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The Impact of Incentive Pay on Corporate Crime

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Daniel Herold*

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Abstract

This paper presents a moral hazard model analyzing the agent's incentive to commit corporate crime. The principal can only observe profits which the agent can increase by committing crime or exerting effort. It is shown how different incentive contracts, i.e., threshold-linear, capped bonus and linear contracts, can be adjusted in order to promote agent's law abiding behavior. Any adjustment implies a loss in internal efficiency which decreases in individual sanctions imposed on the agent.

Keywords: moral hazard, incentive pay, corporate crime, cartels
JEL Codes: D82, D86, L14, L22, K20, K21

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1 Introduction

Agency theory suggests that corporate crime may be facilitated by the separation of ownership and control (Friebel and Guriev, 2012; Arlen, 2012). As an essential element of controlling an agent's behavior, incentive pay typically rewards high profits in order to provide incentives to exert effort (see, for instance, Holmström (1979) or Innes (1990)). However, rewarding high profits may also lead to illegal conduct. Scholars have shown that there exists a trade-off between efficiency and the occurrence of agent's misbehavior when providing an agent with incentive pay (see, for instance, Garoupa (2000); Andergassen (2010); Bergstresser and Philippon (2006)). This trade-off may exist despite the threat of individual and firm-level sanctions (Alexander and Cohen, 1999; Arlen, 2012). This paper thus addresses the question of *how* incentive contracts can be adjusted in order to achieve high profits without inducing corporate crime.

In this paper, I use a double moral-hazard framework to analyze the agent's incentive to commit corporate crime. The agent chooses whether to break or to obey the law and how much effort to exert. By committing corporate crime the firm's profits will be higher in expectation for any given effort level. Corporate crime is thus comparable to a risky investment which allows for a better production technology. Such a comparison was also drawn by Alexander and Cohen (1999) and possible applications are described in the following paragraph. The principal uses an incentive contract based on profits to incentivize the agent because he can neither observe effort nor whether the agent is involved in criminal activities. An authority imposes sanctions on the principal and on the agent in case of detection.

The agent first decides on whether to commit corporate crime and subsequently chooses effort. Robison and Santore (2011) use a similar timing to model fraud. The model may also be applied to cartels (Harrington, 2006; Angelucci and Han, 2015), deception (Eisenkopf et al., 2017), corruption and bribery (Campos et al., 2016; Carrillo, 2000), violations of environmental laws (Shapira and Zingales, 2017) or doping in sports (Robeck, 2014). For instance, think of an executive who engages in price fixing. Such agreements weaken the outside options of customers and thus allow for better deals for the producers (Gill et al., 2013). Another example is the use of inputs which generate harmful substances during the production process. A firm's executive may decide to utilize these inputs despite the threat of sanctions due to their cost effectiveness. Shapira and Zingales (2017) describe that a similar behavior was observable at the US firm DuPont in the mid 1980's. Applied to the anecdotal evidence from the 2008 financial crisis, deceiving the customers by selling 'toxic' assets with high, hidden risks may require less sales effort than offering standard products with low risk and returns (Eisenkopf et al., 2017). In sports, an athlete may use performance enhancing drugs to increase the benefits from training.

To analyze corporate crime I use the state-space representation used by, e.g., Poblete and Spulber (2012) to model the firm's production technology.[1] A random component, the state, and agent's effort increase firm's

[1] This framework allows to isolate the effects of corporate crime and enables an intuitive interpretation of the results. The state-space representation was also used by, e.g., Spence and Zeckhauser (1971). The classical reduced-form approach may also be applied to the model and was used, for instance, by Holmström (1979) and Innes (1990).

profits. By committing corporate crime the expected state is higher than if the agent obeys the law which allows the agent to increase effort or to shirk, depending on the contract and whether the state and effort are substitutes. The possibility to reduce effort by violating the law is also assumed by Aubert (2007, 2009), however, in my model agent's shirking occurs endogenously. This paper analyzes threshold-linear, capped bonus and linear contracts. Poblete and Spulber (2012) show that one of these contracts induces optimal effort levels in the underlying moral-hazard problem when the agent has no option to break the law and when both the principal and the agent are risk-neutral and the agent is protected by limited liability. Moreover, these contracts are commonly observed in practice (Arya et al., 2007; Murphy, 1999; Schmalensee, 1989).

The model shows that the agent always has an incentive to violate the law because he can utilize a more favorable production technology. When agent's sanctions are not sufficiently high to deter a violation, any contract has to be adjusted in order to prevent a violation. Based on the results of Poblete and Spulber (2012), a threshold-linear (capped bonus) contract is optimal when effort and the state are complements (substitutes). When assuming that the optimal type of contract is used, an increase in the threshold, i.e., making it harder to earn a bonus, promotes law abiding behavior. This counterintuitive result arises because the expected loss in utility will be stronger if the agent commits corporate crime than if the obeys the law. To understand this result, note that threshold-linear contracts resemble debt-contracts. Increasing debt decreases agent's utility. Due to the complementarity between the state and effort, agent's effort is higher when he engages in corporate crime in which case the direct effect of higher levels of debt on payoffs is stronger than if the agent obeys the law. The effects of increasing the bonus cap are ambiguous. When such a contract is in place, the agent reduces effort when he breaks the law because he expects a higher state to occur due to the infringement. Thus, lower effort costs and a higher state make an infringement more attractive. However, an increase in the cap may promote law abiding behavior because higher effort increases the chance to hit the bonus cap when the agent obeys the law. When the latter effect is stronger (weaker) increasing the cap promotes law abiding behavior (corporate crime) because a violation decreases (increases) expected rewards. Increasing the slope of a purely linear contract facilitates corporate crime because of the beneficial effect on profits and remuneration due to a more favorable production technology when committing corporate crime.

