Rewarding Whistle-Blowers: Implications to Deterrence and to Principal-Agent Contracts

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Abstract

Rewarding whistle-blowers can improve deterrence on corporate misconduct, but it can also distorts employees' attention from production towards activities related to gathering crime evidence. In this paper, I develop a model that shows the implications of rewarding whistle-blowers to deterrence and to optimal contracts among non-offenders (the firm owner and a non-offender employee). Considering positive (negative) principal's net externalities from crime and the size of rewards, I show how rewarding whistle-blowers can improve deterrence at the expense of compromising productive efficiency, and even at the risk of no production.

1 Introduction

Rewards on whistle-blowing legislation put a serious challenge to the economic theory of enforcement. While they can improve deterrence on corporate misconduct, they can also create a non desired "hunt bounty" environment inside corporations that may create productive inefficiencies by distorting employees' attention from production towards activities related to gathering evidence on corporate misconduct. Indeed, with employees' efforts devoted to production and to gathering crime evidence technologically substitutable, rewards create a decision problem to employees on how to allocate effort among production and gathering evidence activities. In addition, the natural secrecy of the latter activities creates a problem also to employers, who are incapable to govern over their employees' decisions on private actions. In this paper I develop a model that captures the implications that rewarding whistle-blowers brings to deterrence and to optimal contracts among non-offenders.

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Whistle-blower is any individual, or two or more individuals acting jointly, who provides credible information relating to corporate misconduct to the pertinent authorities.[1] A whistle-blower does not perceive any gain/loss from the misconduct, neither is responsible for its avoidance.[2]

The act of whistle-blowing is not meant to cause harm to the organization, rather, it is to facilitate the exposure of committed or probably committing questionable acts by an employee, or a group of employees, that may harm the interest of the organization and/or social wealth.[3] Nevertheless, for years whistle-blowers have been seen as traitors, or disloyal employees who act against the interests of their employers in order to achieve a personal gain.[4]

Among the consequences for blowing the whistle there are included distancing and retaliation from fellow workers and friends, personal attacks on one's character during the course of a protracted dispute, and even dismissal. Hence, to encourage whistle-blowing, most whistle-blower programs offers protection against retaliation to employees who report some corporate misconduct. In addition, USA legislation also includes rewards for blowing the whistle (False Claim Act, 1986; IRS Whistle-blower Reward Program, 2006; and Dodd-Frank Act, 2010).[5] By sharpening the incentives of those who are endowed with information, USA whistle-blowing legislation conceives rewards as a powerful tool to induce employees to became whistle-blowers.

To firms, rewards on whistle-blowing are more than an instrument to deter crime, in the sense that a successful reward program can create a non desired hunt bounty environment inside corporations. With the conviction that rewards may create a decision problem to employees on how to allocate effort among production and gathering evidence on corporate crime, I develop a model that captures the implications of rewarding whistle-blowers to deterrence and to optimal contracts among non-offenders.

In the model there is a principal who owns a firm in which possibly it is the happening of some corporate misconduct. Besides, there are two employees: A

[1] The term whistle-blowing originated from the practice of English policemen who blew their whistle when they observed the happening of some crime. The blowing of whistle alerted other law enforcement officers and the general public that a crime was being committed.

[2] Corporate-misconduct reports from individuals who belong to anti-crime government divisions and/or audit organizations do not apply as whistle-blowing reports.

[3] With 'questionable acts', the whistle-blowing legislation refers to illegal and/or considered immoral or illegitimate acts to the perception of the society.

