sigma\} \neq \{1, 1\}$, while setting t_{11} to bind the incentive compatibility constraint, gives $t_{11} = \frac{E_i[f]-G}{\rho_\pi \rho_\sigma}$,which is paid out with probability $\rho_\pi \rho_\sigma$ in equilibrium and thus $E_i\left[t^b\right] = E_i[f] - G$ if $i \in \{C, R\}$.

Contract preventing breaches. If the principal wants to prevent breaches of the law by action $i \in \{N, C, R\}$, the optimal employment contract is defined as the solution of

$$\max_{t_{\pi,\sigma}} \left\{ 1 - \rho_\pi - \sum_{\pi=0}^{1} \sum_{\sigma=0}^{1} p_{\pi,\sigma}^{n,i} t_{\pi,\sigma} \right\} \qquad \text{s.t.}$$

$$t_{\pi,\sigma} \geq 0, \qquad \forall \pi, \sigma, \tag{LL_n}$$

$$\sum_{\pi=0}^{1} \sum_{\sigma=0}^{1} p_{\pi,\sigma}^{n,i} t_{\pi,\sigma} \geq 0, \tag{PC_n}$$

$$\sum_{\pi=0}^{1} \sum_{\sigma=0}^{1} \left(p_{\pi,\sigma}^{n,i} - p_{\pi,\sigma}^{b,i} \right) t_{\pi,\sigma} + E_i\left[f\right] - G \geq 0. \tag{IC_n}$$

Again, by limited liability (LL_n), the participation constraint (PC_n) is satisfied whenever the incentive compatibility constraint (IC_n) is satisfied. Now, if $E_i\left[f\right] > G$, then (IC_n) is satisfied by setting $t_{\pi,\sigma} = 0$, $\forall \{\pi, \sigma\}$, and thus $E_i\left[t^n\right] = 0$ for $i \in \{N, C, R\}$.

If $E_i\left[f\right] \leq G$, the cheapest way to satisfy (IC_n) is to make a positive transfer only in the state of the world that is most informative about the law not having been breached, i.e. state $\{\pi, \sigma\} = \{0, 0\}$. Setting $t_{\pi,\sigma} = 0$ for every state of the world $\{\pi, \sigma\} \neq \{0, 0\}$, while setting t_{00} to bind the incentive compatibility constraint, gives

(i) $t_{00} = \frac{G - E_N[f]}{\rho_\pi - (1-\rho_\pi)}$ if $i = N$, which is paid out with probability ρ_π in equilibrium and thus $E_N\left[t^n\right] = \gamma^N \left(G - \beta f^N\right)$, and

(ii) $t_{00} = \frac{G - E_i[f]}{\rho_\pi - (1-\rho_\pi)(1-\rho_\sigma)}$ if $i \in \{C, R\}$, which is paid out with probability ρ_π in equilibrium and thus $E_i\left[t^n\right] = \gamma^C \left(G - E_i\left[f\right]\right)$ if $i \in \{C, R\}$, where $\gamma^C = \frac{\rho_\pi}{\rho_\pi - (1-\rho_\pi)(1-\rho_\sigma)}$.

Combining the results. If $i = N$, we thus have

$$E_N\left[t^b\right] = \begin{cases} 0 & \text{if } \beta f^N \leq G, \\ \gamma^N \left(\beta f^N - G\right) & \text{if } \beta f^N > G, \end{cases} \qquad E_N\left[t^n\right] = \begin{cases} \gamma^N \left(G - \beta f^N\right) & \text{if } \beta f^N \leq G, \\ 0 & \text{if } \beta f^N > G, \end{cases}$$

while if $i \in \{C, R\}$, we have

$$E_i\left[t^b\right] = \begin{cases} 0 & \text{if } E_i\left[f\right] \leq G, \\ E_i\left[f\right] - G & \text{if } E_i\left[f\right] > G, \end{cases} \qquad E_i\left[t^n\right] = \begin{cases} \gamma^C \left(G - E_i\left[f\right]\right) & \text{if } E_i\left[f\right] \leq G, \\ 0 & \text{if } E_i\left[f\right] > G, \end{cases}$$

which boils down to Lemma 1 and Lemma 2, respectively. ■

A.2 Proof Proposition 1

By Lemmas 1 and 2, for any $i \in \{N, C, R\}$, increasing f^i weakly increases $E_i\left[t^b\right]$ and weakly decreases $E_i\left[t^n\right]$, thereby weakly relaxing constraint (5). The authority thus optimally sets all managerial fines as high as possible, i.e.

$$f^N = f^C = f^R = \overline{f}.$$

Increasing F^N and F^C also weakly relaxes constraint (5). The authority thus optimally sets

$$F^N = F^C = \overline{F}.$$

We now derive the authority's optimal choice of F^R. Noting that $\rho_\sigma f^R + (1-\rho_\sigma)\beta f^C > \beta f^C$ (because $f^C = f^R = \overline{f}$), we have $E_R\left[t^b\right] > E_C\left[t^b\right]$ and $E_R\left[t^n\right] < E_C\left[t^n\right]$ by Lemma 2.

Principal prevents breach. Suppose the principal adopts a CP and prevents a breach. Since $E_R\left[t^n\right] \leq E_C\left[t^n\right]$, the principal pays a lower salary if she can credibly commit to blow the whistle whenever she finds evidence. Such a commitment also relaxes constraint (5) and is *ex-post* credible if and only if the authority sets $F^R \leq \beta F^C$, because the principal then pays a lower fine if she reports $\left(F^R\right)$ than if she does not report $\left(\beta F^C\right)$.

Principal induces breach. Suppose now the principal adopts a CP and induces a breach. If the authority sets $F^R > \beta F^C$, the principal will not report evidence when she finds it. If instead $F^R < \beta F^C$, the principal cannot help but report evidence whenever she finds it. Finally, if the authority sets $F^R = \beta F^C$, the principal is *ex-post* indifferent between reporting evidence or not. However, *ex-ante* she prefers to commit to not reporting evidence, because that reduces her expected transfer since $E_C\left[t^b\right] < E_R\left[t^b\right]$. Her expected payoff thus is

$$\Pi_i^b = \begin{cases} \Pi_R^b = \rho_\pi - E_R\left[t^b\right] - \rho_\sigma F^R - (1-\rho_\sigma)\beta F^C & \text{if } F^R < \beta F^C, \\ \Pi_C^b = \rho_\pi - E_C\left[t^b\right] - \beta F^C & \text{if } F^R = \beta F^C, \\ \Pi_C^b = \rho_\pi - E_C\left[t^b\right] - \beta F^C & \text{if } F^R > \beta F^C, \end{cases}$$

Now, decreasing $F^R = \beta F^C$ to $F^R < \beta F^C$ entails (i) a discrete downward jump from Π_C^b to Π_R^b, because $E_R\left[t^b\right] > E_C\left[t^b\right]$ and $\rho_\sigma F^R + (1-\rho_\sigma)\beta F^C = \beta F^C$ if $F^R = \beta F^C$, while (ii) continuously increasing Π_R^b, because Π_R^b increases as becomes F^R smaller. Thus, the authority optimally sets F^R slightly under βF^C so as to 'impose' the discrete downward jump on the principal with a minimal effect of the continuous increase. Therefore, $F^R = \beta F^C - |\epsilon|$,where

ϵ is arbitrarily small. ■

A.3 Proof Proposition 3

The proof consists of three steps: (i) we derive the optimal audit probability β^* when CPs are available, (ii) we derive the optimal audit probability $\tilde{\beta}^*$ when CPs are not available, and (iii) we compare the relative sizes of β^* and $\tilde{\beta}^*$.