Adjusting a contract by, e.g., increasing the profit threshold, decreases the gain from corporate crime relative to law abiding behavior. At some point, the gains from crime are lower than individual sanctions. Thus, higher sanctions make it less likely that corporate crime occurs because weaker adjustments to the contracts are required whereby the deviations from the optimal contract become smaller.

The resulting trade-off between a firm's internal efficiency and law abiding behavior was already shown for specific infringements such as earnings manipulation (Crocker and Slemrod, 2007; Andergassen, 2016), fraud (Robison and Santore, 2011) or for cartels (Spagnolo, 2000; Aubert, 2007, 2009). This trade-off was thoroughly studied for stock-based compensation with respect to earnings manipulation (Goldman and Slezak, 2006; Bergstresser and Philippon, 2006). This paper contributes to this strand of literature by showing that such a trade-off exists with incentive contracts for a broad set of corporate infringements (examples were given above). With respect to cartels, (Fershtman et al., 1991) suggest that supra-competitive profit thresholds may induce a stable cartel with two principals and agents. Similarly, Spagnolo (2005) shows that low bonus caps may stabilize collusion by eliminating the gains from deviation. Although it does not take into account the stability aspect of a cartel, my model indicates that by taking into account agent's choice on effort, the results are less straightforward. In particular, less ambitious profit targets may promote agent's law abiding behavior. A similar result was indicated by Andergassen (2010) with respect to stock-based compensation and fraudulent behavior. Throughout the model it is assumed that sanctions are exogenously fixed, however, the principal may also impose sanctions on the agent when an infringement occurs. In an extension of the model the principal is able to recoup agent's remuneration. Comparable measures are deferrals in payments or 'clawbacks' (Angeli and Gitay, 2015). It is shown that those measures can promote but not completely ensure the agent's law abiding behavior.

The paper is structured as follows. In Section 2 the basic structure of the model is outlined whereas in Section 3 the main results are presented. It will be shown how threshold-linear, capped bonus and linear contracts can be adjusted to promote law abiding behavior. In Section 4 the model will be extended by allowing the principal to impose sanctions on the agent in Subsection 4.1 and by briefly analyzing the changes in the optimal contracts when the principal prefers to induce an infringement in Subsection 4.2.

Conclusions are in Section 5.

2 The model

The model has the following timing. The setup is explained in more detail in the following paragraphs.

1. The principal offers a take-it-or-leave-it contract w.
2. The agent decides on whether to obey ($\nu = 0$) or to break ($\nu = 1$) the law and how much effort, a, to exert.
3. The state, θ, is drawn from the distribution function G or H for $\nu = 0$ or $\nu = 1$, respectively. Profits are realized.
4. An authority screens the firm and detects an infringement with probability ρ. In case of detection, fines Φ are imposed on the principal and sanction ϕ are imposed on the agent.

The basic principal-agent relationship follows Poblete and Spulber (2012). Both parties are risk-neutral and the agent is protected by limited liability. The agent can exert effort, a, in order to increase profits, π. The agent exerts effort before observing the realization of a random state, θ. Profits are increasing in effort and the state with diminishing marginal returns which implies $\pi_a > 0$, $\pi_{aa} \leq 0$, $\pi_\theta > 0$ and $\pi_{\theta\theta} \leq 0$.[2] For $\theta = 0$, profits are constant in a. Effort costs are denoted by $\psi(a)$ with $\psi' > 0$ and $\psi'' \geq 0$. The state θ

[2]For notational convenience I use π_a and π_{aa} to denote the first and second derivative of π with respect to effort. The same applies to the state, θ.

is drawn from a cumulative distribution function F with support $[0, \overline{\theta}]$. The principal can neither observe a nor θ, however, he observes profits, π.

Before deciding on how much effort to exert the agent may break the law which is indicated by the variable $\nu \in \{0, 1\}$. For $\nu = 0$ the agent obeys the law and for $\nu = 1$ the agent breaks the law. If the agent obeys the law θ is drawn from the distribution G whereas if he breaks the law, θ is drawn from the distribution H. Whenever the results hold for all choices of ν, the function $F \in \{G, H\}$ will be used in the analysis.

As a central assumption, the benefits of an infringement are that profits $\pi(\theta, a, \nu)$ are always expected to be higher when the agent breaks the law compared to when he obeys the law for any effort level. This is captured by a higher state, θ, in expectation. Technically, the distribution function H first-order stochastically dominates the distribution function G, i.e., $G(x) \geq H(x)$. The state-space formulation allows for an intuitive interpretation of the benefits from corporate crime. The state is similar to an input factor to a production function. Hence, when the agent breaks the law he will be endowed with a (weakly) higher, exogenously given input factor and, hence, with a better production technology.

There is an authority which detects an infringement, $\nu = 1$, with probability ρ. The principal can only observe the agent's infringement when the authority detects it. In case of detection, fines Φ are imposed on the principal and individual sanctions ϕ are imposed on the agent.[3] The Fines Φ may also comprise reputational damages following the detection of illegal conduct

[3]In case of detection, the principal knows that the agent chose $\nu = 1$. In Section 4.1 the principal will be able to impose sanctions on the individual in which case the contract can be designed contingent on external detection.

(Alexander, 1999; Karpoff and Lott, 1993).

Agent's remuneration $w(\pi)$ is non-negative because the agent is protected by limited liability. To eliminate incentives to 'burn output', assume that the principal's and the agent's net payoffs are non-decreasing in profits, π (Innes, 1990). This assumption implies $0 \leq w'(\pi) \leq 1$ (Poblete and Spulber, 2012).