[4] Most of the time, the media promotes whistle-blowers as heroes who are attempting to protect the interests of the members of the society against the wrongdoings committed by their organizations. For instance, Sherron Watkins (Enron's ex-vice president), Coleen Rowley (FBI agent) and Cynthia Cooper (WorldCom employee) were considered persons of the year by the Time magazine in 2002 for blowing the whistle on misconducts in their organizations.
http://www.time.com/time/magazine/article/0,9171,1003998-1,00.html

[5] More information on USA legislation on rewards on whistle-blowing programs in
http://www.justice.gov/
http://www.gpo.gov/fdsys/pkg/PLAW-111publ203/pdf/PLAW-111publ203.pdf
http://www.irs.gov/compliance/article/0,,id=180171,00.html

manager who can get personal gains from committing corporate crime, and a low-range employee (the agent) who is hired to improve profits from production. Besides, the agent can gather evidence of corporate crime to report it to the anti-crime authorities in exchange of a reward. Crime, production and gathering crime evidence require of costly effort. Considering that (i) only effort devoted to production is observable, and (ii) the probability of crime detection depends on efforts devoted to crime and to gathering crime evidence; the employees simultaneously choose how much effort devote to crime (the manager) and to production and gathering crime evidence (the agent). Then, taking into count the solution of this simultaneous game, the principal designs a contract for productive effort.

In this set-up, I show how while rewards can improve deterrence, they also distort the principal-agent contract among the non-offenders. This distortion depends on whether crime creates positive or negative externalities to the principal and on the size of rewards, and it manifests as overpayment or underpayment for productive effort with respect to the efficiency payment.

After a brief section of related literature, I introduce the model in section 3. In sections 4 and 5 I solve the model for the no-reward case (section 4) and for the case with rewards (section 5). I conclude in section 6.

2 Related Literature

In the absence of rewards, the literature conceives whistle-blowers as individuals with a deep sense of social responsibility and altruistic concerns and/or that demand public approval. Only these personal characteristics make the exposure of corporate wrongdoings possible at high retaliation costs. Besides, some studies do also focus on other individual and situational aspects also contributing to become indifferent employees into whistle-blowers, as hierarchical position at the organization, tenure, leadership, sex and type of wrongdoing.[6]

Rewards on whistle-blowing legislation opens the door for a new conceive for whistle-blowers. With rewards, whistle-blowers can also be conceived as *homo economicus* individuals, rational and narrowly self-interested, who decide on whether to whistle the blowing according to an expected reward.

With the same spirit, anti-crime divisions of many countries created leniency programs. These programs reduce sanctions against the offender of an on-going crime that reports information of the crime to the anti-crime authority and cooperates with it along the prosecution phase.[7] Leniency programs are par-

[6] Miceli and Near, 1988; Dworkin and Near, 1997; Miceli *et al.*, 2001; Miceli, 2004; Rehg *et al.*, 2008; among others

[7] The USA have a long history in leniency programs, followed by the European Union. But, it is not until 1993, for USA, and 2002, for the European Union, that these programs got

ticularly known for their success in prosecuting cartels, but the scope of their application applies to an extensive number of crimes.

In this regard, recent literature has proven constructive in shedding light crucial to this work. In particular, I want to make emphasis on three of them, Aubert, Kovacic & Rey (2006); Chen (2008) and Aubert (2007).[8]

Aubert, Kovacic & Rey (2006) analyses the impact that leniency and whistle-blowers programs have on collusion sustainability and cartel firms' efficiency. Arguing that rewards and full amnesties create bribes to informed employees and lead firms to lengthen the tenure of their informed employees (holding the obsolescence of their skills) to avoid possible denunciations, higher deterrence is reached at the expense of firm inefficiencies. With respect to uninformed employees, it argues that rewards increase cartel firm's interest in showing a competitive image to avoid raising suspicions inside the firm, and so it contributes to firm's efficiency. In this case, higher deterrence is reached at the benefit of efficiency. For the analysis, Aubert *et al.* consider how above described effects affect cartel's sustainability condition.[9] My working framework differs from it by seeking into the firm's 'black box' to analyze the effects that rewards have on optimal contracts among non-offenders. This brings into light scenarios for which there are neither deterrence improvement, nor efficiency gains from rewards.