A.3.1 Optimal audit probability when CPs are available (β^*)

Lemma 6 *The optimal audit probability β^*, as a function of $\overline{F}$ and $\overline{f}$, is*

$$\text{If } \bar{f} \in [0, G]: \ \beta^* = \begin{cases} \emptyset & \text{if } \overline{F} < F_0, \\ \frac{2\rho_\pi - 1 + \gamma^C\left(G - \rho_\sigma \bar{f}\right)}{\gamma^C(1-\rho_\sigma)\bar{f} + \bar{F}} & \text{if } \bar{F} \geq F_0, \end{cases} \tag{6}$$

$$\text{If } \bar{f} \in \left(G, \frac{G}{\rho_\sigma}\right): \ \beta^* = \begin{cases} \emptyset & \text{if } \overline{F} < F_1, \\ \frac{2\rho_\pi - 1 + G - \rho_\sigma \bar{f}}{(1-\rho_\sigma)\bar{f} + \bar{F}} & \text{if } F_1 \leq \bar{F} < F_2, \\ \frac{2\rho_\pi - 1 + \gamma^N G}{\gamma^N \bar{f} + \bar{F}} & \text{if } F_2 \leq \bar{F} < F_3, \\ \frac{2\rho_\pi - 1}{\bar{F}} & \text{if } F_3 \leq \bar{F} < F_4, \\ \frac{2\rho_\pi - 1 + \gamma^C\left(G - \rho_\sigma \bar{f}\right)}{\gamma^C(1-\rho_\sigma)\bar{f} + \bar{F}} & \text{if } \bar{F} \geq F_4, \end{cases} \tag{7}$$

$$\text{If } \bar{f} \in \left[\frac{G}{\rho_\sigma}, \infty\right): \ \beta^* = \begin{cases} \emptyset & \text{if } \overline{F} < F_1, \\ \frac{2\rho_\pi - 1 + G - \rho_\sigma \bar{f}}{(1-\rho_\sigma)\bar{f} + \bar{F}} & \text{if } F_1 \leq \bar{F} < F_2, \\ \frac{2\rho_\pi - 1 + \gamma^N G}{\gamma^N \bar{f} + \bar{F}} & \text{if } F_2 \leq \bar{F} < F_3, \\ \frac{2\rho_\pi - 1}{\bar{F}} & \text{if } \bar{F} \geq F_3, \end{cases} \tag{8}$$

where $F_0 = 2\rho_\pi - 1 + \gamma^C\left(G - \bar{f}\right)$, $F_1 = (2\rho_\pi - 1)\,\pi + G - \bar{f}$,
$F_2 = \frac{\left((2\rho_\pi - 1)\pi + \gamma^N G\right)\left(\gamma^N - (1-\rho_\sigma)\right)\bar{f} - \left(\rho_\sigma \bar{f} + \left(\gamma^N - 1\right)G\right)\gamma^N \bar{f}}{\rho_\sigma \bar{f} + (\gamma^N - 1)G}$, $F_3 = \frac{(2\rho_\pi - 1)\bar{f}}{G}$, *and* $F_4 = \frac{(2\rho_\pi - 1)(1-\rho_\sigma)\bar{f}}{G - \rho_\sigma \bar{f}}$.

Proof. By Corollary 1, if the principal prevents a breach, she adopts a CP and the expected transfer is

$$E_R\left[t^n\right] = \max\left\{\gamma^C\left(G - \rho_\sigma \bar{f} - (1-\rho_\sigma)\,\beta\bar{f}\right), 0\right\}. \tag{9}$$

Conversely, if the principal induces a breach, she may or may not adopt a CP, resulting in expected transfer, respectively,

$$E_R\left[t^b\right] = \max\left\{\rho_\sigma \bar{f} + (1-\rho_\sigma)\,\beta\bar{f} - G, 0\right\}, \tag{10}$$

$$E_N\left[t^b\right] = \max\left\{\gamma^N\left(\beta\bar{f} - G\right), 0\right\}. \tag{11}$$

The authority minimises β subject to constraint (5), which then simplifies to

$$1-\rho_\pi-E_R\left[t^n\right]\geq\rho_\pi-\min\left\{E_N\left[t^b\right]+\beta\overline{F},E_R\left[t^b\right]+\beta\overline{F}-\rho_\sigma\left|\epsilon\right|\right\},$$

where we neglect ϵ for notational convenience, yielding

$$1-\rho_\pi-E_R\left[t^n\right]\geq\rho_\pi-\min\left\{E_N\left[t^b\right],E_R\left[t^b\right]\right\}-\beta\overline{F}. \tag{12}$$

The expressions for the expected transfers $E_R\left[t^n\right]$ and $\min\left\{E_N\left[t^b\right],E_R\left[t^b\right]\right\}$ depend on how managerial benefit G compares to the expected managerial fine – see (9), (10), and (11). These expressions are stated in the following table as a function of β:

Audit probability β	Preventing breach: $E_R\left[t^n\right]$	Inducing breach: $\min\left\{E_N\left[t^b\right],E_R\left[t^b\right]\right\}$
$\beta\in\left[0,\frac{G-\rho_\sigma\bar{f}}{(1-\rho_\sigma)\bar{f}}\right)$	$\gamma^C\left(G-\rho_\sigma\bar{f}-(1-\rho_\sigma)\beta\bar{f}\right)$	$E_N\left[t^b\right]=E_R\left[t^b\right]=0$
$\beta\in\left[\frac{G-\rho_\sigma\bar{f}}{(1-\rho_\sigma)\bar{f}},\frac{G}{\bar{f}}\right)$	0	$E_N\left[t^b\right]=0$
$\beta\in\left[\frac{G}{\bar{f}},\frac{\rho_\sigma\bar{f}+\left(\gamma^N-1\right)G}{(\gamma^N-(1-\rho_\sigma))\bar{f}}\right)$	0	$E_N\left[t^b\right]=\gamma^N\left(\beta\bar{f}-G\right)$
$\beta\in\left[\frac{\rho_\sigma\bar{f}+\left(\gamma^N-1\right)G}{(\gamma^N-(1-\rho_\sigma))\bar{f}},1\right]$	0	$E_R\left[t^b\right]=\rho_\sigma\bar{f}+(1-\rho_\sigma)\beta\bar{f}-G$

Depending on the relative sizes of $\overline{f}$ and G, some of the rows of this table violate $\beta\in[0,1]$ and thus need to be disregarded. We consider all possible cases in turn.