Neglecting the agent's incentive to violate the law an equilibrium contract is a solution to the following program.

$$\begin{aligned} &\max_{\{a,w\}} && V = \int_0^{\overline{\theta}} (\pi(\theta, a) - w(\pi(\theta, a)))f(\theta)d\,\theta \\ &\text{subject to} && U = \int_0^{\overline{\theta}} w(\pi(\theta, a))f(\theta)d\,\theta - \psi(a) \geq 0 \\ &\text{and} && a \in \arg\max \int_0^{\overline{\theta}} w(\pi(\theta, a))f(\theta)d\,\theta - \psi(a) \end{aligned} \tag{1}$$

The first line in (1) denotes the principal's expected payoffs V which is computed as the difference between profits π and agent's remuneration w. Agent's expected payoffs U have to be non-negative which constitutes the agent's participation constraint, (PC). The second constraint ensures that the agent chooses effort as to maximize his payoff and is therefore referred to as the incentive constraint, (IC). There is a third constraint to be taken into account in (1) which captures the agent's choice of $\nu \in \{0, 1\}$. The impact of this constraint on the contracts will be analyzed in the following sections.

3 The agent's incentive to break the law

Agent's expected utility for $\nu = 0$ and $\nu = 1$ is defined as U_0 and U_1, respectively, and reads as follows.

$$U_0 = \int_0^{\overline{\theta}} w(\pi(\theta, a))g(\theta)d\,\theta - \psi(a) \tag{2}$$

$$U_1 = \int_0^{\overline{\theta}} w(\pi(\theta, a))h(\theta)d\,\theta - \psi(a) - \rho\phi \tag{3}$$

It immediately follows that $U_1 > U_0$ by FOSD if individual sanctions $\rho\phi$ are sufficiently small.

Lemma 1. *$U_1 \geq U_0$ for any optimal effort level $a^*_\nu > 0$ when $\rho\phi = 0$.*

Proof. Denote by $a^*_\nu > 0$ the effort levels that maximize U_ν for $\nu \in \{0, 1\}$ (See (2) and (3)). Due to $G(x) \geq H(x)$, $U_1(a^*_0) \geq U_0(a^*_0)$. By definition of a^*_1, $U_1(a^*_1) \geq U_1(a^*_0)$ and thus $U_1(a^*_1) \geq U_0(a^*_0)$. $\square$

From Lemma 1 is follows that the agent always has an incentive to break the law when expected sanctions are sufficiently small. The constraint (4), henceforth referred to as ICV_0, ensures that the agent obeys the law given effort levels a_ν depending on agent's choice of $\nu \in \{0, 1\}$.

$$U_0(a_0) \geq U_1(a_1) \tag{4}$$

For any contract w effort levels a_0 and a_1 will differ because the agent is endowed with a higher state when breaking the law ($\nu = 1$) than if he obeys the law ($\nu = 0$). Taking into account condition (4) in program (1) is thus necessary if the principal prefers to induce law-abiding behavior.

Depending on whether the state and effort are complements or substitutes and depending on the type of the contract, w, agent's effort might increase or decrease when he breaks the law relative to when he obeys the law. It will be shown below that this has a strong impact on the agent's incentive to break the law.

To see how the agent's incentive to violate the law gives rise to inefficiencies, suppose the principal chooses an optimal contract w^{**} that solves (1) without taking into account constraint (4). The contract w^{**} induces $a_0(w^{**})$ ($a_1(w^{**})$) when the agent obeys (violates) the law. The agent may break the law despite the principal does not prefer a violation if individual sanctions, $\rho\phi$, are not high enough to satisfy constraint ICV_0 in (4) given w^{**}. Then, from Lemma 1, the agent breaks the law by choosing $a_1(w^{**})$. Thus, the firm is not only exposed to fines but also suffers from suboptimal levels of effort.[4]

Finding an optimal contract thus requires to decrease the gains from a violation until sanctions are sufficiently high to deter a violation. For the following analysis, assume that fines are not high enough to deter a violation given the optimal contract w^{**}. Then, the desired optimal effort level $a_0(w^{**})$ is infeasible when sanctions are too low and the contract has to be adjusted.

As shown by Poblete and Spulber (2012) an optimal solution to program (1), i.e., the contract w^{**}, is either a debt contract, a capped bonus contract or a linear contract. Which contract is optimal is strongly driven by the relationship between effort and the state in the production technology. When effort and the state are complements (substitutes), effort is more productive in higher (lower) states. It is thus necessary to shift effort incentives towards higher (lower) states by using debt-style (capped bonus) contracts. Linear

[4]When the principal prefers the agent to break the law undesired behavior follows when expected sanctions, $\rho\phi$, are too high. This will be analyzed in Section 4.2.

contracts are only optimal when the critical ratio is constant in θ.[5] Although both forms of contracts comprise a threshold –in one case the agent receives all profits above and in the other case all profits below a predefined threshold– I refer to thresholds as the level of debt. This because thresholds or targets are typically referred to the minimum value of the outcome above which the agent receives a bonus (Murphy, 1999; Bose et al., 2011).

In the following it will be analyzed how changes in the respective contract parameters, i.e., an increase in the levels of debt, the cap or the variable bonus, affects the agent's incentive break the law. Throughout the following analysis, optimal values are marked with an asterisk.

Case 1: Threshold-linear contracts Consider a threshold-linear contract of the form $w = \max\{0, \pi - z\}$. The principal's only instrument to control the agent's actions is the cut-off value z. Alternatively, one could assume that the agent only receives a fraction b of profits above a threshold, z, which would then also be set by the principal. Bose et al. (2011) demonstrate that those contracts yield optimal effort levels close to first-best solutions. Varying b is comparable to the analysis of a linear contract (see below), thus, assume that $b = 1$ throughout the analysis of Case 1. To analyze the impact of z on the constraint ICV_0, consider a state $\tilde{\theta}$ which is defined as follows.