Chen (2008) characterizes the effectiveness of leniency programs in deterrence for centralized and decentralized cartel hierarchical organizations. The paper shows how delegating decision rights on collusive activities to subordinates can mitigate the temptation of renege on collusive relationships, and thus it contributes to sustain collusion. Even though being whistle-blowing programs (not leniency programs) the focus of my paper, I am closer to Chen (2008) in the sense that the firm's 'black box' is opened to analyze the intra-firm implications of the policy. Nevertheless, instead of analyzing these implications from the perspective of centralized vis-a-vis decentralized organizations, I concentrate my attention to the efficiency effects that rewards bring to optimal contract among non offenders.

Aubert (2007) investigates the interactions between leniency programs and the incentives of managers to collude, but also to exert productive effort. Managers choose both firm's competitive strategy and own effort to maximize profits. As both collusion and effort increase profits, a manager may substitute collusion to effort. Under private information on efforts, this creates a potentially strong conflict of interest between the manager and shareholders: Incentives to

success, in the sense that an unprecedented number of application that end in crime detection appeared.

[8] Other papers on how leniency programs work are Motta & Polo (2003); Spagnolo (2006); Chen & Rey (2007); Buccirossi & Spagnolo (2007); Spagnolo (2008); Harrington (2008).

[9] Collusion is sustainable as long as firms have no incentives to deviate, ie., when current gains from deviation are no greater than future profits from collusion.

induce competition may conflict with incentives to undertake a high effort level. In this set-up, individual leniency programs appear as effective when one only considers shareholders interested in collusion. But, if shareholders want to induce competition, individual leniency will tend to increase their costs – thereby making it more likely that shareholders will decide in favor of cartel practices. These effects are mitigated under corporate leniency programs. With the same spirit, I deal with employee's new strategies born from an anti-crime policy, and their impact to deterrence. But the use of whistle-blower programs, instead of leniency programs, allows me to consider policy inefficiencies to contractual relationships among non-offenders besides deterrence. What implications bring reward policies to efficient relationships among non-offenders? And to the offender's behavior with respect to crime?

3 The Model

In the model, there is a firm that operates in a competitive market. At the top of the firm there is a principal (the owner of the firm), and after him there is a manager. The manager can commit corporate crime to obtain private profits, but to do it he has to devote costly effort. Effort devoted to crime is non-observable but it creates evidence possible to find. If found, crime evidence entails corporate and individual liability. Besides, to the firm (and so to the principal), crime may also imply a direct payoff (positive/negative).

For illustrative purposes, consider a construction company for public goods (e.g. a bridge construction or a highway expansion), in which the manager gets a bonus for each contract he wins. With some effort and firm's resources, the manager can bribe government employees (which is a corporate crime) and win a contract. To the manager, the bribery implies a new contract that leads him a bonus, but it also implies costly effort and individual liability. To the principal, the bribery implies an externality in terms of a new business net of the bribe, the bonus, and corporate liability.

From now on, I will identify the manager as the 'offender'.

The anti-crime authority have two instruments to battle crime: Inspections and a whistle-blower program. Inspections are regularly done and, given crime, they end up in crime detection with probability $\rho \in [0, 1]$. The whistle-blower program rewards employees who present evidence of the happening of a corporate crime. The program is conditioned to whistle-blowers not being involved in the crime and rewards only in case of a failure of the official inspector in detecting crime.[10] In the case in which crime evidence is found, the firm and the offender pay corporate and individual monetary fines respectively.

[10]These assumptions are in concordance to the USA legislation on whistle-blowing.

In this context, at date 0 the principal can hire an agent in a competitive market for agents. The main task of the agent is to improve firm's profits through innovation, e.g., introduction of new production technologies, switch to new suppliers for inputs, etc. Agent's job position does not allow him to participate in a managerial crime, neither to get any direct payoff from it, but it allows him to find crime evidence if he looks for it. Both productive and gathering evidence activities, require costly effort. Effort devoted to production is observable, but effort devoted to gathering evidence is not.

This is modeled as follows: I define $z, e_1, e_2 \in [0,1]$, efforts devoted to crime to production and to gathering crime evidence, respectively. Effort disutility functions are given by $C(z) = \frac{z^2}{2}$ and $C(e_1, e_2) = \frac{(e_1+e_2)^2}{2}$.