Suppose $\overline{f}\in[0,G]$. Only the first row is then relevant, because $\frac{G-\rho_\sigma\bar{f}}{(1-\rho_\sigma)\bar{f}}\geq 1$. We then have $E_R\left[t^n\right]=\gamma^C\left(G-\rho_\sigma\bar{f}-(1-\rho_\sigma)\beta\bar{f}\right)$ and $\min\left\{E_N\left[t^b\right],E_R\left[t^b\right]\right\}=E_N\left[t^b\right]=0$. Substituting these transfers in constraint (12) and solving for β gives equation (6), where $\overline{F}\geq F_0$ ensures that $\beta^*\leq 1$.

Suppose $\bar{f}\in\left(G,\frac{G}{\rho_\sigma}\right)$. All rows of the table are then relevant. For each region of β (i.e. for each row of the table), substituting the associated transfers in constraint (12) and solving for β gives equation (7), where the conditions on $\overline{F}$ ensure that the derived solution indeed lies within the relevant region of β.

Suppose $\bar{f}\in\left[\frac{G}{\rho_\sigma},\infty\right)$. Only the last three rows of the table are then relevant, because $\frac{G-\rho_\sigma\bar{f}}{(1-\rho_\sigma)\bar{f}}\leq 0$. For each of the last three rows, substituting the associated transfers in constraint (12) and solving for β gives equation (8), where the conditions on $\overline{F}$ ensure that the derived solution indeed lies within the relevant region of β. ■

A.3.2 Optimal audit probability when CPs are not available ($\tilde{\beta}^*$)

By Lemma 1, the expected transfer is $E_N\left[t^b\right] = \max\left\{\gamma^N\left(\beta f^N - G\right), 0\right\}$ when inducing a breach, and $E_N\left[t^n\right] = \max\left\{\gamma^N\left(G - \beta f^N\right), 0\right\}$ when preventing a breach. Thus, we have (i) if $G \leq \beta\overline{f}$ then $E_N\left[t^b\right] = \gamma^N\left(\beta f^N - G\right)$ and $E_N\left[t^n\right] = 0$, while (ii) if $G > \beta\overline{f}$ then $E_N\left[t^b\right] = 0$ and $E_N\left[t^n\right] = \gamma^N\left(G - \beta f^N\right)$. In both cases, we have $E_N\left[t^n\right] - E_N\left[t^b\right] = \gamma^N\left(G - \beta f^N\right)$.

The authority's problem is to minimise β subject to $\Pi_N^n \geq \Pi_N^b$, that is, subject to

$$\begin{aligned} 1 - \rho_\pi - E_N\left[t^n\right] &\geq \rho_\pi - E_N\left[t^b\right] - \beta\overline{F}, \\ \Leftrightarrow \beta\overline{F} &\geq 2\rho_\pi - 1 + E_N\left[t^n\right] - E_N\left[t^b\right]. \end{aligned}$$

Substituting for $E_N\left[t^n\right] - E_N\left[t^b\right] = \gamma^N\left(G - \beta f^N\right)$ and solving for β gives

$$\tilde{\beta}^* = \begin{cases} \emptyset & \text{if } \overline{F} < F_5, \\ \frac{2\rho_\pi - 1 + \gamma^N G}{\gamma^N \bar{f} + \bar{F}} & \text{if } \bar{F} \geq F_5, \end{cases}$$

where $\bar{F} \geq F_5 = 2\rho_\pi - 1 + \gamma^N\left(G - \bar{f}\right)$ ensures that $\tilde{\beta}^* \leq 1$.

A.3.3 Comparison of β^* and $\tilde{\beta}^*$

Assuming that $\overline{F}$ is large enough for $\beta^*, \tilde{\beta}^* \leq 1$ to exist, we have by straighforward algebra

(i) $\beta^* < \tilde{\beta}^*$ if *(a)* $\overline{f} \leq G$, or *(b)* $\bar{f} \in \left(G, \frac{G}{\rho_\sigma}\right)$ and $\overline{F} \geq F_3$, or *(c)* $\bar{f} \geq \frac{G}{\rho_\sigma}$ and $\overline{F} \geq F_3$;

(ii) $\beta^* > \tilde{\beta}^*$ if *(a)* $\bar{f} \in \left(G, \frac{G}{\rho_\sigma}\right)$ and $\overline{F} < F_2$, or if *(b)* $\bar{f} > \frac{G}{\rho_\sigma}$ and $\overline{F} < F_2$; and

(iii) $\beta^* = \tilde{\beta}^*$ if *(a)* $\bar{f} \in \left(G, \frac{G}{\rho_\sigma}\right)$ and $F_2 \leq \overline{F} < F_3$, or if *(b)* $\bar{f} > \frac{G}{\rho_\sigma}$ and $F_2 \leq \overline{F} < F_3$,

which is equivalent to Proposition 3, where we define $F' = F_2$ and $F'' = F_3$. ■

B Appendix: Proof Lemmas 3 and 4

This Appendix derives the expected transfers. Denote by $i = E$ the principal's action of 'not adopting a CP and blowing the whistle when the manager shows evidence to her'. Similar to the results in Section 4, we anticipate that the authority optimally (i) sets the managerial fines f^N, f^C and f^R to their legal maximum $\overline{f}$; (ii) sets the corporate fines F^N and F^C to their legal maximum $\overline{F}$; and (iii) grants partial corporate leniency when the principal reports evidence to the authority, i.e. $F^R = \beta\overline{F} - |\epsilon|$, thereby ensuring that the principal always reports when she has evidence of a breach. We *ex-post* verify that this anticipation is indeed correct; the proof is long and available on request.