Definition 1. *The state $\tilde{\theta}$ is defined as that state for which, given any effort*

[5] More precisely, Poblete and Spulber (2012) show that when a critical ratio defined as the product of the hazard rate of the state, $\frac{f(\theta)}{1-F(\theta)}$ and the marginal rate of technical substitution of the state and agent's effort, $\frac{\pi_a(\theta,a)}{\pi_\theta(\theta,a)}$ is increasing, decreasing or constant in the state, θ, a threshold-linear, capped bonus or linear contract is optimal. The sign of the derivative of this critical ratio is determined by the sign of the derivative $\frac{\partial}{\partial \theta}\frac{\pi_a(\theta,a)}{\pi_\theta(\theta,a)} = \frac{\pi_{a\theta}\pi_\theta - \pi_{\theta\theta}\pi_a}{(\pi_{\theta\theta})^2}$. The sign of the latter condition is determined by the relationship between the two input factors.

level a, expected profits are exactly equal to the threshold z, $\pi(\tilde{\theta}, a) = z$, for any z. The state $\tilde{\theta}(a, z)$ weakly decreases in effort due to the assumption of positive marginal returns of effort, $\pi_a(\theta, a) \geq 0$ for all θ and a, and it weakly increases in z, i.e., $\frac{\partial \tilde{\theta}}{\partial a} = \tilde{\theta}_a \leq 0$ and $\frac{\partial \tilde{\theta}}{\partial z} = \tilde{\theta}_z \geq 0$.

From the assumption $\pi_\theta > 0$ for every profit $\pi = x$ there exists only one θ such that $\pi(\theta, a) = x$ for every given $a > 0$. Therefore, $\pi(\theta, a)$ is invertible and the state $\tilde{\theta}$ is unique.

Based on Definition 1, for all $\theta \in [0, \tilde{\theta}(a, z))$ profits are too low and remuneration will be zero while for all $\theta \in [\tilde{\theta}(a, z), \overline{\theta}]$ the agent receives all profits above the threshold. Agent's utility thus reads

$$U(z, a) = \int_{\tilde{\theta}(a,z)}^{\overline{\theta}} [\pi(\theta, a) - z] \, f(\theta) d\theta - \psi(a). \tag{5}$$

Proposition 1 states that an increase in the threshold, z, strengthens the agent's incentive to obey the law if the state and effort are complements.

Proposition 1. *An increase in z relaxes the incentive constraint ICV_0 if $\pi_{\theta a} > 0$.*

Proof. To proof this proposition, one has to show that $U_0(z)$ and $U_1(z)$ satisfy the single-cross condition. In particular, there exists a z' such that $U_0(z) \geq U_1(z)$ for all $z \geq z'$ and $U_0(z) \leq U_1(z)$ for all $z \leq z'$. This holds if $\frac{d(U_0 - U_1)}{dz} \geq 0$, i.e., if the incentive constraint is relaxed by an increase in z. Substituting agent's effort induced by z, $a_0(z)$ and $a_1(z)$, in (2) and (3), respectively, using the definition of $\tilde{\theta}(a, z)$, $\pi(\tilde{\theta})(a, z) = z$ yields $U_\nu(z)$ for all $\nu \in \{0, 1\}$, i.e.,

$$U_0(z) = \int_{\tilde{\theta}(a_0(z),z)}^{\overline{\theta}} \left[\pi(\theta, a_0(z)) - z\right] g(\theta) d\,\theta - \psi(a_0(z)) \tag{6}$$

and

$$U_1(z) = \int_{\tilde{\theta}(a_1(z),z)}^{\overline{\theta}} \left[\pi(\theta, a_1(z)) - z\right] h(\theta) d\,\theta - \psi(a_1(z)). \tag{7}$$

Applying the envelope theorem to the derivatives $\frac{d\,U_\nu(z)}{d\,z}$, $\frac{d\,(U_0(z)-U_1(z)}{d\,z} \geq 0$ holds if

$$-\int_{\tilde{\theta}(a_0(z))}^{\overline{\theta}} g(\theta) d\,\theta + \int_{\tilde{\theta}(a_1(z))}^{\overline{\theta}} h(\theta) d\,\theta \geq 0 \tag{8}$$

which holds for $G(\tilde{\theta}(a_0(z))) \geq H(\tilde{\theta}(a_1(z)))$. The latter condition always holds when $\tilde{\theta}(a_0(z)) \geq \tilde{\theta}(a_1(z))$ due to First-Order Stochastic Dominance because $G(\tilde{\theta}(a_1(z))) \geq H(\tilde{\theta}(a_1(z)))$ and $G(\tilde{\theta}(a_0(z))) \geq G(\tilde{\theta}(a_1(z)))$ for all $\tilde{\theta}(a_0(z)) \geq \tilde{\theta}(a_1(z))$ implies $G(\tilde{\theta}(a_0(z))) \geq H(\tilde{\theta}(a_1(z)))$. From $\tilde{\theta}_a \leq 0$, $\tilde{\theta}(a_0(z)) \geq \tilde{\theta}(a_1(z))$ follows if $a_1 \geq a_0$.