I identify the probability of crime existence with z, such that the higher the offender's effort devoted to crime, the higher the probability of crime existence. Besides, given crime, I identify the probability of the agent finding hard evidence for condemnation e_2: The higher the agent's effort devoted to gathering evidence, the higher the probability of finding it.

For the contract over e_1, I consider a linear payment scheme $w = \alpha + \beta e_1$, where $\alpha \in \Re$ and $\beta \geq 0$.

To the principal, production entails profits $\pi(e_1) = ye_1 - (\alpha + \beta e_1)$, being $y > 0$, and crime entails a direct payoff $G \in \Re$ and an expected fine.

Finally, I assume that in the absence of a contract, the agent has utility zero and the principal runs his business only with the manager.

At date 1, the agent and the offender simultaneously decide on effort levels, and at date 2 production, crime and gathering crime evidence activities are executed. At the end of this period an inspector visits the firm looking for crime evidence. The inspection ends with a report that states evidence on the occurrence of a crime or that rejects its occurrence. At this time, if the agent has founded evidence, he also presents a report with the evidence he has to the anti-crime authorities.

At date 3 reports are analyzed, giving priority to the official report. Priority implies that the agent's report is considered only if the official report rejected crime. If the inspector or the agent reports evidence on the occurrence of a crime, the firm and the offender are condemned to pay corporate and individual fines, respectively. The agent gets a reward only if he is the only one that reports crime evidence.

In this set-up, the agent's utility function is:

$$U(e_1, e_2) = \alpha + \beta e_1 - \frac{(e_1 + e_2)^2}{2} + (1 - \rho)\ z\ e_2\ R$$

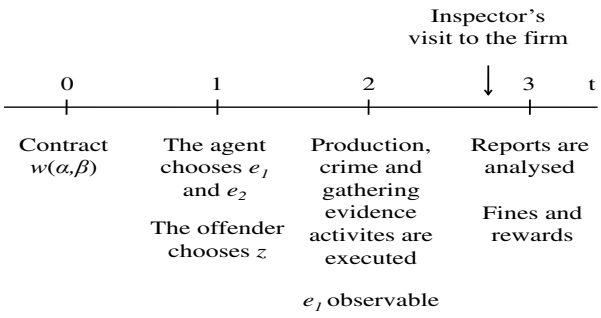

Figure 1: Time-structure of the model

where R is the reward, $R \in [\underline{R}, F]$. I denote with F the corporate fine.[11] The first two terms in the RHS are the agent's utility from effort devoted to production, the following two terms are the agent's disutility from effort, and the last term is the agent's utility from effort devoted to gathering crime evidence.

The offender's utility function is:

$$O(z) = z \ \{ \ g - [\ \rho + (1-\rho)\, e_2] \ \ f \ \} \ - \ \frac{z^2}{2}$$

where g are the offender's private profits from crime and f the individual fine. The first term in the RHS is the offender's expected utility from crime, and the second term is the offender's disutility from effort devoted to crime.

For expository reasons, along the paper I will set $g = f = 1$, and so the offender's utility function yields:

$$O(z) = z \ \{ \ 1 - [\ \rho + (1-\rho)\, e_2 \ ] \ \} \ - \ \frac{z^2}{2}$$

This simplification is not relevant for any of the results of the paper.

Finally, the principal's utility function is

$$V(\alpha, \beta) = ye_1 - (\alpha + \beta e_1) + z \ \{ \ G - [\rho + (1-\rho)\, e_2] \ \ F \ \}$$

The first two terms in the RHS are the principal's utility from production, and the last term is the externality that the efforts devoted to crime and to gathering crime evidence create to him. In other words, this last term represents the net utility that the principal gets in the presence of crime when there are rewards on whistle-blowing.

[11] The lower-bound for R can be interpreted as an attempt to reduce the discretion of the 'prize' for the whistle-blow, and so to induce whistle-blowing. The upper-bound $R = F$ guaranties the sustainability of the program.