B.1 Proof Lemma 3: Expected transfer to prevent a breach

If the principal prevents a breach, she optimally implements a CP to monitor the manager, while paying him a positive transfer if and only if $\pi = 0$, $\sigma = 0$, $r_a = 0$ and $r_p = 0$. Denoting transfers by t_{π,σ,r_a,r_p}, the principal minimises $t_{0,0,0,0} \geq 0$, subject to

$$\rho_\pi t_{0,0,0,0} \geq (1-\rho_\pi)(1-\rho_\sigma) t_{0,0,0,0} + G - \rho_\sigma f^R - (1-\rho_\sigma)\beta f^C, \tag{13}$$

$$\rho_\pi t_{0,0,0,0} \geq G - f^r, \tag{14}$$

$$\rho_\pi t_{0,0,0,0} \geq G - f^R, \tag{15}$$

$$\rho_\pi t_{0,0,0,0} \geq 0, \tag{16}$$

where (13) ensures that the principal does not 'breach and not show evidence to the principal and not blow the whistle', (14) ensures that the principal does not 'breach and blow the whistle', (15) ensures that the manager does not 'breach and show evidence to the principal', and (16) is the participation constraint. Anticipating that $f^C = f^R = \overline{f}$, we then have

$$E_R[t^n] = \rho_\pi t_{0,0,0,0} = \max\left\{\gamma^C\left(G - \rho_\sigma f^R - (1-\rho_\sigma)\beta f^C\right), G - f^r, 0\right\}. \tag{17}$$

■

B.2 Proof Lemma 4: Expected transfer to induce a breach

When the principal induces a breach, she may do so by (i) adopting a CP or not, and (ii) requesting evidence from the manager or not, while (iii) ensuring that the manager does not blow the whistle.[40] We consider the four possible cases in turn.

B.2.1 Case I: CP and no request for evidence

Suppose the principal adopts a CP and does not request evidence from the manager. She will then use signal $\sigma = 1$ to induce a breach, because $\sigma = 1$ is a perfectly informative signal of a breach having occurred. The realisation of π is then irrelevant. Moreover, the principal must ensure that the manager does not blow the whistle or shows evidence to the principal. Transfers are thus contingent on the realisation of σ, r_a and r_p. We denote them by t_{σ,r_a,r_p}, such that $t_{\sigma,r_a,r_p} = 0$ if $r_a = 1$ and/or $r_p = 1$.

[40] We assume that $\overline{F}$ is sufficiently large such that the principal never induces a breach by requiring the manager to blow the whistle. Anticipating that the authority sets corporate fines to the maximum, such a strategy would mean being imposed the corporate fine $\overline{F}$ for sure, which is irrational if $\overline{F}$ is large enough.

Interim stage 5'. Suppose the manager has breached and signal σ has been realised. If $\sigma = 1$ the principal blows the whistle and the game ends. However, if $\sigma = 0$ the principal must ensure that the manager does not blow the whistle or reports to the principal, which is the case if she compensates him by $t_{0,0,0} \geq \beta f^C - \min\left\{f^r, f^R\right\}$.

Ex-ante stage 4'. To induce the manager to breach the law in the first place, the principal must create a wedge, say Δ, between $t_{1,0,0}$ and $t_{0,0,0}$. She optimally does so by setting $t_{0,0,0} = \max\left\{\beta f^C - \min\left\{f^r, f^R\right\}, 0\right\}$ and minimising $t_{1,0,0} = t_{0,0,0} + \Delta$, subject to

$$\rho_\sigma\left(t_{0,0,0} + \Delta\right) + \left(1 - \rho_\sigma\right) t_{0,0,0} + G - \rho_\sigma f^R - \left(1 - \rho_\sigma\right)\beta f^C \geq t_{0,0,0}, \tag{18}$$

$$\rho_\sigma\left(t_{0,0,0} + \Delta\right) + \left(1 - \rho_\sigma\right) t_{0,0,0} + G - \rho_\sigma f^R - \left(1 - \rho_\sigma\right)\beta f^C \geq G - \min\left\{f^r, f^R\right\}, \tag{19}$$

$$\rho_\sigma\left(t_{0,0,0} + \Delta\right) + \left(1 - \rho_\sigma\right) t_{0,0,0} + G - \rho_\sigma f^R - \left(1 - \rho_\sigma\right)\beta f^C \geq 0, \tag{20}$$

where (**??**) ensures that the manager does not 'not breach the law', (**??**) ensures that the manager does not 'breach and blow the whistle or report to the principal', and (**??**) is the participation constraint, which is implied by (**??**). We then have by (**??**) and (**??**) that

$$\begin{aligned} E_R\left[t^b\right] &= \rho_\sigma\left(t_{0,0,0} + \Delta\right) + \left(1 - \rho_\sigma\right) t_{0,0,0} \\ &= \max\left\{\rho_\sigma f^R + \left(1 - \rho_\sigma\right)\beta f^C - G + \max\left\{\beta f^C - \min\left\{f^r, f^R\right\}, 0\right\},\right. \\ &\qquad \left.\rho_\sigma f^R + \left(1 - \rho_\sigma\right)\beta f^C - \min\left\{f^r, f^R\right\}, 0\right\}. \end{aligned}$$

B.2.2 Case II: No CP and no request for evidence

Suppose the principal does not adopt a CP and does not request evidence from the manager. She will then use signal $\pi = 1$ to induce a breach. Moreover, the principal must ensure that the manager does not blow the whistle or reports evidence to the principal. Transfers are thus contingent on the realisation of π, r_a and r_p. We denote them by t_{π,r_a,r_p}, such that $t_{\sigma,r_a,r_p} = 0$ if $r_a = 1$ and/or $r_p = 1$.

Interim stage 5'. Suppose the manager has breached and profit π has been realised. The principal then ensures that the manager does not blow the whistle or reports evidence to the principal by paying him $t_{\pi,0,0} \geq \beta f^N - \min\left\{f^r, f^E\right\}$ for both $\pi \in \{0, 1\}$.

Ex-ante stage 4'. To induce the manager to breach the law in the first place, the principal must create a wedge, say $\Delta > 0$, between $t_{1,0,0}$ and $t_{0,0,0}$. She optimally does so by setting

$t_{0,0,0} = \max\left\{\beta f^N - \min\left\{f^r, f^E\right\}, 0\right\}$ and minimising $t_{1,0,0} = t_{0,0,0} + \Delta$, subject to

$$\rho_\pi\left(t_{0,0,0} + \Delta\right) + \left(1 - \rho_\pi\right) t_{0,0,0} + G - \beta f^N \geq \left(1 - \rho_\pi\right)\left(t_{0,0,0} + \Delta\right) + \rho_\pi t_{0,0,0}, \tag{21}$$

$$\rho_\pi\left(t_{0,0,0} + \Delta\right) + \left(1 - \rho_\pi\right) t_{0,0,0} + G - \beta f^N \geq G - \min\left\{f^r, f^E\right\}, \tag{22}$$

$$\rho_\pi\left(t_{0,0,0} + \Delta\right) + \left(1 - \rho_\pi\right) t_{0,0,0} + G - \beta f^N \geq 0, \tag{23}$$

where (21) ensures that the manager does not 'not breach the law', (22) ensures that the manager does not 'breach and blow the whistle or report to the principal', and (23) is the participation constraint, which is implied by (21). Noting that (22) is always satisfied, we have by (21) that

$$\Delta = \max\left\{\frac{\beta f^N - G}{2\rho_\pi - 1}, 0\right\},$$

resulting in expected transfer

$$\begin{aligned} E\left[t^b\right] &= \rho_\pi\left(t_{0,0,0} + \Delta\right) + \left(1 - \rho_\pi\right) t_{0,0,0} \\ &= \max\left\{\gamma^N\left(\beta f^N - G\right), 0\right\} + \max\left\{\beta f^C - \min\left\{f^r, f^E\right\}, 0\right\}. \end{aligned}$$

B.2.3 Case III: CP and request for evidence

Suppose the principal adopts a CP and requests evidence from the manager. She can optimally induce a breach by paying the manager a positive transfer if and only if $r_a = 0$ and $r_p = 1$. We thus denote the transfers by t_{r_a,r_p}, where $t_{r_a,r_p} = 0$ if $(r_a, r_p) \neq (0, 1)$.