The next step is to show that $a_1 \geq a_0$ always holds. Applying integration by parts to the definition of $U(z, a)$ in (5) yields

$$U(z,a) = [\pi(\tilde{\theta}(a,z),a) - z](1 - F(\tilde{\theta}(a,z))) + \int_{\tilde{\theta}(a,z)}^{\overline{\theta}} \pi_\theta(\theta,a)(1-F(\theta))d\,\theta - \psi(a_0). \tag{9}$$

Marginal benefit of effort thus reads

$$(z - \pi(\tilde{\theta}(a,z),a))F_\theta(\tilde{\theta})\tilde{\theta}_a(a,z) + \pi_a(\tilde{\theta}(a,z),a)(1 - F(\tilde{\theta}(a,z))) + \int_{\tilde{\theta}(a,z)}^{\overline{\theta}} \pi_{\theta a}(\theta,a)(1 - F(\theta))d\,\theta. \quad (10)$$

The first term in (10) is zero due to Definition 1. Thus, marginal benefit of effort is weakly higher for $\nu = 1$ than for $\nu = 0$ if

$$\pi_a(\tilde{\theta}(a,z))(1 - G(\tilde{\theta}(a,z))) + \int_{\tilde{\theta}(a,z)}^{\overline{\theta}} \pi_{\theta a}(\theta,a)(1 - G(\theta))d\,\theta \leq \pi_a(\tilde{\theta}(a,z))(1 - H(\tilde{\theta}(a,z))) + \int_{\tilde{\theta}(a,z)}^{\overline{\theta}} \pi_{\theta a}(\theta,a)(1 - H(\theta))d\,\theta \quad (11)$$

which reduces to

$$0 \leq \pi_a(\tilde{\theta}(a,z))(G(\tilde{\theta}(a,z)) - H(\tilde{\theta}(a,z))) + \int_{\tilde{\theta}(a,z)}^{\overline{\theta}} \pi_{\theta a}(\theta,a)(G(\theta) - H(\theta))d\,\theta \quad (12)$$

From $\pi_a > 0$ and from first-order stochastic dominance, $G(\theta) \geq H(\theta)$, condition (12) is always satisfied for $\pi_{\theta a} > 0$.

□

A consequence of this result is that higher profit thresholds promote agent's law-abiding behavior. This result seems counterintuitive. As higher profit thresholds are harder to meet, the agent may have an incentive to violate the law in order to receive a bonus. However, such a behavior does not occur in equilibrium.

An increase in the threshold, z, also resembles an increase in the level of debt to be paid to the principal. As shown in Proposition 1, the agent uses an infringement, $\nu = 1$, as a means to increase profits by exerting higher effort levels. This is because the state, θ, is expected to be higher when he violates the law. Thus, the agent is endowed with a more favorable exogenous input factor when the state and effort are complements. As shown by Poblete and Spulber (2012), this is the condition for the critical ratio to be increasing in θ whereby the contract $w = \max\{0, \pi - z\}$ is optimal.

Provided that the principal employs such a debt-style contract when the state and effort are complements, a higher likelihood that the state, θ, is higher increases agent's marginal productivity of effort which leads to higher effort levels. As a consequence, expected remuneration increases when the agent breaks the law, $\nu = 1$. It follows that the decrease in expected remuneration following an increase in the threshold, z, is more severe when the agent breaks the law compared to when he does not. This is because the direct effect of a marginal increase in the level of debt and the following decrease in remuneration is stronger for $\nu = 1$ than for $\nu = 0$. Second-order effects on effort do not occur at the margin. Thus, increasing the threshold decreases agent's utility when breaking the law more strongly relative to when obeying the law such that (expected) sanctions $\rho\phi$ are, at some point, sufficiently high to ensure that the incentive constraint ICV_0 in (4) is satisfied.

Case 2: Capped bonus contracts Suppose the agent's remuneration takes the form of a capped bonus scheme, $w = \min\{\pi, R\}$. Similar to the analysis of threshold-linear contracts, consider a state $\hat{\theta}$ defined as follows.

Definition 2. *The state $\hat{\theta}(a,R)$ is defined as that state for which, given any effort level a, expected profits are exactly equal to the cap R, $\pi(\tilde{\theta},a)=R$, for any cap R. The state $\hat{\theta}(a,R)$ weakly decreases in effort due to the assumption of positive marginal returns of effort, $\pi_a(\theta,a)\geq 0$ for all θ and a, and it weakly increases in R, i.e., $\frac{\partial\hat{\theta}}{\partial a}=\tilde{\theta}_a\leq 0$ and $\frac{\partial\hat{\theta}}{\partial R}=\hat{\theta}_z\geq 0$.*

Due to $\pi(\theta,a)$ being invertible for a given a, $\hat{\theta}$ exists and is unique. Using Definition 2 allows for a straightforward analysis of the impact of an increase in R on the agent's incentive to engage in corporate crime. Agent's utility thus reads

$$U(R,a)=\int_0^{\hat{\theta}(a,R)}\pi(\theta,a)f(\theta)d\theta+\int_{\hat{\theta}(a,R)}^{\overline{\theta}}Rf(\theta)d\theta-\psi(a). \tag{13}$$

Variations in the cap, R, not only influence the agent's effort choice but also his propensity to obey the law. From Proposition 2 it follows that an increase in R weakens the agent's incentive to obey the law if the following condition holds.

$$G(\hat{\theta}(a_0(R),R))\geq H(\hat{\theta}(a_1(R),R)) \tag{14}$$

According to condition (14), if the probability that profits are below the cap is higher when the agent obeys the law increasing the cap will facilitate corporate crime. Contrary to threshold-linear contracts this result does not necessarily occur. This is because the agent exerts higher effort levels when he obeys the law which is stated in Lemma 2.