4 A Model Without Rewards on Whistle-Blowing

As a benchmark case assume no rewards on whistle-blowing legislation. In the absence of rewards the agent has no incentives to make costly effort to gathering crime evidence and so, if there is crime, the probability of crime detection is ρ.

By backward induction, at date 1, the offender chooses the level of z that maximizes his utility for $e_2 = 0$:

$$\max_{z} \; O(z) = z\,(1-\rho) - \frac{z^2}{2}$$

And the agent choses the level of e_1 that maximizes his utility for $e_2 = 0$:

$$\max_{e_1} \; U(e_1) = \alpha + \beta e_1 - \frac{e_1^2}{2}$$

Lemma 1 *Without rewards on whistle-blowing, effort devoted to crime is* $z^B = 1-\rho$*, and effort devoted to production is* $e_1^B = \min\{\beta, 1\}$.

The supra-index B means *Benchmarck case*.

In the absence of rewards, effort choices are independent one to each other, in the sense that neither the agent, nor the offender take into account the other's effort to choose own effort. Hence, both the agent and the offender, make the effort level that equals their marginal utility and marginal disutility from effort devoted to production and crime, respectively.

At date 0, the principal chooses a contract (α, β) that maximizes his utility and is incentive compatible to the agent and acceptable to both:

$$\max_{\alpha,\beta} \; V(\alpha,\beta) = y e_1 - (\alpha + \beta e_1) + z\,(G - \rho\, F)$$

$$s.t. \quad e_1 \in arg\max_{e_1'} \left\{ \alpha + \beta e_1' - \frac{e_1'^2}{2} \right\} \tag{IC}$$

$$\alpha + \beta e_1 - \frac{e_1^2}{2} \geq 0 \tag{PCa}$$

$$y e_1 - (\alpha + \beta e_1) + z\,(G - \rho\, F) \geq z\,(G - \rho\, F) \tag{PCp}$$

Where the IC is the agent's incentive compatibility constraint, and the PCa and the PCp the agent and the principal's participation constraints respectively. Note that the principal's disutility from crime, $z\,(G - \rho\, F)$, appears in both sides of the PCp, so that for the PCp it only matters whether the principal's utility from production is non-negative. Indeed, remember that in the absence

of contract the principal runs business with the manager, and so his outside option is given by his expected disutility from crime. And, as for $e_2 = 0$ the principal's disutility from crime is not affected by the contractual relationship for e_1, then for the PCp, it only matters the principal's utility from production.

Proposition 1 *Without rewards on whistle-blowing, the optimal contract is* $\left(\alpha^B, \beta^B\right) = \left(-\frac{y^2}{2} \ , \ y \right)$ *for* $y \leq 1$, *and* $\left(\alpha^B, \beta^B\right) = \left(-\frac{1}{2} \ , \ 1 \right)$ *for* $y > 1$. *In both cases the principal gets all agent's surplus.*

Corollary 1 *Without rewards on whistle-blowing, at the optimal contract the agent exerts effort* $e_1^B = \min\{y, 1\}$.

Without rewards on whistle-blowing, there is an efficient contract in which the agent makes the effort level that equals his marginal utility and marginal disutility from effort, and the principal pays effort according to its marginal productivity. Besides, the optimal contract does not depend on the particular value of z; i.e., the contract (α^B, β^B) is the same regardless of the offender's effort devoted to crime.

5 Rewarding Whistle-Blowers

Given crime, rewards on whistle-blowing creates incentives to the agent to devote costly effort to gathering crime evidence. But, this effort devoted to gathering crime evidence implies a higher probability of detection to the offender that, in turns, reduces his willingness to commit crime. In this scenario, efforts devoted to commit crime and to gathering crime evidence are dependent one of the other.

To the principal, rewards on whistle-blowing imply a change in utility through changes in his expected cost from crime and in the optimal contract. The former change arises from a (now) endogenous probability of condemnation depending on the agent's effort devoted to gathering evidence. The latter change arises from the efforts' technical substitutability: Given rewards the agent may wish to substitute effort from production to gathering crime evidence.

