CEO's Morality and Incentives

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PRELIMINARY DRAFT

Abstract

We study the shareholder-manager relationship when a fraudulent strategy is available. In a canonical agency setting, we introduce privately known CEO's morality, modeled as a cost of breaking the law. We derive the optimal compensation offered by the firm and examine how it affects the CEO's action. In the optimal contract, there are two regimes, depending on the quality of law enforcement: providing incentives and preventing fraud can be either complements or substitutes. As a consequence, either the variable or the fixed part of remuneration helps preventing fraud. We also point out that, given the agency problem, the level of corporate fines cannot be a substitute for low levels of detection. Finally, the comparative statics of our model shed light on contradictory empirical evidence in the literature.

Key Word: incentives, corporate fraud, moral hazard, adverse selection.
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1 Introduction

Two aspects of CEO's pay are abundantly debated: whether it is deserved and whether it really provides incentives. When extremely well-paid CEOs and managers are caught red handed in fraudulent operations, the debate legitimately gets even more intense. One important risk with high-powered incentives is that, by increasing the stake for the CEO, they might push him to cross the legal line. Clearly, high bonuses not only increase the propensity of the CEO to work hard, they might also overshadow the psychological barrier of lower morality CEOs. We study this issue in a canonical principal-agent model augmented by the possibility of fraud.

Our analysis emphasizes CEO's morality as a crucial determinant of firm's fraudulent behavior. Heterogeneity in morality is by now a well documented fact, that we extensively discuss below. Taking it into account allows in particular to consider fraud as an equilibrium phenomenon. Our results imply for instance that in the cross-section, high-powered incentives may either increase or decrease the risk of fraud, depending on the institutional setting of corporate fraud deterrence.

In our model, the CEO/agent is protected by limited liability, which is the source of rents accruing to the CEO. As is well known, limited liability distorts effort provision, and induces CEO to potentially take too risky action–*legally* risky action in our setting. The shareholders/principal introduces variable pay to increase effort provision, but at the same time this potentially makes the illegal action more desirable to the CEO, since the legal punishment in case fraud is detected is mostly born by the principal and not the agent himself. However, this happens only when working hard pays less than defrauding. Working hard provides rents, but how hard (and hence how much rent) is endogenous to the contract offered to the CEO. This introduces a second distortion in the optimal contract beyond the usual moral hazard rents. In general, we show that the principal increases the CEO's total remuneration to increase the rent of working hard beyond the reference case where fraud is not an option. A more subtle question is what part of the pay, fixed or variable, should the principal increase? We show that endogenously two regimes occur: when (public) detection of fraud is high enough, increasing the variable part is the best way of de-

terring fraud, while increasing the fixed part is optimal otherwise. Hence in general more or less high-powered incentives can lead to less fraud. Moreover, morality is an elusive parameter, and we consider in the full-fledged model that it is private information of the CEO. Absent moral hazard problem, this adverse selection aspect would actually be socially beneficial, as it decreases the value of fraud to the shareholders, who are then more eager to prevent it. But the combination of both adverse selection on morality and moral hazard aggravates the problem, and fraud is on average (over morality) more prevalent in equilibrium than in a perfect information world. We provide a tractable solution for the optimal contract which allows to study effort and probability of fraud in equilibrium. We obtain formulas to qualify the distortions with respect to the first-best and second-best (where morality considerations and fraud are absent), which enables testable predictions.

Corporate Fraud and Agency Theory. Since the late 1970's, the structure of executives' compensation has evolved and become more sophisticated so as to base CEO's compensation on performance (variable pay, stock options, bonuses, etc.). Jensen and Meckling (1976) seminal paper laid down the theory of the agency, showing how these instruments could align the interests of the managers on those of the shareholders. Nevertheless, numerous instances of corporate fraud–and implications of top management therein–have triggered doubts in both scholars and the public on whether agency theory is relevant and whether perverse effects of incentives do not offset their benefits. Indeed, these schemes can induce executives to adopt illicit behaviors, such as collusion, accounting and environmental fraud, as well as tax evasion etc. Many companies condemned for corporate fraud had put in place these performance-based compensation schemes. For instance, in 1993 the former managing director of Nissan UK, Michael Hunt, whose compensation package was complex; was found guilty of Britain's biggest tax fraud. The Enron scandal revealed in October 2001 involved top CEO's in accounting fraud. At the same time, the compensation package of Enron's managers was extensively composed of stock options. In 1998, the top 200 highest-paid employees received $193 million from salaries, bonuses, and stocks. Two years later, the figure jumped to $1.4 billion,

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and on December 31, 2000, Enron had 96 million shares outstanding as stock option plans. In 2007, the European Commission fined Saint-Gobain over 800 million euros for market sharing cartel (its fine was increased by 60% because it was a repeat offender). During the cartel lifetime, Saint-Gobain distributed to its top executives more than 420,000 options. High-powered incentives increase the stake for the CEO, and might push him to cross the legal line. When exactly this does happen depends on the stake and individual characteristics of those taking the decisions.

A very substantial empirical literature has studied the link between fraud and compensation, in the aftermath of corporate scandals of the past fifteen years.[1] Goldman and Slezak (2006) show that compensation schemes induce effort but also fraudulent activity. Bergstresser and Philippon (2006) reported that earnings manipulation is more pronounced at firms where the CEO's compensation is more closely tied to the value of stock and option holdings. Denis et al. (2006) find a positive association between the likelihood of securities fraud allegations and a measure of executive stock option incentive. Johnson et al. (2009) reports that executives at fraud firms face greater financial incentives to commit fraud than do executives at control firms. They find that the likelihood of fraud is positively related to incentives from unrestricted stock holdings. Burns and Kedia (2006) underline that stronger incentive lead to a larger probability of observing fraud. Bebchuk et al. (2010) provide a case study of compensation at Bear Stearns and Lehmann (2000-2008) and conclude that it was not possible to rule out that the executive pay arrangement provided them with excessive risk taking incentives (bonuses were not clawed back when firms collapsed). Nevertheless, this link has also been challenged. In their empirical work, Armstrong et al. (2010) do not find evidence of a positive association between CEO equity incentives and accounting irregularities. Rosenbaum (2002) does not observe either a positive relationship between CEO equity incentives and the incidence of irregularities. Comparing executives incentives of firms accused of accounting frauds with those of firms not accused of fraud, Erickson et al. (2006) find no consistent ev-

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[1]Global figures on corporate fraud are obviously hard to produce. Dyck et al. (2014) provide estimates for the US suggesting that only one fourth of frauds are uncovered, and that fraud costs up to $380 billions a year.

idence that executive equity incentives are associated with fraud. Last, executive compensation has also been analyzed as an agency problem. Bebchuk and Fried (2003) argues that managerial power affects the design of executive compensation in companies with a separation of ownership and control. Conyon (2006) who studied the changes in executive pay and incentives in U.S. firms between 1993 and 2003 shows that boards and compensation committees have become more independent over time.

On the theory side, recent contributions have studied fraud in relation to incentives. In a strand of the literature pertaining to account manipulation, Crocker and Slemrod (2007) consider an agent/CEO who both exert effort and privately observe the profit. They show that providing incentives to truthfully reveal earnings on top of providing incentives is particularly tricky. Kumar and Landberg (2009) draw the consequences of earning manipulation on inefficient investment by outside investors. In Andergassen (2008) CEO are more short-sighted than stakeholders and more inclined to manipulate the information. Andergassen (2010) argues that stronger incentives do not necessarily lead to more fraud if product market competition is sufficiently strong. Benmelech et al. (2010) study the dynamics of earning manipulation and the optimal contract to mitigate its effect. Fleckinger et al. (2013) focus on the interplay between policy instruments and CEO's incentives.

Morality as an individual characteristic.   In our model, we introduce the issue of the morality of CEOs (and its intensity) and analyze its consequences on optimal compensation. Linking corporate performance to individual fixed effect has proved fruitful (see e.g. Bertrand and Schoar, 2003, for an early contribution). Previous works on compensation and corporate fraud do not address the morality theoretically whereas the link between morality and corporate fraud is well documented, as well as the different factors of this fraud.

In their meta-analysis draw from over 30 years of research, Kisk-Gephart et al. (2010) studies individual moral issue and organizational environment antecedents of unethical choice.[2] Ferrel and Ferrel (2011) investigate the role of CEO in corpo-

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[2]For a synthesis of the literature on ethical behaviors and causes of corporate wrongdoing

rate fraud and in developing an ethical corporate culture. Jones (1991) shows that moral intensity, and particularly the ability of the agent to recognize the moral issue of its decision, influences decision-making. Shafer (2002) evaluates whether quantitative materiality influences judgments of the ethical acceptability of fraud. Trevino (1986) develops a model of ethical decision making which combines individual variables (moral developments etc.) with situational variables to predict and explain ethical decision-making behavior. Zona et al. (2013) frames the antecedents of corporate scandals in terms of the interplay of CEOs' personal traits with corporate strategy and stakeholders' cohesion. Based on cases studies (Enron, Worldcom etc.), Soltani (2014) underlines the role of ineffective boards, ineffective corporate governance and control mechanisms, distorted incentive schemes, accounting irregularities, failure of auditors, dominant CEOs, dysfunctional management behavior and the lack of a sound ethical tone at the top in corporate failures. Pendse (2012) argues that a conjunction of motive, means, and opportunity creates 'an ethical hazard' making questionable executive decisions probable. It suggests that corporate unethical behavior can be minimized by creating a process to identify and remove ethical hazards. These works are consistent with the fraud triangle, which explains the conditions of fraud. These factors are pressure (incentive or compensation), opportunity (weak control), rationalization (attitude/morality). Many works suggest that morality is not uniform among population and depends on various characteristics. In our model, it is captured through our morality parameter which is heterogeneously distributed.