The principal can request for evidence before or after profit π and signal σ are realised. Since both pieces of information do not affect the transfers, it does not matter when the principal requests for evidence. She minimises $t_{0,1}$, subject to

$$t_{0,1} + G - f^R \geq 0, \tag{24}$$

$$t_{0,1} + G - f^R \geq G - \rho_\sigma f^R - \left(1 - \rho_\sigma\right)\beta f^C, \tag{25}$$

$$t_{0,1} + G - f^R \geq G - f^r, \tag{26}$$

$$t_{0,1} + G - f^R \geq 0, \tag{27}$$

where (24) ensures that the does not 'not breach', (25) ensures that the manager does not 'breach and not report evidence to the principal', (26) ensures that the manager does not 'breach and blow the whistle', and (27) is the participation constraint. The expected transfer is then

$$E_R\left[t^b\right] = \max\left\{f^R - G, \left(1 - \rho_\sigma\right)\left(f^R - \beta f^C\right), f^R - f^r, 0\right\}.$$

B.2.4 Case IV: No CP and request for evidence

Suppose the principal does not adopt a CP, but requests to see the evidence. Again, she optimally induces a breach by paying the manager a positive transfer if and only if $r_a = 0$ and $r_p = 1$. We thus denote the transfers by t_{r_a,r_p}, where $t_{r_a,r_p} = 0$ if $(r_a, r_p) \neq (0, 1)$.

Again, the principal can request for evidence before or after profit π and signal σ are realised. Since both pieces of information do not affect the transfers, it does not matter when the principal requests for evidence. She minimises $t_{0,1}$, subject to

$$t_{0,1} + G - f^E \geq 0, \tag{28}$$
$$t_{0,1} + G - f^E \geq G - \beta f^N, \tag{29}$$
$$t_{0,1} + G - f^E \geq G - f^r, \tag{30}$$
$$t_{0,1} + G - f^E \geq 0, \tag{31}$$

where (28) ensures that the manager does not 'not breach the law', (29) ensures that the manager does not 'breach and not show evidence to the principal', (30) ensures that the principal does not 'breach and blow the whistle', and (30) is the participation constraint. The expected transfer is then

$$E_E\left[t^b\right] = \max\left\{f^E - G, f^E - \beta f^N, f^E - f^r, 0\right\}.$$

B.2.5 Summary of expected transfers to induce a breach

Substituting $f^N = f^C = f^R = f^E = \overline{f}$ into the expected transfers $E_i\left[t^b\right]$ derived above, we arrive at the following table for $E_i\left[t^b\right]$, where $E_R[f] = \rho_\sigma \bar{f} + (1 - \rho_\sigma)\beta\bar{f}$.

	Request for evidence	Not request for evidence
CP	$\max\left\{\bar{f} - G, (1-\rho_\sigma)(1-\beta)\bar{f}, \bar{f} - f^r, 0\right\}$	$\max\left\{E_R[f] - G + \max\left(\beta\bar{f} - f^r, 0\right), E_R[f] - f^r, 0\right\}$
No CP	$\max\left\{\bar{f} - G, (1-\beta)\bar{f}, \bar{f} - f^r, 0\right\}$ $(*)$	$\max\left\{\gamma^N\left(\beta\bar{f} - G\right), 0\right\} + \max\left\{\beta\bar{f} - f^r, 0\right\}$

$(*)$ Noting that the strategy 'no CP, request for evidence' entails a weakly higher expected transfer than the strategy 'CP, request for evidence', we eliminate the former from the problem. The remaining expected transfers are stated in Lemma 4. ■

C Appendix: Proof Proposition 4

This Appendix solves for the optimal managerial leniency policy f^r, which the authority sets so as to maximise the wedge $E\left[t^b\right] - E\left[t^n\right]$. Subsections C.1 and C.2, respectively, determine this wedge if $f^r = \overline{f}$ and $\overline{f} = 0$. We compare those wedges in Subsection B.2.5 so as to derive the optimal f^r. Throughout the analysis, we assume $\rho_\sigma > \frac{1-\rho_\pi}{\rho_\pi}$ so as to reduce the number of cases.

C.1 No managerial leniency

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 (17) becomes

$$E\left[t^n\right] = \max\left\{\underbrace{\gamma^C\left(G - \rho_\sigma \bar{f} - (1-\rho_\sigma)\,\beta\bar{f}\right)}_{A}, \underbrace{G - \bar{f}}_{B}, 0\right\},$$

where constraint B is irrelevant, because (i) if $\overline{f} < G$ then $B < A$, and (ii) if $\overline{f} \geq G$ then $B < 0$. Therefore,

$$E\left[t^n\right] = \max\left\{\gamma^C\left(G - \rho_\sigma \bar{f} - (1-\rho_\sigma)\,\beta\bar{f}\right), 0\right\}. \tag{32}$$

Inducing a breach. Substituting $f^r = \overline{f}$ in the expressions in Subsection B.2.5 yields

$$E\left[t^b\right] = \min\left\{\max\left(\rho_\sigma \bar{f} + (1-\rho_\sigma)\,\beta\bar{f} - G, 0\right), \max\left\{\gamma^N\left(\beta\bar{f} - G\right), 0\right\}\right\}. \tag{33}$$

The wedge. From (32) and (33) we have that the wedge $E\left[t^b\right] - E\left[t^n\right]$ is the same as in the case in which the manager does not possess evidence, yielding the table on page 35.