In what follows I get the optimal contract by backward induction. First, I present how the agent and the offender simultaneous make effort decisions. And then, given these effort decisions, I solve the principal-agent problem (i.e., I get the optimal contract for e_1).

5.1 The Agent and Offender's Simultaneous Effort Choices

At date 1, the offender chooses the level of z that maximizes his utility taking e_2 as given:

$$\max_{z} \; O(z) = z\left\{1 - \left[\rho + (1-\rho)\, e_2\right]\right\} - \frac{z^2}{2} \tag{1}$$

And the agent choses the levels of e_1 and e_2 that maximizes his utility taking z as given:

$$\max_{e_1, e_2} \; U(e_1, e_2) = \alpha + \beta e_1 - \frac{(e_1 + e_2)^2}{2} + (1-\rho)\; z\; e_2\; R \tag{2}$$

Taking the derivatives of equation (1) with respect to z and of equation (2) with respect to e_1 and e_2, equating them to zero, and solving for optimal efforts, there is the interior solution:

$$e_2^* = \beta - e_1^* = \frac{(1-\rho)^2 R - \beta}{(1-\rho)^2 R} \tag{3}$$

$$z^* = (1-\rho)\,(1 - e_2^*) = \frac{\beta}{(1-\rho)\, R} \tag{4}$$

Assuming $\underline{R} = \frac{1}{(1-\rho)^2}$, equation (3) holds for $\beta \in [\ \beta_0\ ,\ \beta_1\ ]$. Where β_0 and β_1 are the values of β for which $e_1 = 0$ and $e_1 = 1$ respectively, being $\beta_0 \in [0, 1)$, $\beta_1 \geq 0$ and $\frac{\partial \beta_0}{\partial R}, \frac{\partial \beta_1}{\partial R} \geq 0$.[12]

Equation (3) shows the agent's effort allocation in terms of e_1 and e_2's marginal contributions to agent's utility. Each effort is positively related to its own marginal contribution and negatively related to rival's one. In terms of β, this implies that the agent substitutes e_2 for e_1 as β goes up (and vice verse). Besides, total effort is positively related to β ($e_1^* + e_2^* = \beta$), so that there is an *effort-creation* process as β goes up.

Equation (4) shows the offender's effort devoted to crime. To understand how z behaves with respect to β, we have to bear in mind how the agent distorts his effort allocation with changes in β: The higher the β, the lower the agent's effort devoted to gathering crime evidence and so the lower the probability of condemnation for a whistle-blowing, hence the higher the z.

[12] For the general case, equation (3) holds for $\beta \in [\ \beta_0\ ,\ \min\{\beta_1, \beta_2\}\ ]$. Where β_0, β_1 and β_2 are the values of β for which $e_1 = 0$, $e_1 = 1$ and $e_2 = 0$, respectively:

$$\beta_0 = \frac{(1-\rho)^2 R}{1 + (1-\rho)^2 R} < 1 \qquad \beta_2 = (1-\rho)^2 R \qquad \beta_1 = 2\beta_0$$

Whether β_1 is higher(lower) than β_2 depends on the policy instruments R and ρ: For $R < \frac{1}{(1-\rho)^2}$, $\beta_1 > \beta_2$; otherwise, $\beta_1 < \beta_2$. For expository reasons, I assume $\underline{R} = \frac{1}{(1-\rho)^2}$, such that the relevant interval for β is $[\beta_0, \beta_1]$.

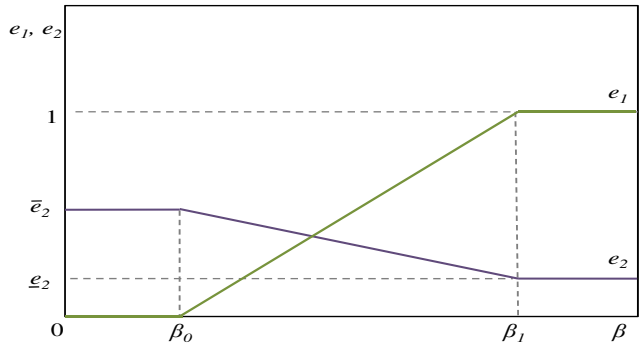

Figure 2: Agent's efforts devoted to production (green) and to gathering crime evidence (violet).