Some firms (managed by CEOs with a particularly low degree of morality) can be the subject of different frauds at the same time. For instance, Gonzales et al.(2013) analyze financial reporting and corporate governance in companies accused of price fixing. They find that cartel firms favor outside directors likely to monitor inattentively. Cartel firms have unusually low CEO turnover and rely on internal management promotions. They find that these firms engage in many other type of fraud such as evasive financial reporting strategies, including earnings smoothing, seg-

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(attributed to either organizational characteristics or individual malfeasance), see also Davis et al. (2007). Bertrand (2009) calls for more research on individual characteristics of CEOs.

ment reclassification, and restatements. This result could indicate that their managers have a low morality. Biggerstaff et al. (2014) find that firms with CEO who personally benefit from options backdating are more likely to engage on other corporate misbehaviors, suggestive of an unethical corporate culture.

There is ample evidence of the influence of personal traits of CEOs on corporate fraud. Cohen et al. (2011) analyze evidence from press articles covering corporate fraud cases and show that the personality traits of managers appear to be a major fraud-risk factor. Benmelech and Frydman (2013) study the relationship between military service of CEOs and managerial decisions. They show that military service is associated with conservative corporate policies an ethical behavior, and that military CEOs are less likely to be involved in corporate fraud. Tanner et al.(2010) point out individual differences in the propensity to tell the truth and highlight the role of honesty in shaping the impact of monetary incentives. Rijsenbilt and Commandeur (2012) find a positive relationship between plausible proxies for CEO narcissism and fraud which confirms the psychologic perspective of CEO narcissism as a cause of fraud. Van Staveren(2013) reviews empirical literature about gender differences in behavioral, experimental and neuro-economics. She concludes that women tend to perform on average better than men under uncertainty and that their reasoning in complex situations is more contextual than men's. Such contextual reasoning involves ethical matter. Ramdani and Van Witteloostuijn (2012) show for instance that bribery is more likely to occur when the principal-owner is male rather than female.

Who wants fraud? In the previous literature, it is almost always postulated that shareholders want to avoid fraud as they do not benefit from it. For instance, Andergassen (2008) who focuses on earnings manipulation, considers that this fraud can boost the short-term cash flow of the firm but is assumed to decrease the company's long term value. Benmelech et al. (2010) find that stock-based compensation induces managers to conceal bad news about future growth options and to choose suboptimal investment policies. This leads to overvaluation, ultimately followed by a crash in the stock price. Robinson and Santore (2010) underline the reputational damages caused when a fraud is discovered. For Biggerstaff et al. (2014), the costs

of these misbehaviors are reflected in larger stocks price decline during a market correction.

Our model is not limited to those instances where shareholders always want to eradicate fraud. Fraud can benefit both managers and shareholders and can thus be desired, and happen at equilibrium. Actually, most types of fraud would be wanted by the shareholders if they were not detected. This is usually not discussed in the literature, where it is always assumed that the board setting the remuneration would a priori not want fraud. Sometimes the firm may tolerate, or even want some amount of fraud. This is the case for instance when the fine and/or the detection are low. Then the principal might actually value some fraudulent behavior like collusion, tax evasion, environmental and social abuses, etc. In other cases, like accounting fraud, corruption and bribery, spying, earning and signaling manipulation, a long run shareholder may always prefer to minimize this type of fraudulent behavior. We also incorporate this dimension on our analysis.

Of course, the legal system puts limits to corporate fraud by detecting (some) instances, and deterring others. In its seminal work, Becker (1968) defines a simple criterion to determine the optimal dissuasive sanction. He introduced the idea that the probability of crime detection (enforcement effort) and the level of sanctions are substitutes in enforcement. In order to deter crime, he concludes that the sanction imposed on the wrongdoer should be such that the expected sanction just exceeds the benefits of his crime (or to the social harm). These reasoning can apply to any actor, including a firm. For instance, Landes (1983) applies this Beckerian theory to the specific case of antitrust law enforcement. Then, a large body of literature has addressed a vast array of managerial and policy issues, from the optimal level of fines and optimal level of resources to be devoted to the fight against corporate fraud, to the appropriate form of the sanction between fine and imprisonment which raises the agency dilemma and the individual vs. corporate liability issue (see Polinsky and Shavell (2000)). We here focus on the morality dimension, for a given legal system and enforcement regime.

Law enforcement. As a matter of fact, corporate crimes differ from individual crimes because the firm involves multiple actors. Therefore, it cannot be regarded as a single individual making isolated rational decisions (without taking into account contracts between agents). Within the firm, the individual who decides to break the law can have his own motivations, including for instance improving his remuneration. Thus, several contributions related to optimal remuneration literature address the case of corporate fraud; using for instance a model in which the CEO can make an effort to manipulate the figures of the firm so as to increase the perception of the value of the firm by the market (Peng and Roel (2008), Robinson and Santore (2010)). Spagnolo (2000) shows that stock-based compensation plans facilitate collusion. These schemes link manager's present remuneration to the stock market's expectations about firm's future profits. Hence, these plans lower the gain from deviation and strengthen collusion, because when a deviation occurs, the market anticipates its negative effect (punishment and market war) and discounts it immediately on the stock price. Cohen (1996) and Garoupa (2000) underline the advantages of a public policy based on corporate liability. They assume that shareholders will then be induced to dissuade fraud within the firm through the setting of monitoring mechanism and the imposition of internal sanctions to their agents. Aubert (2009) develops a model in which individual liability is more efficient than corporate liability. Arlen and Kraakman (1997), Arlen (1994), Arlen (1999) show that strict corporate liability cannot simultaneously induce optimal prevention and policing (internal monitoring and sanctions), as a firm that undertakes effective policing increases its expected liability helping the public authorities detect and sanction wrongdoings. Hence, they conclude that to induce corporate policing, the authorities should use a "duty-based" or conditional liability regime, under which firms are obliged to undertake optimal monitoring, reporting and cooperation, and are subject to a special sanction for violating these duties[3]. This regime reduces the cost of detection for the government but it increases the internal policing cost for the firm (internal-

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[3]For instance, in 1999 in the United States, the Department of Justice adopted a policy under which firms can avoid liability for their employees' crime by engaging in good corporate conduct, such as self-reporting the wrong-doing or full cooperation with the authorities.

izing the social cost of agents' wrongs (Alexander and Cohen, 1999)). Nevertheless, those additional costs have been studied in terms of monitoring costs, not in terms of additional payment, as we do here.

In our model, we consider a two-tier agency problem: on the one hand, the agency problem between the government and the firm, and on the other hand, the agency problem between the shareholders and the executives. We show that the intensity of fraud detection has an influence on the agency dilemma within the firm, whereas the expected fine only impacts the principal-agent problem between the firm and the government. We show that the probability of fraud detection influences the rent sharing between shareholders and CEOs and that the risk of corporate fraud lessens the efficiency of compensation packages, in particular, for managers benefiting from a low probability of detection. We also discuss the impact of clawback provisions in compensation contracts. Moreover, while many articles explain excessive managers' rent in different ways (see Bebchuk and Fried (2003)), we show that compensation can appear excessive because of this double agency dilemma, the risk of fraud and the internal need to deter it. Indeed, the more a manager is prone to commit fraud, the more he can extract rent. In addition, when managers do not have the same sense of morality (measured as the individual cost of breaking the law), we observe wrongdoing at equilibrium. Finally, we show that the existence of immoral CEOs has a positive impact on the rent awarded to virtuous managers. The biggest challenge for authorities is therefore to deter the group of people who display lower morality, as it would be too expensive for shareholders to dissuade these managers to commit fraud. We also point out that the government cannot rely on firm internal policing.

We first present the model and analyze two benchmark cases: (1) the canonical agency model without possibility of fraud, and (2) the case in which morality is a known parameter. Then we turn to the solution of the principal's problem under both adverse selection and moral hazard. We then undertake the comparative statics of our model with respect to the legal environment and the morality of the CEO, in order to explain some empirical evidence and discuss policy recommendations. The last section consider some extensions and further discussions.

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2 The model

2.1 Fundamentals

Types and actions. We consider the board/shareholders and CEO relationship, assuming that the CEO is the agent.[4] The CEO/agent picks an action a, which can be either a level of effort $e \in \mathbb{R}_+$, or an illegal action i. This illegal action stands for a large range of fraudulent behavior: account manipulation, collusive behavior, environmental law infringement, stock manipulation etc. We assume that the cost of effort is exactly its intensity: e, while the illegal action costs $\theta \in \mathbb{R}_+$. The parameter θ characterizes the CEO, and we refer to it as the morality of the CEO.[5] The distribution of θ is $g(\theta)$ and the cumulative distribution is $G(\theta)$.