Proposition 2. *When remuneration takes the form $w=\min\{\pi,R\}$, an* *increase in R tightens the incentive constraint ICV_0 if $G(\hat{\theta}(a_0(R), R)) \geq H(\hat{\theta}(a_1(R), R))$.*

Proof. Proposition 2 holds if there exists an R' such that for all $R \geq R'$, $U_1(R) \geq U_0(R)$ and for all $R \leq R'$, $U_0(R) \geq U_1(R)$. This is true if $\frac{d\,(U_0 - U_1)}{d\,R} \leq 0$. Consider the expected, indirect utility for any effort level $a(R)$ induced by R in (13) as follows.

$$U(R) = \int_0^{\hat{\theta}(a(R),R)} \pi(\theta, a(R)) f(\theta) d\,\theta + R \int_{\hat{\theta}(a(R),R)}^{\overline{\theta}} f(\theta) d\,\theta - \psi(a(R)) \quad (15)$$

Differentiating (15) with respect to R reads

$$\begin{aligned}\frac{d\,U(R)}{d\,R} &= \hat{\theta}_R(a(R), R)(\pi(\hat{\theta}(a(R), R)) - R) f(\hat{\theta}(a(R), R)) \\ &\quad + \hat{\theta}_a(a(R), R)(\pi(\hat{\theta}(a(R), R)) - R) f(\hat{\theta}(a(R), R)) \\ &\quad + a'(R) \left(\int_0^{\hat{\theta}(a(R),R)} \pi_a(\theta, a(R)) f(\theta) d\,\theta - \psi'(a(R)) \right) \\ &\quad + \int_{\hat{\theta}(a(R),R)}^{\overline{\theta}} f(\theta) d\,\theta. \quad (16)\end{aligned}$$

By the envelope theorem and by Definition 2, $\pi(\hat{\theta}(a, R)) = R$ for all a, the first three lines in (16) are equal zero. The derivative $\frac{d\,(U_0(R) - U_1(R))}{d\,R}$ given optimal effort levels $a_0(R)$ and $a_1(R)$ thus reads

$$\int_{\hat{\theta}(a_0(R),R)}^{\overline{\theta}} g(\theta) d\,\theta - \int_{\hat{\theta}(a_1(R),R)}^{\overline{\theta}} h(\theta) d\,\theta. \quad (17)$$

Condition (17) is non-positive if $G(\hat{\theta}(a_0(R),R)) \geq H(\hat{\theta}(a_1(R),R))$. The latter condition is only unambiguously satisfied when $a_1(R) \geq a_0(R)$ due to first-order stochastic dominance, $G(\theta) \geq H(\theta)$, and due to $\hat{\theta}_a < 0$ which follows from $\pi_a > 0$ (see Definition 2).

□

Lemma 2. *For* $w = \min\{\pi, R\}$ *it follows that* $a_0 \geq a_1$.

Proof. Applying integration by parts to (13) while noting that $\pi(\hat{\theta}, a) = R$ by the definition of $\hat{\theta}$ yields

$$U(R,a) = \pi(0,a) + \int_0^{\hat{\theta}(a,R)} \pi_\theta(\theta,a)(1-F(\theta))d\,\theta + R(1-F(\hat{\theta}(a,R))) - \psi(a). \tag{18}$$

From (18) and from the assumption that $\pi_a(0,a) = 0$ marginal benefit of effort can be formulated as

$$\hat{\theta}_a(a,R)\pi_\theta(\hat{\theta},a)(1-F(\hat{\theta})) + \int_0^{\hat{\theta}(a,R)} \pi_{\theta a}(\theta,a)(1-F(\theta))d\,\theta. \tag{19}$$

Given (19) the marginal benefit of effort is higher for $\nu = 0$ than for $\nu = 1$ if

$$\hat{\theta}_a(a,R)\pi_\theta(\hat{\theta},a)(G(\hat{\theta}) - H(\hat{\theta})) \leq \int_0^{\hat{\theta}(a,R)} \pi_{\theta a}(\theta,a)(H(\theta)-G(\theta))d\,\theta. \tag{20}$$

The left-hand term in (20) is non-positive because $\hat{\theta}_a \leq 0$ and $G(\hat{\theta}) \geq H(\hat{\theta})$ by First-Order Stochastic Dominance. The right-hand term in (20) is non-negative when $\pi_{\theta a} < 0$. Hence, marginal benefit of effort is lower for $\nu = 1$

than for $\nu = 0$ from which $a_0 \geq a_1$ follows.

$\square$

The ambiguous effect of an increase in the cap on the agent's propensity to violate the law can be explained as follows. A capped bonus is contract is optimal when effort and the state are substitutes (Poblete and Spulber, 2012). When the principal employs such a contract the agent thus exerts higher effort levels when the state is low and reduces effort for higher states. When the agent violates the law he is inclined to reduce effort because he expects that a higher state is realized compared to law-abiding behavior.

Whether or not an increase in the cap fosters or deters a violation thus depends on the likelihood that the cap is reached. Two effects influence this result. Firstly, a violation of the law increases the state, θ, in expectation which *ceteris paribus* increases expected profits. Secondly, due to the expected increase in θ, the agent reduces effort when he violates the law compared to when he obeys the law. For a given cap R, the reduction in optimal effort may overcompensate the expected increase in θ. Accordingly, the agent's chance to meet the cap decreases. This result is more likely to occur when the effort cost function $\psi(a)$ is steep so that the agent's incentive to save on effort is relatively high. A similar result is indicated by Aubert (2009) who investigates the agent's incentive to save on effort by colluding with a competitor. According to Spagnolo (2005) a lower bonus cap may stabilize collusive agreements by reducing an agent's benefits from deviation. However, according the results shown above, a collusive agreement may become more attractive in the first place with lower bonus caps when the chance to hit the bonus cap is higher for a violation.

Case 3: Linear Contracts Consider now a linear remuneration scheme of the form $w = b\pi$ where $b \in (0, 1)$ is a fraction of profits paid as remuneration to the agent. Agent's utility then reads

$$U(a, b) = \int_0^{\overline{\theta}} b\pi(\theta, a) f(\theta) d\theta - \psi(a). \tag{21}$$

Lemma 3 states that when remuneration is linear the agent exerts higher effort when he violates the law provided that the state and effort are complements. Based on this result, Proposition 3 states that when the fraction of profits paid as bonuses, b, increases the agent's incentive to obey the law is weakened.