C.2 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 (17) becomes

$$E\left[t^n\right] = \max\left\{\gamma^C\left(G - \rho_\sigma \bar{f} - (1-\rho_\sigma)\,\beta\bar{f}\right), G, 0\right\},$$

and the "reporting constraint" G binds if and only if $G > \gamma^C \left(G - \rho_\sigma \bar{f} - (1-\rho_\sigma)\beta\bar{f}\right)$, that is, if and only if

$$\beta > \hat{\beta} = \frac{\left(\gamma^C - 1\right) G - \gamma^C \rho_\sigma \bar{f}}{\gamma^C (1-\rho_\sigma)\bar{f}},$$

where we note that $\hat{\beta} > 0 \Leftrightarrow \bar{f} < \frac{(\gamma^C-1)G}{\gamma^C \rho_\sigma}$ and $\hat{\beta} < 1 \Leftrightarrow \bar{f} > \frac{(\gamma^C-1)G}{\gamma^C}$. The following table then summarises the expected transfer needed to prevent a breach depending on $\bar{f}$ and β.

Cap on managerial fine $\bar{f}$	Audit prob. β	Expected transfer $E[t^n]$
$\bar{f} \in \left[0, \frac{(\gamma^C-1)G}{\gamma^C}\right)$	$\beta \in [0,1]$	$E[t^n] = \gamma^C \left(G - \rho_\sigma \bar{f} - (1-\rho_\sigma)\beta\bar{f}\right)$
$\bar{f} \in \left[\frac{(\gamma^C-1)G}{\gamma^C}, \frac{(\gamma^C-1)G}{\gamma^C \rho_\sigma}\right)$	$\beta \in \left[0, \hat{\beta}\right)$	$E[t^n] = \gamma^C \left(G - \rho_\sigma \bar{f} - (1-\rho_\sigma)\beta\bar{f}\right)$
	$\beta \in \left[\hat{\beta}, 1\right]$	$E[t^n] = G$
$\bar{f} \in \left[\frac{(\gamma^C-1)G}{\gamma^C \rho_\sigma}, \infty\right)$	$\beta \in [0,1]$	$E[t^n] = G$

Inducing a breach. Substituting $f^r = 0$ in the expressions in Subsection B.2.5 yields

$$E\left[t^b\right] = \min\left\{\bar{f}, \max\left\{E_R[f] - G + \beta\bar{f}, E_R[f]\right\}, \max\left\{\gamma^N\left(\beta\bar{f} - G\right), 0\right\} + \beta\bar{f}, 0\right\}. \quad (34)$$

If either $\bar{f} < G$ or $\overline{f} > G$ *and* $\beta < \frac{G}{\bar{f}}$, then (34) becomes

$$E\left[t^b\right] = \min\left\{\bar{f}, \rho_\sigma\bar{f} + (1-\rho_\sigma)\beta\bar{f}, \beta\bar{f}\right\} = \beta\bar{f}. \quad (35)$$

If $\overline{f} > G$ and $\beta > \frac{G}{\bar{f}}$, then we have

$$E\left[t^b\right] = \min\left\{\bar{f}, \underbrace{\rho_\sigma\bar{f} + (1-\rho_\sigma)\beta\bar{f} - G + \beta\bar{f}}_{A}, \underbrace{\gamma^N\left(\beta\bar{f} - G\right) + \beta\bar{f}}_{B}\right\},$$

where we note that

$$B < A \Leftrightarrow \beta < \tilde{\tilde{\beta}} = \frac{\left(\gamma^N - 1\right) G + \rho_\sigma \bar{f}}{\left(\gamma^N - (1 - \rho_\sigma)\right) \bar{f}},$$
$$B < \bar{f} \Leftrightarrow \beta < \tilde{\tilde{\beta}} = \frac{\gamma^N G + \bar{f}}{\left(\gamma^N + 1\right) \bar{f}}, \text{ and}$$
$$A < \bar{f} \Leftrightarrow \beta < \tilde{\beta} = \frac{\left(1 - \rho_\sigma\right) \bar{f} + G}{\left(2 - \rho_\sigma\right) \bar{f}},$$

where $0 < \tilde{\beta} < \tilde{\tilde{\beta}} < \tilde{\tilde{\tilde{\beta}}} < 1$, because $\bar{f} > G$ and by assumption $\rho_\sigma > \frac{1-\rho_\pi}{\rho_\pi}$. Thus,

$$E\left[t^b\right] = B \Leftrightarrow \left\{\beta < \tilde{\tilde{\beta}} \text{ and } \beta < \tilde{\tilde{\tilde{\beta}}}\right\} \Leftrightarrow \beta < \tilde{\tilde{\beta}},$$
$$E\left[t^b\right] = A \Leftrightarrow \left\{\beta < \tilde{\beta} \text{ and } \beta > \tilde{\tilde{\beta}}\right\}, \text{ which cannot hold, and}$$
$$E\left[t^b\right] = \bar{f} \Leftrightarrow \left\{\beta > \tilde{\beta} \text{ and } \beta > \tilde{\tilde{\beta}}\right\} \Leftrightarrow \beta > \tilde{\tilde{\beta}}.$$

The following table summarises.

Cap on managerial fine $\bar{f}$	Audit prob. β	Expected transfer $E\left[t^b\right]$
$\bar{f} \in [0, G)$	$\beta \in [0, 1]$	$E\left[t^b\right] = \beta \bar{f}$
$\bar{f} \in [G, \infty)$	$\beta \in \left[0, \frac{G}{\bar{f}}\right)$	$E\left[t^b\right] = \beta \bar{f}$
	$\beta \in \left[\frac{G}{\bar{f}}, \tilde{\beta}\right)$	$E\left[t^b\right] = \gamma^N \left(\beta \bar{f} - G\right) + \beta \bar{f}$
	$\beta \in \left[\tilde{\beta}, 1\right]$	$E\left[t^b\right] = \bar{f}$

The wedge. Noting that $\frac{\left(\gamma^C - 1\right)G}{\gamma^C \rho_\sigma} < G$ by assumption $\rho_\sigma > \frac{1-\rho_\pi}{\rho_\pi}$, the two tables above yield the wedge $E\left[t^b\right] - E\left[t^n\right]$ outlined in the following table.

Cap on managerial fine $\bar{f}$	Audit prob. β	Wedge $E\left[t^b\right]-E\left[t^n\right]$
$\bar{f}\in\left[0,\frac{\left(\gamma^C-1\right)G}{\gamma^C}\right)$	$\beta\in[0,1]$	$\beta\bar{f}-\gamma^C\left(G-\rho_\sigma\bar{f}-\left(1-\rho_\sigma\right)\beta\bar{f}\right)$
$\bar{f}\in\left[\frac{\left(\gamma^C-1\right)G}{\gamma^C},\frac{\left(\gamma^C-1\right)G}{\gamma^C\rho_\sigma}\right)$	$\beta\in\left[0,\hat{\beta}\right)$	$\beta\bar{f}-\gamma^C\left(G-\rho_\sigma\bar{f}-\left(1-\rho_\sigma\right)\beta\bar{f}\right)$
	$\beta\in\left[\hat{\beta},1\right]$	$\beta\bar{f}-G$
$\bar{f}\in\left[\frac{\left(\gamma^C-1\right)G}{\gamma^C\rho_\sigma},G\right)$	$\beta\in[0,1]$	$\beta\bar{f}-G$
$\bar{f}\in[G,\infty)$	$\beta\in\left[0,\frac{G}{\bar{f}}\right)$	$\beta\bar{f}-G$
	$\beta\left[\frac{G}{\bar{f}},\tilde{\tilde{\beta}}\right)$	$\gamma^N\left(\beta\bar{f}-G\right)+\beta\bar{f}-G$
	$\beta\in\left[\tilde{\tilde{\beta}},1\right]$	$\bar{f}-G$

C.3 Deriving the optimal f^r

Combining the last table above with that on page 35, we have the following table. Comparing the wedge $E\left[t^b\right]-E\left[t^n\right]$ if $f^r=0$ and if $f^r=\overline{f}$, the last column states the optimal managerial leniency policy by maximising this wedge. The cells containing numbers in brackets are not straightforward to determine and are therefore derived in more detail below.