Production. Effort e leads to a high gross profit H with probability $p(e)$ and L with probability $1 - p(e)$. We assume that p is increasing and concave, with $p(0) = 0$ and $\lim_{e \to 0} p'(e) = +\infty$.[6] We also make the technical assumption that $\frac{p'''}{p''} > 2\frac{p''}{p'}$, which always guarantees strict concavity of the Principal's objective. We denote by $\Pi(e)$ the corresponding expected gross profit. Importantly, we assume that fraud aims at inflating profits: specifically, the illegal action yields a high profit for sure.[7] For instance, in the case of account manipulation, the CEO would claim the profit is high while it is in fact low. In a scenario of environmental compliance, the CEO would not take appropriate costly measures to abide by the law, in order to increase operational profits. However, the illegal action comes with a legal risk. When the

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[4]This is hence in the pure agency tradition of Jensen and Meckling (1976), and we abstract here from the alternative theory of CEO power (Bertrand and Mullainathan, 2001; Bebchuk and Fried, 2004), whereby CEOs have a significant influence on how their pay is determined.

[5]In the last section we discuss a variant of the model where the cost θ is incurred only if it is publicly discovered that the CEO chose the illegal action.

[6]This assumption guarantees interior effort in the various scenarios.

[7]It does not matter that fraud succeeds in yielding a high profit for sure, our model can accommodate any probability of obtaining the high profit. The interesting case arises when this probability is high enough.

CEO picks the illegal action, this is publicly detected[8] with probability q. If fraud is detected, the firm is fined an amount F by the relevant authority, who wants to discourage fraud because of its (unmodeled) social cost. Hence the expected gross profit upon fraud is $\Pi(i) = H - qF$. Importantly, we will assume that the fine is low enough that the shareholders do not always try to fully prevent fraud. This amounts to limited liability. The policy (q, F) is given before contracting takes place inside the firm.

Contracts. Both the Agent and the Principal are assumed to be risk neutral, and the agent is protected by a limited liability: the transfers cannot be negative. We also normalize the CEO's outside option to zero. If the Principal can contract on the action a taken, then he simply transfers t_a to the agent and can induce any desired action. In turn, when the principal cannot contract directly on the action, on top of ensuring participation, he must provide incentives to control the CEOs behavior. The principal can only make the payment contingent on the observable state ex-post, $\sigma \in \{H, L, D\}$, where D stands for the case of illegal action detection. Let $t(\sigma)$ denote the transfer specified in the contract when σ is observed. We will mostly focus on the case where the principal fires the CEO in case of detected fraud, either because the law mandates so, or because the principal chooses to do that. Hence, we set $t(D) = 0$, and postpone the discussion of this assumption to the final section. To highlight the influence of variable pay, we will from now on use the notation $t(L) = w$ and $t(H) = w + b$, so that w is the fixed wage of the CEO and b is the bonus in case of a good result. Then b measures the power of incentives. Figure 1 summarizes the game.

Before solving the full model, we study a series of benchmark cases, with and without illegal action, with and without moral hazard and adverse selection. These reference cases are instructive *per se* in allowing an understanding of each distortions independently.

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[8]In the last section, we also study supplementary internal detection, e.g. as enabled by compliance programs in antitrust issues.
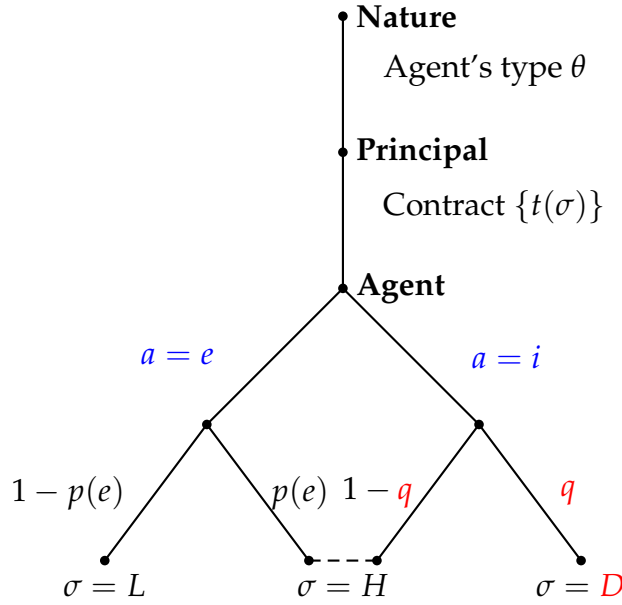
Figure 1: the Game Tree

2.2 The canonical Agency model

Suppose that no illegal action is available, and the only issue is to provide incentive for effort. The First Best effort obtains when the principal can directly contract on the effort, hence implements a forcing contract with a compensation exactly equal to the cost of the action, $t_e = e$, so that participation is just ensured.[9] The principal therefore chooses e to maximize $\Pi(e) - e$, which yields:

$$\Pi'(e^{FB}) = 1. \tag{1}$$

We now consider the second-best scenario where effort is not contractable and limited liability prevents the first-best. The firm will offer a fixed wage w, plus a bonus b when profits are high. The limited liability constraint implies that the transfers must be non-negative, so that participation of the CEO is always ensured.[10]

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[9]Note that this first-best effort level e^{FB} is also implementable when the effort is not contractible but the CEO is not subject to limited liability. Indeed in this case a stick-and-carrot contract with $w < 0 < w + b$ can be used that implements the first-best at the true cost.

[10]Note that a nonnegative effort requires a positive bonus, hence we can ignore limited liability in the case $\sigma = H$.

The maximization program of the principal is:

$$\begin{cases} & Max \ \Pi(e) - w - p(e)b \\ (IC) & e \in ArgMax[w + p(e)b - e] \\ (LL) & w \geq 0 \end{cases}$$

The agent's utility is strictly concave in effort since $p'' < 0$, so that the (IC) constraint can be substituted by the First-Order Condition: $p'(e)b = 1$. Substituting this in the objective of the principal, and noticing that $w = 0$ is always optimal, we obtain that the second-best effort is such that:[11]

$$\Pi'(e^{SB}) = 1 - p(e^{SB}) \frac{p''(e^{SB})}{p'(e^{SB})^2}. \tag{2}$$

Compared to the first-best, limited liability introduces a distortion in equilibrium effort provision. Since p is concave, this distortion implies a reduction in effort provision: $e^{SB} < e^{FB}$, due to the corresponding rent obtained by the agent.

2.3 Observable morality

We now (re-)introduce the illegal action. First, if the effort is contractible, the choice of the principal simply amounts to compare the net profit with the first-best effort to the net profit under illegal behavior, $\Pi(i) - \theta$. Obviously, the principal will choose to implement the fraudulent behavior only if θ is low enough, i.e. all agent below some θ^{FB} are asked $a = i$, and the others $a = e^{FB}$, where:

$$\Pi(i) - \theta^{FB} = \Pi(e^{FB}) - e^{FB}. \tag{3}$$

In the following, we will assume that F is small enough that it is strictly optimal for the principal to dictate illegal behavior for zero morality agent. In other words, the threshold θ^{FB} is strictly positive. This will be the source of tension we study.

We assume now that the action is not contractible, while morality is observable. The principal thus faces a pure moral hazard problem, and the agent will receive

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[11]Substituting the previous FOC in the principal's objective leads to a strictly concave objective in e under the technical assumption $\frac{p'''}{p''} > 2\frac{p''}{p'}$.

limited liability rents. The optimal contract features a fixed wage w and a bonus b, and implementing an effort requires providing incentives not to deviate to the illegal action. Then, on top of the limited liability constraint $w \geq 0$ the following two incentive constraints should also hold:

$$e \in ArgMax[w + p(e)b - e], \tag{4}$$

and

$$w + p(e)b - e \geq (1 - q)(w + b) - \theta. \tag{5}$$

The following proposition gives the optimal contract to provide incentives and deter fraud.