Lemma 3. *When $w = b\pi$ and $\pi_{\theta a} > 0$, $a_1 \geq a_0$.*

Proof. Applying integration by parts to (21) one obtains

$$U(a, b) = b\left[\pi(0, a) + \int_0^{\overline{\theta}} \pi_\theta(\theta, a)(1 - F(\theta)) d\theta\right] - \psi(a). \tag{22}$$

Marginal benefit of effort thus reads

$$b \int_0^{\overline{\theta}} \pi_{\theta a}(1 - F(\theta)) d\theta. \tag{23}$$

Based on (23), marginal benefit of effort is higher for $\nu = 1$ than for $\nu = 0$ if

$$\int_0^{\overline{\theta}} \pi_{\theta a}(G(\theta) - H(\theta)) d\theta \geq 0. \tag{24}$$

Due to First-Order Stochastic Dominance, $G(\theta) \geq H(\theta)$. When the state and effort are complements, $\pi_{\theta a} > 0$ and, therefore, $a_1 \geq a_0$. $\square$

When the state and effort are complements, agent's effort is more productive in higher states. The agent can increase the state in expectation by violating the law thereby increasing marginal benefit of effort with linear contracts. Agent's effort will thus be higher when he violates the law for any given share b. The opposite occurs when the state and effort are substitutes. Agent's effort becomes less productive in higher states and, therefore, the agent reduces effort when he expects a higher state to be realized, i.e., when he violates the law.

Proposition 3. *When $\pi_{\theta a} > 0$ an increase in b tightens the incentive constraint $U_0(b) \geq U_1(b)$.*

Proof. Given (22), for any effort $a_\nu(b)$ induced by b expected indirect utility reads

$$U(b) = \pi(0, a(b)) + b \int_0^{\overline{\theta}} \pi_\theta(\theta, a(b))(1 - F(\theta))d\,\theta - \psi(a(b)) \qquad (25)$$

Similar to the proofs of Propositions 1 and 2, an increase in b relaxes the incentive constraint $U_0(b) \geq U_1(b)$ when $\frac{d\,(U_0(b))-(U_1(b))}{d\,b} \geq 0$. Applying the envelope theorem and noting that $\pi_a(0, a) = 0$, the latter condition reduces to

$$\int_0^{\overline{\theta}} \left[\pi_\theta(\theta, a_0(b))(1 - G(\theta)) - \pi_\theta(\theta, a_1(b))(1 - H(\theta))\right] d\,\theta \geq 0 \qquad (26)$$

From Lemma 3, $a_1(b) \geq a_1(b)$ for a given b when $\pi_{\theta a} > 0$. Hence, $\pi_\theta(a_0(b)) \leq \pi_\theta(a_1(b))$ for $\pi_{\theta a} > 0$. From First-Order stochastic dominance, $H(\theta) \leq G(\theta)$. It follows that (26) is non-positive.

$\square$

Suppose effort and the state are complements. As shown in Lemma 3 the agent increases effort when he violates the law because he is endowed with a better production technology in expectation. Ignoring expected fines profits will therefore be higher when the agent violates the law. Thus, when remuneration is linear, an increase in the slope, b, provides higher benefits when the agent is endowed with a more productive technology, or state, i.e., when he violates the law.

The same result occurs when the state and effort are substitutes. The agent's incentive to exert effort decreases in the state and, therefore, the agent reduces effort when he violates the law because he expects that a higher state will be realized. Endowed with a more favorable production technology, an increase in b increases utility more strongly when the agent violates the law compared to when he obeys the law.[6] Although expected profits may be lower when breaking the law, the direct, positive effect on agent's income following an increase in b thus promotes a violation of the law.

4 Extensions

The basic model can be extended in multiple ways. In the following to sections, firstly, the principal's ability to impose sanctions and the changes to the results will discussed. Secondly, it will be examined when the principal

[6]This follows from condition (26) for $\pi_{a\theta} < 0$ whereby $\pi_\theta(a_0(b)) \geq \pi_\theta(a_1(b))$ for all $a_0(b) \geq a_1(b)$ which follows from (24). The first-order effect of an increase b through higher remuneration overcompensates the second-order effect, i.e., the increase in effort is stronger for $\nu = 0$ than for $\nu = 1$.

prefers to obey the law and how the contracts would change when he prefers to induce a violation.

4.1 Sanctions imposed by the principal

With limited liability the principal's ability to sanction the agent is limited to the agent's wealth, or income (Polinsky and Shavell, 1993).[7] In the model, the principal can, at best, recoup all remuneration paid to the agent. Examples of these types of sanctions are mali, clawbacks or deferred remuneration. Such measures are common in financial institutions and also widely used in other industries (Babenko et al., 2015).[8] With such provisions installed, the agent may only earn a certain percentage of his bonus upfront while the rest is deferred and will not be paid if a violation is revealed (malus). Clawbacks are even more drastic: An agent is forced to pay back bonuses he received by the time of the infringement (Angeli and Gitay, 2015).

Technically, let s be sanctions imposed by the principal in case the authority detects the agent's infringement, i.e., with probability ρ. Although there might be a legal maximum for the fraction of remuneration to be recouped, suppose the principal could recoup 100 %. By conditioning the penalty on the external detection of the agent's infringement, the principal would thus always prefer to impose the maximum possible sanction because this provides the maximum level of deterrence. Sanctions s only weaken the agent's incentive to break the law by decreasing his utility $U_1(w, a, s)$ as depicted

[7] Dismissal captured in fixed fine

[8] For instance, the *New York Times* states that that nearly 73 % of *Fortune* 100 firms used clawback provisions in 2009 (The New York Times, April 3, 2010. URL: https://goo.gl/Rc0i60, last accessed July 16, 2017).

in (27). The principal's objective or the agent's participation and incentive constraint are the same as in (1). Sanctions s thus take the value $w(\theta, a)$ with probability ρ and are zero otherwise.