Fine $\bar{f}\in$	Prob. $\beta\in$	Wedge if $f^r=0$	Wedge if $f^r=\overline{f}$	Optimal f^r
$\left[0,\frac{\left(\gamma^C-1\right)G}{\gamma^C}\right)$	$[0,1]$	$\beta\bar{f}-\gamma^C\left(G-E_R\left[f\right]\right)$	$-\gamma^C\left(G-E_R\left[f\right]\right)$	0
$\left[\frac{\left(\gamma^C-1\right)G}{\gamma^C},\frac{\left(\gamma^C-1\right)G}{\gamma^C\rho_\sigma}\right)$	$\left[0,\hat{\beta}\right)$	$\beta\bar{f}-\gamma^C\left(G-E_R\left[f\right]\right)$	$-\gamma^C\left(G-E_R\left[f\right]\right)$	0
	$\left[\hat{\beta},1\right]$	$\beta\bar{f}-G$	$-\gamma^C\left(G-E_R\left[f\right]\right)$	0 (1)
$\left[\frac{\left(\gamma^C-1\right)G}{\gamma^C\rho_\sigma},G\right)$	$[0,1]$	$\beta\bar{f}-G$	$-\gamma^C\left(G-E_R\left[f\right]\right)$	$f^r=\overline{f}$ if $\beta<\beta''$, $f^r=0$ if $\beta>\beta''$ (3)
$[G,\infty)$ $(*)$	$\left[0,\frac{G-\rho_\sigma\bar{f}}{\left(1-\rho_\sigma\right)\bar{f}}\right)$	$\beta\bar{f}-G$	$-\gamma^C\left(G-E_R\left[f\right]\right)$	$\bar{f}$ (2)
	$\left[\frac{G-\rho_\sigma\bar{f}}{\left(1-\rho_\sigma\right)\bar{f}},\frac{G}{\bar{f}}\right)$	$\beta\bar{f}-G$	0	$\bar{f}$
	$\left[\frac{G}{\bar{f}},\tilde{\tilde{\beta}}\right)$	$\gamma^N\left(\beta\bar{f}-G\right)+\beta\bar{f}-G$	$\gamma^N\left(\beta\bar{f}-G\right)$	0
	$\left[\tilde{\tilde{\beta}},\tilde{\tilde{\tilde{\beta}}}\right)$	$\bar{f}-G$	$\gamma^N\left(\beta\bar{f}-G\right)$	0 (4)
	$\left[\tilde{\tilde{\tilde{\beta}}},1\right]$	$\bar{f}-G$	$E_R\left[f\right]-G$	0

$(*)$ The row with $\beta\in\left[0,\frac{G-\rho_\sigma\bar{f}}{\left(1-\rho_\sigma\right)\bar{f}}\right)$ is irrelevant if $\overline{f}>\frac{G}{\rho_\sigma}$, because then $\frac{G-\rho_\sigma\bar{f}}{\left(1-\rho_\sigma\right)\bar{f}}<0$.

(1) Granting managerial leniency is optimal iff. $\beta\bar{f} - G > -\gamma^C\left(G - \rho_\sigma\bar{f} - (1-\rho_\sigma)\beta\bar{f}\right) \Leftrightarrow$

$$\left(\gamma^C(1-\rho_\sigma) - 1\right)\beta\bar{f} < \left(\gamma^C - 1\right)G - \gamma^C\rho_\sigma\bar{f}, \tag{36}$$

where the LHS is negative by assumption $\rho_\sigma > \frac{1-\rho_\pi}{\rho_\pi}$ and the RHS is positive by $\bar{f} < \frac{\left(\gamma^C-1\right)G}{\gamma^C\rho_\sigma}$. Therefore, (36) holds and thus $f^r = 0$.
(2) Rewriting (36) gives

$$\beta > \beta'' = \frac{\gamma^C\rho_\sigma\bar{f} - \left(\gamma^C - 1\right)G}{\gamma^C\rho_\sigma\overline{f} - \left(\gamma^C - 1\right)\bar{f}},$$

where $\beta'' > 1$ if $\overline{f} > G$ and thus it can never be the case that $\beta > \beta''$. Therefore, $f^r = \overline{f}$.
(3) If $\overline{f} < G$ then $\beta'' < 1$ and thus we have $f^r = 0$ if $\beta > \beta''$, while $f^r = \overline{f}$ if $\beta < \beta''$.
(4) Granting managerial leniency is optimal if and only if $\overline{f} - G > \gamma^N\left(\beta\bar{f} - G\right) \Leftrightarrow$

$$\beta < \beta''' = \frac{\left(\gamma^N - 1\right)G + \overline{f}}{\gamma^N\overline{f}}.$$

In this region of β, we have

$$\beta < \tilde{\tilde{\beta}} = \frac{\left(\gamma^N - 1\right)G + \rho_\sigma\overline{f}}{\left(\gamma^N - (1-\rho_\sigma)\right)\overline{f}} = \frac{\left(\gamma^N - 1\right)G + \overline{f} - (1-\rho_\sigma)\overline{f}}{\gamma^N\overline{f} - (1-\rho_\sigma)\overline{f}},$$

from which we see that $\tilde{\tilde{\beta}} < \beta'''$ and thus we have $\beta < \beta'''$ in this region. Therefore, $f^r = 0$.