Proposition 1 *When morality is observable and the principal wants to induce a legal action the bonus is equal to $b = \frac{1}{p'(e)}$ and the effort level is such that:*

$$\Pi'(e) = 1 - p\frac{p''}{p'^2} - (1 - \mu)\frac{(1 - p - q)}{q}\frac{p''}{p'^2}, \tag{6}$$

where $\mu \in [0, 1]$ is the lagrangian multiplier associated with the limited liability constraint. Let $\bar{e}$ be the solution of $\Pi' = 1 - \frac{(1-p)(1-q)}{qp'^2}p''$ and let $e(\theta)$ be the solution of $e(\theta) = \theta - \frac{1-q-p(e(\theta))}{p'(e(\theta))}$. Then

- *if $\theta \geq e^{SB} + \frac{1-q-p(e^{SB})}{p'(e^{SB})}$, then $w = 0$ and e^{SB} is implemented ($\mu = 1$).*

- *if $\bar{e} + \frac{1-q-p(\bar{e})}{p'(\bar{e})} \leq \theta \leq e^{SB} + \frac{1-q-p(e^{SB})}{p'(e^{SB})}$, then $w = 0$ and $e(\theta)$ is implemented.*

- *if $\theta < \bar{e} + \frac{1-q-p(\bar{e})}{p'(\bar{e})}$, then $w = \frac{1-q-p(\bar{e})}{qp'(\bar{e})} + \frac{\bar{e}-\theta}{q}$ and $\bar{e}$ is implemented ($\mu = 0$).*

The intuition for this result is the following: at one extreme, the morality is high enough that the illegal action is not tempting, so that the principal can simply implement the second-best effort. In turn, for lower degrees of morality, the principal must care about deviation towards illegal behavior. Here there are two possible regimes: either detection is good, so that paying a relatively high bonus helps preventing illegal behavior, and the principal might even want to increase effort with

respect to the second best to prevent fraud. Or detection is relatively poor, so that bonuses at the second-best level would induce fraud, hence the principal should propose also a fixed wage. The fixed wage being lost in case of detection, it induces a cost of taking the illegal action which reduces its desirability for the agent.

In more details, there are indeed two cases depending on the probability of detection q that need to be distinguished:

Either $e^{SB} < p^{-1}(1 - q)$ and for high degree of morality the second best effort is achieved with the second best bonus $\frac{1}{p'(e^{SB})}$. When morality decreases the bonus starts to decrease and a lower effort is implemented until the effort $\bar{e} < e^{SB}$, and for lower morality the principal sets a bonus equal to $\frac{1}{p'(\bar{e})}$ and starts compensating with an increasing fixed wage.

Or $e^{SB} > p^{-1}(1 - q)$ and for high degree of morality the second best effort is still achieved with the second best bonus. But when morality decreases the bonus starts to increase and a higher effort appears, until the effort $\bar{e} > e^{SB}$ then the principal sets a fix bonus $\frac{1}{p'(\bar{e})}$ and starts compensating with an increasing fixed wage.

The particular case where $e^{SB} = p^1(1 - q)$ is such that the second best effort is always achieved: for all $\theta \geq e^{SB}$ there is only the bonus $\frac{1}{p'(e^{SB})}$ and for $\theta < e^{SB}$ there is also a fixed wage $w = \frac{e^{SB} - \theta}{q}$.

The next proposition characterizes the optimal contract where the principal attempt to implement the illegal action.

Proposition 2 *When morality is observable and the principal wants to induce an illegal action, the principal always sets $w = 0$. If $\theta \geq p^{-1}(1 - q)$ then the illegal action is not implementable. Otherwise, Let $e(\theta)$ be the solution of $e(\theta) = \theta - \frac{1 - p(e(\theta)) - q}{p'(e(\theta))}$ where $q \leq 1 - p(e(\theta))$, then the principal can implement the illegal action by setting $b = \frac{1}{p'(e(\theta))}$.*

The intuition is in line with the previous proposition. First, fixed wage can not help implementing the illegal action, hence only bonus can be used. Then the bonus serves two purposes: compensating for the cost θ, and making i more desirable than effort. For low detection, these two objectives can be attained, but for high detection, the bonus needed to compensate the cost θ is sometimes so high that the rents induced when effort is chosen would be too tempting, and i is then not

implementable. Note that the critical effort $e(\theta)$ as defined in both proposition plays a key role. It corresponds to the particular level of effort where an agent of type θ is indifferent between fraud and optimal effort given the associated bonus.

Let $\hat{e}(\theta)$ and $\hat{\theta}$ be the effort and morality threshold when morality is observable. We can remark that q and F are not substituable. q affects the effort chosen by the CEO independently of F. When q is low this effort is lower than the second best effort. Whereas if q is high the effort $\hat{e}$ is such that $e^{SB} \leq \hat{e} < e^{FB}$. The fine F directly affects the morality threshold $\hat{\theta}$. The higher the fine the lower $\hat{\theta}$.

2.4 Contractible action and unknown morality

We consider now the principal's choice when the action is contractible, but the morality of the CEO is not observable. Hence the principal just needs to compensate the agent for the cost of the action–i.e. the principal only needs to make sure the participation constraint of the agent is satisfied. Implementing $a = e$ costs e, and the first-best effort remains implementable.

In turn, implementing the illegal action comes at an a priori unknown cost, since θ is unknown. It is routine to show that the best option for the principal is to set a fixed transfer for the illegal action, since there is no screening means.[12] This amounts to post a price t_i for illegal behavior, and the agents with a moral cost below will choose $a = i$. Hence one can view the problem of the agent as choosing what action to undertake when the transfers are $t = e$ and some t_i. The principal seeks to determine a threshold $\tilde{\theta}$ to maximize $G(\theta)\left[H - qF - t_i\right] + (1 - G(\theta))\left[p(e)H + (1 - p(e))L - e\right]$. Since the agent has no rent if he chooses a legal action, he faces a choice between obtaining 0 or $t_i - \theta$, hence the threshold is exactly equal to t_i. Assuming an interior solution for $t_i = \theta$, we obtain that the optimal threshold satisfies:

$$\Pi(i) - \left(\tilde{\theta} + \frac{G(\tilde{\theta})}{g(\tilde{\theta})}\right) = \Pi(e^{FB}) - e^{FB} \tag{7}$$

This equation says that since the (low morality) agents obtain a rent, fraud is more

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[12] Applying standard mechanism design techniques, one obtains in this well known case of a fixed cost that the transfer can not depend on actual cost θ.

costly than in the first-best case relative to the other actions. This is apparent in the additional term $\frac{G(\theta)}{g(\theta)}$. As a consequence, fraud will be implemented for a smaller set of types $\tilde{\theta} < \theta^{FB}$. In other words, the agent's adverse selection rents are actually socially good: the fact that the agents could pretend their morality is higher than it really is favors the social interest.

3 Optimal contract under a risk of fraud

We consider the full game in which the CEO might undertake an illicit action to increase profits, at the risk of potential detection by a regulator and at the morality cost $\theta \in \mathbb{R}_+$, which is private information of the CEO.

The first incentive constraint pertains to the case where a productive effort is undertaken. It simply says that such an effort should constitute a best reply for the agent:

$$e^* \in \ Argmax[w + p(e)b - e].$$

The first order condition implies $p'(e)b = 1$. If the incentive wedge is positive, i.e. $b > 0$, it admits at most one solution as the function is concave in e. This constraint indeed imply by assumption that $b \geq 0$. Moreover, the implicit function theorem applies since $p' \neq 0$, which allows us to invert the problem to work with e as the control variable. In other words we will consider optimizing directly with respect to the effort provided e, and see the required incentive gap b as a function of e.

Note that the optimal effort undertaken does not depend on the type θ of the CEO. However, depending on his type, the CEO may undertake the illegal action rather than the optimal effort. The second constraint states that for an agent of type θ to prefer effort over fraudulent behavior, it must be the case that:

$$w + p(e)b - e \geq (1 - q)(w + b) - \theta.$$

This constraint can be written as:

$$\theta \geq (1 - p(e) - q)b + e + q(w). \tag{8}$$

We are now in a position to analyze how the principal should handle this constraint. As the optimal effort does not depend on the type of the agent, either no agent undertakes the illegal action or there is a cutoff type θ^* such that if $\theta < \theta^*$, the agent undertakes the illegal, and otherwise he exerts effort.[13] In the first case, where all type of agents choose not to fraud, it must be that $qw \geq (1 - q - p(e))b + e$ where e is chosen according to the first order condition. In order to avoid this trivial solution we assume further that we are always in the subsequent case i.e. the model parameters are such that the optimal contract is always such that the most immoral agent ($\theta = 0$) chooses the illegal action. In the second case, $\theta^* = (1 - p(e) - q)b + e - qw$ and the cutoff is nonnegative.

The optimal contract is obtained through the following maximization program:

$$\max_{w,b} \ G(\theta^*) \left[H - qF - (1 - q)(w + b)\right] + (1 - G(\theta^*)) \left[L + p(e)(H - L) - w - p(e)b\right]$$

$$s.t. \begin{cases} (IC) & e \in ArgMax[w + p(e)b - e] \\ (Moral\ threshold) & \theta^* = (1 - p(e) - q)b + e - qw \\ (LL) & w \geq 0 \end{cases}$$

Existence. When w goes to infinity the Principal's profit tends to $-\infty$. Moreover, when e goes to infinity then $p'(e)$ tends to zero hence b goes to infinity and the Principal's profit goes to $-\infty$ as well. The same result holds in any other infinite directions, it is therefore obvious that as functions are continuous there is a global maximum.

Proposition 3 *When actions and morality are not observable, the optimal effort is such that:*

$$\Pi'(e^*) = 1 - \frac{(1 - p(e^*)(1 - q)(1 - \mu) + \mu pq}{q(1 - G(\theta^*))} \frac{p''(e^*)}{p'^2(e^*)}, \tag{9}$$

and the optimal moral threshold θ^* is such that:

$$\Pi(e^*) - e^* = \Pi(i) - \left(\theta^* - \frac{1 - qG(\theta^*) - \mu}{qg(\theta^*)}\right). \tag{10}$$

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[13]We assume that in case of equality the agent chooses the effort, but this assumption is anyway innocuous as the indifferent type has zero probability mass.