Given sanctions s and taking into account individual penalties imposed by the authority, $\rho\phi$, agent's utility from violating the law, $\nu = 1$, reads

$$U_1(w, a, s) = (1-\rho)\int_0^{\overline{\theta}} w(\pi(\theta, a))h(\theta)d\,\theta - \psi(a) - \rho\phi. \tag{27}$$

Anticipating to loose all remuneration in case of detection, agent's marginal benefit of effort when violating the law decreases in ρ. To see this, note that

$$\frac{\partial^2 U_1}{\partial\rho\,\partial a} = -\int_0^{\overline{\theta}} w'(\pi(\theta, a))\pi_a(\theta, a)h(\theta)d\,\theta \tag{28}$$

is negative. Agent's effort and payoffs therefore decrease due to sanctions s. However, violating the law still provides a higher state, θ, in expectation which increases effort as well as expected utility. By imposing individual sanctions the principal can weaken but not completely eliminate the agent's incentive to break the law. Whether these sanctions are sufficient to deter an infringement crucially depends on the profitability of the latter.

One potential drawback of individual penalties imposed by firms such as clawbacks are false convictions. When the principal sanctions an innocent manager with a certain probability, also U_0 would decrease. Similar to the case of a violation the agent would anticipate such wrongly imposed sanctions and decrease effort. This would lead to a similar situation as described in Paha (2017) where firms refrain from taking welfare enhancing measures due to uncertainty about antitrust law.

4.2 The principal prefers to induce a violation

Throughout the paper it was assumed that the agent prefers to obey the law. However, this does not have to be the case. For example, Alexander and Cohen (1999) describe that crime may be a good 'investment' for a firm's shareholders if fines are low. While sanctions constitute the costs of that investment, the gains depend, firstly, on the distribution H relative to G and, secondly, on agent's effort when he breaks the law. In order to determine the principal's incentive to induce a violation, $\nu = 1$, the following program has to be analyzed.

$$
\begin{aligned}
&\max_{\{a,w\}} && V_1 = \int_0^{\bar{\theta}} (\pi(\theta,a) - w(\pi(\theta,a)))h(\theta)d\,\theta - \rho\Phi \\
&\text{subject to} && U_1 = \int_0^{\bar{\theta}} w(\pi(\theta,a))h(\theta)d\,\theta - \psi(a) - \rho\phi \geq 0 \\
&\text{and} && U_1(a_1) \geq U_0(a_0) \qquad (29) \\
&\text{and} && a_0 \in \arg\max \int_0^{\bar{\theta}} w(\pi(\theta,a))g(\theta)d\,\theta - \psi(a) \\
&\text{and} && a_1 \in \arg\max \int_0^{\bar{\theta}} w(\pi(\theta,a))h(\theta)d\,\theta - \psi(a) - \rho\phi
\end{aligned}
$$

In (29), the first constraint ensures the agent's participation while the second constraint corresponds to ICV_0 in (4) whereas here the goal is to induce a violation. The last two constraint ensure that the agent chooses effort optimally given the contract w. The analysis of (29) is qualitatively similar to the analysis of the case for $\nu = 0$. Thus, the results established in the last chapters apply here as well, however, with reversed signs. According to Propositions 1 and 2, when effort and the state are complements (substitutes) and a threshold-linear (capped bonus) contract is installed the agent's incentive to break the law decreases in the threshold (increases in the cap).

High penalties imposed on the agent by an authority, $\rho\phi$, make a violation less attractive to the principal for two reasons. Firstly, similar to arguments made by Angelucci and Han (2015), the principal has to leave rent to the agent in order to compensate for the (expected) sanctions. Remuneration thus has to increase which can be achieved by decreasing the threshold, increasing the cap or by increasing the fraction of profits paid as bonuses. Secondly, due to the deviation from optimal effort levels, sanctions decrease internal efficiency and, therefore, expected profits from a violation. To see why, suppose w_1^* induces first-best effort $a_1(w_1^*)$. When sanctions are too high, the third constraint in (29) may be violated, i.e., $U_1(a_1(w_1^*)) \leq U_0(a_0(w_1^*))$ for a given level of sanctions $\rho\phi$. In this case $a_1(w_1^*)$ is no feasible solution to (29). The contract w_1^* has to be adjusted such that $U_1(a_1(w)) \geq U_0(a_0(w))$ is satisfied. Accordingly, when sanctions $\rho\phi$ are high the first-best solution will not be attainable.

5 Conclusion

The goal of this paper was to analyze how incentive pay shapes an agent's incentive to engage in illegal activity. Moreover, it was addressed how different contracts can be adjusted to confine the agent's incentive to break the law. An increase in remuneration is observable when, for instance, the agent's effort and the random state are complements and a threshold-linear or purely linear contract is installed. By breaking the law the agent can increase his marginal product of effort and, thereby, expected remuneration.

What is remarkably in this case is that law abiding behavior is promoted for higher levels of debt, i.e., by decreasing agent's expected remuneration.

This paper adds another facet to the debate on whom sanctions should be imposed on: the firm or the individual.[9] It is shown that imposing sanctions on the involved managers makes the infringement not only less attractive for the manager but also for the firm as a whole. To compensate for severe individual sanctions the manager has to receive additional rents as, for instance, in Angelucci and Han (2015). Without direct transfers, adjustments of the contract are necessary. Thereby, first-best effort levels may not be obtained and the infringement becomes less profitable.

[9] See, for instance, the memorandum of Sally Quillian Yates for the U.S. Department of Justice from 2015 on Individual Accountability for Corporate Wrongdoing, URL: https://www.justice.gov/archives/dag/file/769036/download; last accessed on October 26, 2017.

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