Conclusion on managerial leniency. From the table we observe the following:

1. If $\overline{f} \in \left[0, \tilde{f}\right)$, where $\tilde{f} = \frac{\left(\gamma^C-1\right)G}{\gamma^C\rho_\sigma}$, then $f^r = 0$;
2. If $\overline{f} \in \left[\tilde{f}, G\right)$, then when $f^r = \overline{f}$, we determine β^* by solving

$$\pi - \beta\overline{f} - \beta\overline{F} < 1 - \pi - G \Leftrightarrow \beta > \frac{2\pi - 1 + G}{\overline{F} + \overline{f}} \Rightarrow \beta^* = \frac{2\pi - 1 + G}{\overline{F} + \overline{f}},$$

   provided that

$$\beta^* < \beta'' \Leftrightarrow \overline{F} > \tilde{F} = \frac{2\pi - 1 + G}{\beta''} - \overline{f}; \text{ and}$$

3. If $\overline{f} \in [G, \infty)$, then when $f^r = \overline{f}$, we determine β^* by solving

$$\pi - \beta\overline{f} - \beta\overline{F} < 1 - \pi - G \Leftrightarrow \beta > \frac{2\pi - 1 + G}{\overline{F} + \overline{f}} \Rightarrow \beta^* = \frac{2\pi - 1 + G}{\overline{F} + \overline{f}},$$

provided that

$$\beta^* < \frac{G}{\overline{f}} \Leftrightarrow \overline{F} > \tilde{\tilde{F}} = \frac{(2\pi - 1)\,\overline{f}}{G}.$$

These results are the technical equilavent of Proposition 4. ■

References

[1] Arlen, J.H. (1994). The Potentially Perverse Effects of Corporate Criminal Liability. *The Journal of Legal Studies* 23(2), 833-867.

[2] Aubert, C. (2009). Managerial Effort Incentives and Market Collusion. Toulouse School of Economics Working Paper 09-127.

[3] Aubert, C., Rey, P. and W.E. Kovacic. (2006). The Impact of Leniency and Whistle-blowing Programs on Cartels. *International Journal of Industrial Organization* 24(6), 1241-1266.

[4] Calkins, S. (1997). Corporate Compliance and the Antitrust Agencies' Bi-Modal Penalties. *Law and Contemporary Problems* 60(3), 127-167.

[5] Chen, Z. and P. Rey. (2007). On the Design of Leniency Programs. IDEI Working Paper No. 452, Toulouse.

[6] Fershtman, C. and K.L. Judd. (1987). Equilibrium Incentives in Oligopoly. *The American Economic Review* 77(5), 927-940.

[7] Hammond, S.D. (2004). Cornerstones of an Effective Leniency Program. U.S. Department of Justice, Antitrust Division. Speech delivered at ICN Workshop on Leniency Programs, Sydney, Australia. Available at `<http://www.justice.gov/atr/public/speeches/206611.htm>`.

[8] Harrington Jr., J.E. (2008). Optimal Corporate Leniency Programs. *The Journal of Industrial Economics* 56(2), 215-246.

[9] Inderst, R. and M. Ottaviani. (2009). Misselling through Agents. *The American Economic Review* 99(3), 883–908.

[10] Khalil, F. (1997). Auditing Without Commitment. *The RAND Journal of Economics* 28(4), 629-640.

[11] Khanna, V.S. (1996). Corporate Criminal Liability: What Purpose Does it Serve? *Harvard Law Review* 109(7), 1477-1534.

[12] Langevoort, D.C. (2002). Monitoring: The Behavioral Economics of Corporate Compliance With Law. *Columbia Business Law Review* 2002(1), 71-118.

[13] Miller, N.H. (2009). Strategic Leniency and Cartel Enforcement. *The American Economic Review* 99(3), 750-768.

[14] Motta, M. and M. Polo. (2003). Leniency Programs and Cartel Prosecution. *International Journal of Industrial Organization* 21(3), 347-379.

[15] Polinsky, A. M. and S. Shavell. (1993). Should Employees Be Subject to Fines and Imprisonment Given the Existence of Corporate Liability? *International Review of Law and Economics* 1993(3), 239-257.

[16] Scharfstein, D. (1988). Product-Market Competition and Managerial Slack. *The RAND Journal of Economics* 19(1), 147-155.

[17] Schmidt, K.M. (1997). Managerial Incentives and Product Market Competition. *The Review of Economic Studies* 64(2), 191-213.

[18] Segerson, K. and T. Tietenberg. (1992). The Structure of Penalties in Environmental Enforcement: An Economic Analysis. *Journal of Environmental Economics and Management* 23(2), 179-200.

[19] Shavell, S. (1997). The Optimal Level of Corporate Liability Given the Limited Ability of Corporations to Penalize Their Employees. *International Review of Law and Economics* 17(2), 203-213.

[20] Sklivas, S.D. (1987). The Strategic Choice of Managerial Incentives. *The RAND Journal of Economics* 18(3), 452-458.

[21] Spagnolo, G. (2000). Stock-Related Compensation and Product-Market Competition. *The RAND Journal of Economics* 31(1), 22-42.

[22] Spagnolo, G. (2004). Divide et Impera: Optimal Leniency Programs. CEPR Discussion Paper No. 4840.

[23] Spagnolo, G. (2005). Managerial Incentives and Collusive Behavior. *European Economic Review* 49(6), 1501-1523.

[24] Spagnolo, G. (2008). Leniency and Whistleblowers in Antitrust. In: P. Buccirossi (Ed.), *Handbook of Antitrust Economics*. Cambridge, Massachusetts: MIT Press.

[25] Price Waterhouse Coopers. (2009). 2009 Global Economic Crime Survey: Economic Crime in a Downturn. Available at <http://www.pwc.com/en_GX/gx/economic-crime-survey/pdf/global-economic-crime-survey-2009.pdf>.

[26] Stephan, A. (2009). Hear No Evil, See No Evil: Why Antitrust Compliance Programmes May Be Ineffective at Preventing Cartels. CCP Working Paper No. 09-09.

[27] Sykes, A.O. (1984). The Economics of Vicarious Liability. *Yale Law Journal* 93(7), 1231-1280.

[28] Tirole, J. (1986). Hierarchies and Bureaucracies: On the Role of Collusion in Organizations. *Journal of Law, Economics and Organization* 2(2), 181-214.

[29] United States Sentencing Commission (2010). An Overview of the Organizational Guidelines. By: Paula Desio, Deputy General Counsel. Available at <http://www.ussc.gov/Guidelines/Organizational_Guidelines/ORGOVERVIEW.pdf>.

[30] Webb, D.K. and S.F. Molo. (1993). Some Practical Considerations in Developing Effective Compliance Programs: A Framework for Meeting the Requirements of the Sentencing Guidelines. *Washington University Law Quarterly* 71, 375-396.

[31] Wils, W.P.J. (2005). Is Criminalization of EU Competition Law the Answer? *World Competition* 28(2), 117-159.

[32] Wils, W.P.J. (2006). Optimal Antitrust Fines: Theory and Practice. *World Competition* 29(2), 183-208.

[33] Wils, W.P.J. (2007). The European Commission's 2006 Guideline on Antitrust Fines: A Legal and Economics Analysis. *World Competition* 30(2), 197-229.