The corresponding optimal contract is: $b^* = \frac{1}{p'(e^*)}$ and if $\mu = 0$ then $w^* = \frac{1-p(e^*)-q}{q}b + \frac{e^*-\theta^*}{q}$ else $w^* = 0$.

The next corollary characterizes the optimal contract in the first regime, where the limited liability constraint is not binding.

Corollary 1 *If the limited liability constraint is not binding, the optimal effort is such that:*

$$\Pi'(e^*) = 1 - \frac{(1 - p(e^*))(1 - q)}{q(1 - G(\theta^*))} \frac{p''(e^*)}{p'^2(e^*)}, \tag{11}$$

and the optimal threshold θ^* is such that:

$$\Pi(e^*) - e^* = \Pi(i) - \left(\theta^* - \frac{1 - qG(\theta^*)}{qg(\theta^*)}\right). \tag{12}$$

The corresponding optimal contract is: $w^* = \frac{1-p(e^*)-q}{q}b + \frac{e^*-\theta^*}{q}$; $b^* = \frac{1}{p'(e^*)}$. In this regime, there is a lower effort and more fraud than in the first best.

The term $\theta - \frac{1 - qG(\theta^*)}{qg(\theta^*)} \equiv H(\theta^*)$ is analogous to the virtual valuation in Myerson's theory of auctions.[14] In addition, the distribution G is adjusted by the probability q. We hence refer to $H(\theta^*)$ as the *adjusted virtual cost*. The second equation says that in an optimal contract, the virtual social surplus in the Principal-Agent relationship at the cutoff should be equal to the social surplus whether the agent frauds or chooses the high effort.

In order to induce effort, the principal must increase b. However increasing b may also increase the incentive to act illegally. In order to still induce a legal conduct, the principal has to also increase w. Since this is costly for the principal because all moral agents will be paid, deterring the marginal agent introduces a distortion expressed by the adjusted virtual surplus.

Corollary 2 *When the limited liability constraint is binding, the optimal effort is such that:*

$$\Pi'(e^*) = 1 - \frac{pp''}{p'^2} - \left[\frac{(1-q)G(\theta^*)}{1 - G(\theta^*)} + (p + q - 1)\frac{g(\theta^*)}{1 - G(\theta^*)}\left[(1 - p)(H - L) + \frac{p + q - 1}{p'} - qF\right]\right]\frac{p''}{p'^2}$$

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[14]In an auction under adverse selection, the *virtual valuation* of a buyer with willingness to pay v is $v - \frac{1-G(v)}{g(v)}$.

Where θ^* is such that:

$$\theta^* = e^* + \frac{1 - q - p(e^*)}{p'(e^*)}$$

In this case, the optimal contract is: $w = 0$; $b = \frac{1}{p'(e^*)}$.

Corollary 3 *If, at the moral threshold, the Principal prefers a legal action rather than an illegal one[15] then $e^* < e^{FB}$ and $\theta^* > \theta^{FB}$. Hence, we have a lower effort and more fraud than in the first best.*

In both cases, there might be fraud at equilibrium depending on the morality of the agent. Moreover, if the expected fine is low the principal may indeed prefer more fraud. This is the case when at equilibrium the profit increases in the threshold θ^*.

4 Comparative Statics

[TO BE ADDED]

5 Extensions

CEO liability and clawbacks. In the main model, we have assumed that the CEO is fired in case fraud is detected: $t(D) = 0$. This also corresponds to the scenario where the CEO is liable in court in case of fraud. Two other scenarios can also be studied: (1) only clawback provisions are in place, that is only the bonus is kept by the firm in case of detection so that $t(D) = w$, and (2) no clawback provision are in place and the CEO keeps his full pay $t(D) = w + b$. The first scenario leads to $w = 0$, and it therefore always correspond to corollary 2. In turn, the second scenario is different. The interesting point is that that scenario actually makes fraud more costly, hence the firm might be more reluctant to induce fraud. However, at the same time it makes fraud harder to contain.

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[15]Note that if $w > 0$ then this condition is always satisfied.

Stock-options and market value.   We have assumed that bonuses where indexed on the operational profit (i.e. the signal σ). In publicly traded companies, CEOs' pay usually feature a component of variable pay that is indexed on the market value of the firm, typically stock-options. In order to accommodate this type of pay in our model, we need to introduce a Bayesian investor to determine what the stock price is. Since a result L can be generated only when the CEO does not defraud, the market value would be L in this case. In turn, under a contract where fraud may occur, a signal H can correspond to the case of a fraudulent firm that is not yet detected, hence the value should feature a Bayesian premium. This raises the question of when can the CEO exert his options: as soon as the operational profit is realized, or after some period during which detection of misbehavior might occur. Depending on the type of clawback options in place, and the incentives of the CEO, the stock price should be formed using Bayes' rule as a response to all the considerations just mentioned. Such extension would allow to study the confidence of the market when fraud might be an issue.

Moral cost: remorse vs shame.   In the main model, the morality of the CEO entails a cost θ as soon as he chooses the illegal action. In another version of the model, θ could be only an ex-post cost in case of detection. Whether it is a material cost or moral cost, the cost θ of being discovered as dishonest is then incurred only with probability q. This differences amounts to the difference between remorse–an intrinsic cost incurred irrespective of social context–and shame–a cost incurred only with regard to an audience. Our model can be amended to study this case.

Talent for fraud.   While we have assumed that q is a characteristic of the judicial system and institutional context, there is evidence that managers differ in their ability of dissimulating fraud.[16] This can be taken into account, in a model *à la* Bebchuk and Kaplow (1993). In terms of mechanism design, a difference emerges in this context: the private information of the CEO then has common value (since the

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[16]It seems in particular that CEOs that are more knowledgeable in antitrust law are also the ones that are more likely to fraud, because they know better how to hide the wrongdoings.

firm cares about the corresponding detection probability directly), while the cost θ has only private value. It would be interesting to study this heterogeneity in CEOs characteristic.

Governance and internal information.   When fraudulent behavior of managers is about self-dealing and harms the firm, internal detection systems provided by better governance and internal audits are an obvious desirable option for shareholders and boards. Then both shareholders' interest and social interest are better served with better information. In turn, when it comes to the type of fraud we have studied in this paper, where both shareholders and management can benefit from the wrongdoings, such internal monitoring and more transparent governance might not delivered better outcomes socially. If revealing fraud publicly harms the benefits (through the fine, most obviously, but maybe also through a reputational cost), then better internal detection systems might not be used in the socially efficient way. In other words, increasing fraud detection *internally* only helps the shareholders interest: once fraud is revealed internally, all informed parties are likely to prefer to keep it secret–all the more so if abnormal profits have been generated.

6   Literature review and discussion

6.1   The use of stock options and free shares

The optimal compensation package we have obtained can be linked to standard pay packages actually and usually awarded. In the two cases, it can correspond to stock options. Nevertheless, the optimal contract is such that $t(D) = 0$, it means that the firm must be able to withdraw the options when an illegal action is detected[17]. When $w = 0$ and $b > 0$, options must be distributed with a high strike price and thus will be profitable only if the high result is reached. However, $w > 0$ corresponds

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[17]These claw back provisions allow a firm to recoup compensation from its executives upon occurrence of a pre-defined event (such as ethical misconduct or executive fraud). Claw back clause became prevalent following the Sarbanes-Oxley Act of 2002 and Dodd-Frank Act of 2010. They permit to link executive's remunerations to their behaviors.

to stock options with a low strike price which always yield a rent to executives, even in case of bad corporate performance. These options are subject to criticism as managers always win. Under these circumstances, giving free shares to executives could be an alternative way to incite managers to exert effort. Nevertheless, the use of stock options or free shares introduces new compensation leverage. As a matter of fact, when q differs from 1, the remuneration paid by the firm through the optimal contract cannot take into account the potential ex post fraud detection (after being paid). Whereas, the use of stock options or free share may imply a third agent (the potential investor) when the manager will exercise the option or sell its shares. If this investor is well informed, he can anticipate the behavior of the agent at the equilibrium, and the share price will therefore encompass the risk of ex post detection. In this case, the question of the detection before or after the payment is no more relevant. This external control by the financial market increases the q in our model.

In this perspective, empirical studies show that the structure of the remuneration matters more than its level. Equity incentives or stock options are not necessarily harmful; it depends of their conditions. Whereas Erickson et al. (2006) compare executive equity incentives of firms accused of accounting fraud with firms not accused of fraud and find no evidence that executive equity incentives are associated with fraud, Johnson et al. (2009) emphasize the importance of the shape and vesting status of managerial pay packages in providing incentive to commit fraud. More precisely, their study shows that firms which committed fraud have significantly greater incentives from unrestricted stock-holdings than the other firms do (control firms which do not fraud). Moreover, they find that unrestricted stock-holdings are the largest source of incentive at firms which committed fraud. Edmans et al. (2012) show that efficient compensation packages involve long vesting periods and that extending the vesting period until after the CEO leave the company encourages the latter to think long term and reduces the risk that the CEO undertakes harmful short terms actions (as illegal actions) which temporary lift the stock price.

6.2 Who benefits from the crime?

If the expected sanction imposed on the firm is dissuasive, but the probability of detection is too low, shareholders should pay their executives a higher compensation so that they do not infringe the law. Aubert et al. (2006) have pointed out social costs induced by the fight against cartels and in particular by whistle-blowing programs which can deter efficient cooperation between firms (preventing good communication, restricting information flows between employees and inducing a rigid employment structure). As for Alexander and Cohen (1999), they underline that internal policing cost is borne by the firm which has to monitor their managers. In our article, we show that in addition to these costs, the risk of fraud generates a supplementary wage cost. Indeed, as long as the principal induces the agent to effort, the rent awarded to the manager by shareholders so that the former does not break the law rises when the probability of detection decreases. In the discrete framework, it appears that some infringements may result from compensation schemes which do not anticipate the risk of fraud.

However, actual corporate frauds can also result from insufficient corporate sanctions[18]. In this case, shareholders should induce their managers to break the law. Some CEOs may thus choose the illicit action because it benefits their firm and may then be rewarded by the shareholders for taking this risk (even if the fraud is finally detected) which has already been observed. Stephan (2011) notes that British Airways decided promote one of its executives pending trial for price fixing. He also states that: "the willingness of firms to employ executives, who have served jail sentences for antitrust offenses in the US, shows the retained value of their expertise and skills in the job market".

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[18]For instance, Combe and Monnier (2011) show that fines imposed against cartels by the Commission are overall suboptimal.

6.3 Executives' morality : the role of shareholders and public policy

In our continuous model, the existence of managers having a low sense of morality (breaking the law implies very low or no cost for them) has two major implications. First, it means that the other agents (moral ones) can earn from these immoral executives. Indeed, besides the inability to observe the level of effort undertaken by the manager (and/or the illicit action), there is an additional information asymmetry arising, as the shareholders do not know the sense of morality of their manager when they design their compensation schemes. The most moral CEOs have therefore no interest in revealing their moral type. Second, the fact that some CEOs can be immoral explains why a certain level of fraud can be observed at the equilibrium, despite a corporate liability which should induce shareholders to design pay packages compatible with law obedience (when public policy is optimal). Indeed, if some managers are immoral, it becomes too costly for shareholders to deter this particular group of executives from breaking the law, even when the expected corporate fine imposed by the government is dissuasive. Our conclusions derived from our model are consistent with empirical studies on corporate fraud and CEOs' morality.

Intrinsic morality or consequentialism ? One can wonder if the intensity of morality of an individual results from an intrinsic value (or absolute value), or whether it depends on the expected consequences of its potential fraudulent behavior. If morality is intrinsic, public policy or shareholders cannot easily influence this morality factor. On the contrary, if consequentialism prevails, compliance programs which explain and underline the adverse and negative effects of fraud on the long term profit or the firm (accounting fraud) or on third parties' welfare as consumers (cartel, environment abuses etc.) can help to enhance and strengthen the degree of morality of CEOs. These compliance programs inside a firm appear as a signal. But to be effective and credible, they need to rely on a strong commitment of the top managers. In their study on the airfreight cartel, Bergman and Sokol (2014) show that the compliance programs of Lufthansa were very effective as these programs were actively backed by the top CEOs of the group. These programs have favored

the building of a relationship based on trust between the legal department and the operating entities, which permitted to reveal and denounced rapidly the collusive practices.

Behavioral studies show that both type of morality intervene. For instance, an empirical and behavioral study undertaken for the UK Office of Fair Trading by Damgaard et al. (2012), show that the choice of whether or not to participate in a cartel depends not only on financial incentives, but also on the social preferences to minimize costs to other people in the economy (i.e. consumers). The impact of the social cost of breaking the law can be interpreted in terms of morality. Their results show that some executives display risk-loving behavior or immorality, as they always choose the fraud option, whatever the probability of detection, the fine, the additional profit and the social cost imposed on others as a result of this illegal action. Hence, the biggest challenge for the government is to deter this particular group of people who always commit fraud because it involves the possibility of a high gain. This study also shows that CEOs who display a better knowledge of antitrust law are more prone to form a cartel, which indicates that they have a low degree of morality (as they choose to fraud knowing the harm inflicted to other participants).

Public policy can have an influence on the distribution of the θ, reinforcing the perception of the social cost inflicted to other people in the economy by corporate fraud. Stucke (2011) discusses how antitrust agencies can promote moral norms to better deter anticompetitive behavior. In particular, he considers that policymakers can develop norms against price fixing by accentuating the conduct?s immoral content. In this perspective, criminalization of corporate fraud (imposing penal sanction as imprisonment sentences to executives who commit fraud) can contribute to effectively deter immoral managers and/or to lower the proportion of immoral CEOs as it enhances the individual cost of breaking the law. Stephan (2011) indicates that media coverage of law enforcement can contribute to educate and influence people?s beliefs, values and reactions to a given behavior (for instance corporate fraud). He considers that media coverage of cartel cases has the potential to explain the nature and shed light on the effects of practices such as collusion. Thus, it could

help to strengthen pro-competitive social norms. Beyond the role of media, politics and the political agenda can contribute to spread an ethical corporate culture (see for instance the australian exemple display Beaton-Wells et al. (2010) who analyze how politics transform the fight against cartel into a key social issue.

If morality derived from consequentialism, the corporate culture inside the firm is very important to promote a moral behavior. Some organizations and top CEOs or shareholders manage to inverse values so as to present fraud as a positive and "generous" act, or a necessary evil. Corporate culture inside the firm is very important to promote a moral behavior. Some firms and organization manage to inverse moral values so as to promote fraud. In the case of a cartel or an environmental abuse, the individual can be convinced by its hierarchy that the objective of high return justifies illicit practices. For instance, Bryan Allison, who join the marine hose cartel, explain that the necessity to comply with its profit objectives has played a crucial role in its fraudulent behavior. (O?Kane, 2011). A cartel can for instance be justified by the necessity to adapt to a fierce competition harmful for jobs and product quality. Stucke (2011) also reports the motto of some professional association which promote anticompetitive values, as "competition is war and war is evil", or the vitamins famous cartel : "Our competitors are our friends, our customers are the enemy". Moreover, if the harm (externality) induced by the fraud is not easily observed by the individual, it will be underestimate and the fraud will be associated with a weak consequential morality. Bryan Allison member of the Marine Hose cartel, declares that (O?Kane, 2011) : "We are a tiny outfit, we are not involved with consumers, who are we hurting ? (?) Who cares about us ?". Values, ethics and morality can be reversed and apply to fraud itself and to its preservation. For instance, referring to leniency programs, Bryan Allison explains that to denounce the fraud is an amoral behavior (O?Kane, 2011) : "I rather think that "grassing people up" isn't really the done thing. Isn't that a little unethical ? (...) Go shop your fellow conspirators, it's a bit below the belt ". If morality is mainly intrinsic and that environment cannot influence CEOs morality, shareholders who want to reduce fraud should modify their recruitment policy. It raises the question of the identification of immoral individuals. Recruiting interviews should include moral and ethics cri-

teria. Moreover, shareholders can favor a certain type of manager if they can use a list of parameters correlated to risk behavior or lack of morality. In this respect, the gender of the potential CEO could be taken into account (see Van Staveren, 2014).

6.4   The instruments of public policy : fine and detection

In the Beckerian literature, the probability of detection and the average fine are two substitutes of the public policy against crime. Indeed, corporate fraud can be dissuaded either by raising the average fine or by increasing the probability of detection, so that the expected fine is at least equal to the illicit profit generated by the fraud. As it is costly to deter and convict fraud, public policy should favor high fines rather than an increase in the probability of detection. Nevertheless, Polinsky and Shavell (1979) show that if the agents are risk averse, fixing a low probability of detection coupled with a high average fine is not optimal. Moreover, the theory of optimal sanction suffers from some limits. First, the proportionality of the punishment principle could be in contradiction with the theory of optimal fines consisting in imposing heavy fines associated with a weak probability of detection. Second, some firms could face inability to pay the amount of the optimal fine. Craycraft et al. (1997) found that in the U.S., over the period 1955-1993, only 18 percent of the convicted firms for price-fixing would have had sufficient available funds to pay optimal fines. The risk is that firms could be driven out of the market and could get bankrupt, the result being in last resort the exclusion of competitors implying even less efficiency and competition. According to Garoupa (2001), if firms or agents have a low financial capacity or resources, the dissuasive effect of fines will be limited and the government will not invest in fraud detection. Third, the principle of equal treatment is a general principle of Community law (this requirement is a related variation of the principle of proportionality) that should be respected when enforcing law. Finally, agents who collude may not be risk neutral and only subjective estimates of the probability of detection matter. Wils (2008) considers that to inflict heavy fines whereas the probability of detection is very low will be in contradiction with the memory effect. Indeed, in case of a low probability of detection, individuals will forget that these actions are illegal or believe that they will never get

caught. The conclusions of our model also plead for a high probability of detection, as the two tools of public policy are not substitutes in our framework. Nevertheless, we can note that the cost of the fight against corporate fraud is borne by the public agency if detection is important and by the shareholders through a greater wage cost otherwise. Moreover, as soon as the fine is high enough, the shareholders must cooperate with the government to reinforce fraud detection, which can lead the firm to adopt compliance programs and to put in place internal monitoring schemes.

Introducing penal sanctions ? Our model is based on an exclusive corporate lia-bility, in which an ex post transfer of liability to the manager can occur (the man-ager is not paid in case of fraud using claw back provisions). Developing individual liability through the imposition of penal sanctions could also permit to align man-agers? interests with those of the authorities, without disturbing the internal incen-tive mechanisms in the firm. It can also contribute to dissuade immoral agents to break the law.

To be effective such sanctions should be viewed as legitimate by the society as a whole (see for instance Beaton-Wells and al. (2010) for the Australian case, and Stephan (2012) for the british case). Moreover the penal system should be regularly applied to corporate fraud, otherwise it does not appear as credible enough. Indeed, in the U.K, the penal risk does not seem credible, as underlines it the British CEOs condemned for the marine hose cartel, O?Kane [2011]) who explains that "I knew from the legislation coming in 2003, that is was a criminal offense (...). But I hadn't thought anything would really happen" (p. 8). Penal sanctions can contribute to reinforce intrinsic morality against corporate fraud, as it stigmatizes a practice.

7 Conclusion

We have developed an agency model highlighting new trade-offs in CEO's incen-tives provision when illegal behavior is a moral risk that should be addressed by the compensation package. In our model fraud can be an equilibrium phenomenon, and we have discussed how the principal (board, shareholders) should design in-

centives to trade-off effort provision and fraud prevention. The two objectives are not necessarily at odds. While the fixed part of the compensation of the manager is always a good instrument to reduce fraud, variable pay may or may not help this goal–while being the relevant instrument for providing incentives. Our results help understand why the relationship between high-powered incentives and fraud is more elusive than is sometimes thought, and can be useful in understanding the mixed empirical evidence.

Our analysis also sheds a new light on the interplay between the quality of the legal system and fraud, by pointing out that the beckerian substitutability between fines and probability of detection breaks down when taking into account incentives of the top management. Our results imply that an insufficient level of corporate fraud detection (rather than the average level of fine) allows significant rent extraction in executive compensation, which can be illustrated by stock options with a low strike price. More generally, the use of stock options remains efficient under two conditions: first, claw back provisions are crucial to preserve the optimality of incentive contracts; second public policy must internalize the effects of its decisions on the corporate governance issues that our models have characterized (efficiency of incentive schemes). This paper raises thus the issue of alternative instruments and approaches to deter fraud (individual liability, the role of media etc.).

A Proofs

A.1 Proof of proposition 1

The principal's program writes:

$$\max_{w,b} L + p(e)(H - L) - w - p(e)b$$

$$s.t. \begin{cases} (IC) & e \in ArgMax[w + p(e)b - e] \\ (IC2) & \theta \geq (1 - p(e) - q)b + e - qw \\ (LL) & w \geq 0 \end{cases}$$

The first constraint always leads to $b = \frac{1}{p'(e)}$, so we substitute it in the objective. We use use the lagrangian with variables e and w and nonnegative multipliers for the constraint IC2 and LL. $\mathcal{L} = L + p(e)(H - L) - w - \frac{p(e)}{p'(e)} + \mu w + \nu(\theta - e + qw - \frac{1-q-p(e)}{p'(e)})$. The first order conditions leads to:

$$\begin{cases} \frac{\partial \mathcal{L}}{\partial e} = p'(e)(H - L) - 1 + \frac{pp''}{p'^2} + \nu(1 - q - p(e))\frac{p''}{p'^2} = 0 \\ \frac{\partial \mathcal{L}}{\partial w} = -1 + \nu q + \mu = 0 \\ \nu(\theta - e + qw - \frac{1-q-p(e)}{p'(e)}) = 0 \\ \mu w = 0 \\ \theta \geq (1 - p(e) - q)b + e - qw \\ w, \mu, \nu \geq 0 \end{cases}$$

There are three cases, depending on the multipliers μ and ν.

First case: $\mu = 0$, then the second equation leads to $\nu = \frac{1}{q}$ and the first one to: $p'(\bar{e})(H - L) = 1 - (1 - q)(1 - p)\frac{p''}{qp'^2}$. The fixed wage is $w = \frac{1-q-p(\bar{e})}{qp'(\bar{e})} + \frac{\bar{e}-\theta}{q}$, this wage has to be nonnegative hence this regime is valid for $\theta \leq \bar{e} + \frac{1-q-p}{p'}$.

In the two other cases μ is positive, so that $w = 0$.

Second case: $\mu > 0$ and $\nu = 0$. The effort required is then $p'(e^{SB})(H - L) = 1 - \frac{pp''}{p'^2}$ thus the optimal effort is the second best one. However, the (IC2) constraint needs to be satisfied. Hence, this regime is valid for $\theta \geq e^{SB} + \frac{1-q-p}{p'}$.

Third case: $\mu > 0$ and $\nu > 0$. The second FOC implies $\nu = \frac{1-\mu}{q}$ as both multipliers must be nonnegative we have $0 \leq \mu \leq 1$. In this case the effort is chosen according to the binding (IC2) constraint: $\theta = \frac{1-p(e)-q}{p'(e)} + e$ and μ can be computed according to the first constraint.

As $p'''p' - 2p''^2 < 0$ then it is straightforward to prove that the function $\Phi(e) = p'(e)(H-L) - 1 + \frac{p(e)p''(e)}{p'(e)^2}$ is decreasing. $\Phi(e^{SB}) = 0$ and $\Phi(\bar{e}) = -(1-p-q)\frac{p''}{qp'^2}$. First if $1 - p(\bar{e}) - q > 0$ then $\Phi(\bar{e}) > \Phi(e^{SB}) \Rightarrow \bar{e} < e^{SB}$. Moreover, as $\Psi(e) = e + \frac{1-p-q}{p'}$ is increasing: $\bar{e} + \frac{1-q-p}{p'} \leq e^{SB} + \frac{1-q-p}{p'}$. Second, when $1 - p(\bar{e}) - q < 0$ then $\Phi(\bar{e}) < \Phi(e^{SB}) \Rightarrow \hat{e} > e^{SB}$ but $\Psi(e)$ is in this case decreasing hence $\bar{e} + \frac{1-q-p}{p'} \leq e^{SB} + \frac{1-q-p}{p'}$. Hence we always have $\bar{e} + \frac{1-q-p}{p'} \leq e^{SB} + \frac{1-q-p}{p'}$ and depending on q we only have two possible cases.

Finally, note that e^{SB} does not depend on q moreover $\bar{e}$ is a continuous function of θ and q. We can check that $\frac{d\bar{e}}{dq}$ is positive. Hence more detection implies a higher bonus for low types. The proof is the following: Consider $\Omega(e,q) = p'(e)(H-L) - 1 + \frac{(1-p)(1-q)}{qp'^2}p''$. This function is such that $\Omega(\bar{e}(q),q) = 0$ for all q. Hence $\frac{d}{dq}[\Omega(\bar{e}(q),q)] = \frac{\partial\Omega}{\partial\bar{e}}\frac{d\bar{e}}{dq} + \frac{\partial\Omega}{\partial q} = 0$. Moreover $\frac{\partial\Omega}{\partial\bar{e}} = p''(H-L) + \frac{1-q}{q}\left[-\frac{1}{p'^2} + \frac{1-p}{p'^3}(p'''p' - 2p''^2)\right]$ which is negative by assumption. $\frac{\partial\Omega}{\partial q} = \frac{-1}{q^2}\frac{1-p}{p'^2}p''$ is positive. Hence $\frac{d\bar{e}}{dq}$ is positive. Note now that if q is large then $p^{-1}(1-q) < \bar{e} < e^{SB}$ and if q is low then $e^{SB} < \bar{e} < p^{-1}(1-q)$. As when $q = 1 - p(e^{SB})$ then $e^{SB} = \bar{e}$ as they both verifies the two equations, by continuity we deduce that we cannot have $p(\bar{e}) < 1 - q < p(e^{SB})$.

A.2 Proof of proposition 2

First, we prove that it is not possible to induce the illegal action when $\theta > p^{-1}(1-q)$ by contradiction. Assume that $p(\theta) > (1-q)$ a bonus and hence an equivalent effort will induce the illegal action iff $e \geq \theta + (p(e) + q - 1)$. First note that we cannot have $p(e) \geq 1 - q$ indeed in this case $e \geq \theta$ hence $p(e) \geq p(\theta) > 1 - q$ contradiction. Therefore, $p(e) + q - 1 < 0$ and $p(e) < 1 - q < p(\theta)$ hence $e < \theta$. Consider the function $\phi(e) = \frac{p+q-1}{p'} + \theta - e$ it must be negative by assumption. But $\phi'(e) = \frac{1-p-q}{p'^2}p'' < 0$ and $\phi(\theta) = \frac{p(\theta)+q-1}{p'(\theta)} > 0$ and as $e \leq \theta$ we cannot have $\phi(e) < 0$ contradiction. Finally, we can conclude that the illegal action is implementable only

for θ lower than $p^{-1}(1-q)$.

The Principal's program writes:

$$\max_{w,b} H - qF - (1-q)(w+b)$$

$$s.t. \begin{cases} (IC) & e \in ArgMax[w + p(e)b - e] \\ (IC2) & \theta \leq (1 - p(e) - q)b + e - qw \\ (LL) & w \geq 0 \end{cases}$$

The first constraint leads to $b = \frac{1}{p'(e)}$. As the objective function is decreasing in w and as w decreases the left hand side of the (IC2) it is optimal to set $w = 0$. We use the lagrangian with variable e and nonnegative multiplier for the constraint IC2. $\mathfrak{L} = H - qF - \frac{1-q}{p'(e)} + \mu[\frac{1-p(e)-q}{p'(e)} + e - \theta]$. The first order conditions leads to:

$$\begin{cases} \frac{\partial \mathfrak{L}}{\partial e} = \frac{p''}{p'^2}[1 - q + \mu(q + p(e) - 1)] = 0 \\ \mu(\theta - e + \frac{q+p(e)-1}{p'(e)}) = 0 \\ \mu \geq 0 \\ \theta \leq (1 - p(e) - q)b + e - qw \end{cases}$$

Assume that $\mu = 0$ then the first equation is impossible. Thus $\mu > 0$, the first equation implies that $q + p(e) - 1 \neq 0$ and as μ as to be positive it implies that $1 - q - p(e) > 0$. The (IC2) constraint is binding hence the equivalent effort is defined by $\theta = e + \frac{1-p(e)-q}{p'(e)}$ and must satisfy the condition $1 - p(e) - q > 0$. It is straightforward to prove that the function $\theta(e) > e$ is increasing and there is a unique solution in e for each θ. Moreover $\theta(e) = e$ at a point e such that $1 - p(e) - q = 0$. It implicitly means that for each type greater than this particular e it is not possible to implement the illegal action.

The second order condition at point e and the corresponding multiplier μ is verified: $\frac{\partial^2 \mathfrak{L}}{\partial e^2} = \mu \frac{p''}{p'}$ and p'' is negative.

A.3 Proof of proposition 3

Using the fact that $w = \frac{1-p(e)-q}{q}b + \frac{e-\theta^*}{q}$ and $b = \frac{1}{p'(e)}$, the Principal's profit can be written as a function of e and θ^*:

$$
\begin{aligned}
\Pi &= G(\theta^*)\left[H - qF - \frac{1-q}{p'} - \frac{(1-q)(1-q-p)}{qp'} - \frac{1-q}{q}(e-\theta^*)\right] \\
&+ (1-G(\theta^*))\left[L + p(H-L) - \frac{p}{p'} + \frac{p+q-1}{qp'} - \frac{e-\theta^*}{q}\right]
\end{aligned}
$$

and the constraint $w = \frac{1-p(e)-q}{q}b + \frac{e-\theta^*}{q} \geq 0$ must be satisfied. We see the problem with e^* and θ^* as control variables.

The Jacobian of the constraint is $J_g = [-\frac{1-q-p}{qp'^2}p'', -\frac{1}{q}]$ and the rank is 1 therefore we have the Linear independence constraint qualification.

The Lagrangian is $\mathcal{L} = \Pi(e, \hat{\theta}) + \mu\left(\frac{1-p(e)-q}{q}b + \frac{e-\theta^*}{q}\right)$

The First order condition leads to:

$\frac{\partial \mathcal{L}}{\partial e} = \frac{p''}{qp'^2}[(1-q)(1-p) - \mu(1-q-p)] + (1-G(\theta^*))(p'(H-L) - 1) = 0$

Hence, $p'(e)(H-L) = 1 - \frac{1}{q(1-G(\theta^*))}[(1-p)(1-q)(1-\mu) + \mu pq]\frac{p''}{p'^2}$

Moreover, $\frac{\partial \mathcal{L}}{\partial \theta^*} = \frac{1-\mu}{q} - G(\theta^*) + [(1-p)(H-L) + e - \theta^* - qF]g(\theta^*) = 0$

Hence, $\Pi(i) - (\theta^* - \frac{1-qG(\theta^*)-\mu}{qg(\theta^*)}) = \Pi(e) - e$.

Finally, if $\mu > 0$ then the constraint is binding and $\theta^* = e^* + \frac{1-q-p(e^*)}{p'(e^*)}$.

A.4 Proof of corollary 1

If the limited liability constraint is not binding then $\mu = 0$. The fix wage is $w = \frac{1-p(e)-q}{q}b + \frac{e-\hat{\theta}}{q}$ and e^* and θ^* are computed using the two formulas of proposition 3.

A.5 Proof of corollary 2

If the constraint is binding then $w = 0$, θ^* is given by $\theta^* = e^* + \frac{1-q-p(e^*)}{p'(e^*)}$. μ can be computed using $\Pi(i) - (\theta^* - \frac{1-qG(\theta^*)-\mu}{qg(\theta^*)}) = \Pi(e) - e$. If we substitute this formula

in the formula defining e^* in the proposition 3 one gets:

$$\Pi'(e^*) = 1 - \frac{pp''}{p'^2} - \left[\frac{(1-q)G(\theta^*)}{1-G(\theta^*)} + (p+q-1)\frac{g(\theta^*)}{1-G(\theta^*)}\left[(1-p)(H-L) + \frac{p+q-1}{p'} - qF\right]\right]\frac{p''}{p'^2}$$

A.6 Proof of corollary 3

First, if the limited liability constraint is not binding then $\mu = 0$ and $\Pi'(e^*) = 1 - \frac{(1-p(e^*))(1-q)}{q(1-G(\theta^*))}\frac{p''(e^*)}{p'^2(e^*)} > 1$ therefore $e^* < e^{FB}$. Moreover, $\Pi(i) - \left(\theta^* - \frac{1-qG(\theta^*)}{qg(\theta^*)}\right) = \Pi(e) - e$ But as e^{FB} maximizes $\Pi(e) - e$ and as $\Pi(e^{FB}) - e^{FB} = \Pi(i) - \theta^{FB}$ we obtain that: $\Pi(i) - \left(\theta^* - \frac{1-qG(\theta^*)}{qg(\theta^*)}\right) \leq \Pi(e^{FB}) - e^{FB} = \Pi(i) - \theta^{FB}$ Hence $\theta^{FB} \leq \theta^* - \frac{1-qG(\theta^*)}{qg(\theta^*)}$ which implies that $\theta^* \geq \theta^{FB}$. Note that we do not need any further assumption to prove this result, the reason is that when $w > 0$ a fortiori the principal prefers a legal action rather than an illegal one.

Second, assume that the Principal's profit is Π with a binding constraint $w = 0$. Suppose now that the limited liability constraint becomes $w \geq \epsilon$ with ϵ close to zero. The lagrangian multiplier μ measures the marginal decrease in the principal profits. Hence, the profit of the principal will be $\Pi - \mu\epsilon$ for $\epsilon \approx 0$.

Assume now that the principal keeps the same bonus $b = \frac{1}{p'(e)}$ then the effort will remain the same but $\theta = (1 - p(e) - q)b + e - qw$ needs to be modified. The marginal impact on profits is:

$$\frac{\partial\Pi}{\partial w} = -(1-q)G(\theta^*) - (1 - G(\theta^*)) + g(\theta^*)\left[\Pi(i) - (1-q)(w+b) - \Pi(e^*) + w + pb\right]\frac{d\theta^*}{dw}$$

Hence

$$\frac{\partial\Pi}{\partial w} = -(1 - qG(\theta^*)) - qg(\theta^*)\left[\Pi(i) - (1-q)(w+b) - \Pi(e^*) + w + pb\right]$$

The principal will always do better if he can now adjust the bonus to this new liability constraint, hence:

$$\begin{aligned}\Pi - \mu\epsilon \geq{}& \Pi - (1 - qG(\theta^*)\epsilon \\ &- qg(\theta^*)\left[\Pi(i) - (1-q)w - (1-q)b - \Pi(e^*) + pb + w\right]\epsilon\end{aligned}$$

As $w = \epsilon$ is close to zero the term in brackets represent the gap in profits from a legal action to an illegal one at the moral threshold. Hence by assumption this term is non positive.

Therefore $\mu \leq 1 - qG(\theta^*)$. It implies that $\mu \leq 1$ which proves that $e^* < e^{FB}$ as $p'(e^*)(H - L) = 1 - \frac{1}{q(1-G(\hat{\theta}))}[(1-p)(1-q)(1-\mu) + \mu pq]\frac{p''}{p'^2} > 1$. Moreover, $\Pi(i) - (\theta^* - \frac{1-qG(\theta^*)-\mu}{qg(\theta^*)}) = \Pi(e^*) - e^* \leq \Pi(e^{FB}) - e^{FB} = \Pi(i) - \theta^{FB}$.

Hence $\theta^* - \frac{1-qG(\theta^*)-\mu}{qg(\theta^*)} \geq \theta^{FB}$ and $\theta^* \geq \theta^{FB}$.

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