Proposition 2 *With rewards on whistle-blowing, there exist* $\beta_0 < \beta_1$*, such that for* $\beta \in [\beta_0, \beta_1]$*,* $e_1, e_2, z \in [0,1]$*, with* e_1 *and* z *increasing in* β *and* e_2 *decreasing in* β*. For* $\beta < \beta_0$*,* $(\underline{e}_1, \overline{e}_2) = (0\ ,\ \beta_0)$ *and* $\underline{z} = (1-\rho)(1-\beta_0)$*; and for* $\beta > \beta_1$*,* $(\overline{e}_1, \underline{e}_2) = (1\ ,\ \beta_1 - 1)$ *and* $\overline{z} = (1-\rho)(2-\beta_1)$*.*

Over-lines and under-lines show maximum and minimum values, respectively.

Given $\frac{\partial \beta_0}{\partial R},\ \frac{\partial \beta_1}{\partial R} \geq 0$, from proposition 1 yields:

Corollary 2 *With rewards on whistle-blowing, there exist* $\beta_0 < \beta_1$*, such that for* $\beta \notin [\beta_0, \beta_1]$*, the higher the level of* R*, the higher the levels of* $\overline{e}_2$ *and* $\underline{e}_2$*, and the lower the levels of* $\overline{z}$ *and* $\underline{z}$*.*

For $\beta < \beta_0$, e_2's marginal contribution to agent's utility is higher than e_1's marginal contribution, and the agent only wishes to gather crime evidence. In this case, the offender minimizes effort to commit crime, and deterrence is maximized (z takes its minimum value). For $\beta \in [\beta_0, \beta_1]$ the agent allocates effort among production and gathering crime evidence. The higher the value of β, the more biased is agent's effort allocation towards production, and so the lower the deterrence improvement from rewards (z goes up). Finally, for $\beta > \beta_1$, the agent allocates all his effort e_1 to production, effort e_2 freezes at $e_2(\beta_1)$, and deterrence takes its minimum value. (Figures 2 and 3)

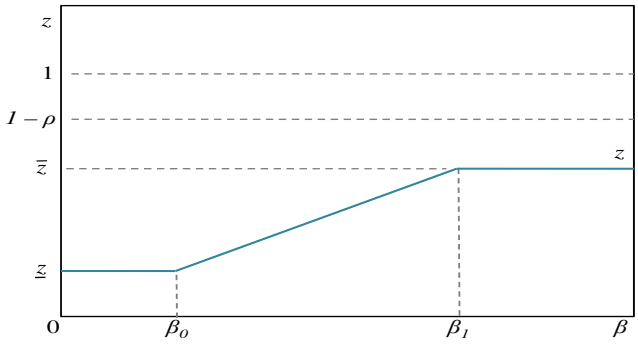

Figure 3: Offender's effort devoted to crime.

5.2 The Principal-Agent Problem

At date 0, the principal chooses a contract (α, β) that maximizes his utility and is incentive compatible to the agent and acceptable to both:

$$\max_{\alpha,\beta} \; V(\alpha,\beta) = ye_1 - (\alpha + \beta e_1) + z \; \{ \; G - [\rho + (1-\rho)\, e_2] \;\; F \; \}$$

$$s.t: \quad (e_1, e_2) \in arg \max_{e_1^{'}, e_2^{'}} \left\{ \alpha + \beta e_1^{'} - \frac{\left(e_1^{'} + e_2^{'}\right)^2}{2} + (1-\rho)\, z e_2^{'} R \right\} \tag{IC}$$

$$z = (1-\rho)\,(1-e_2) \tag{CC}$$

$$\alpha + \beta e_1 - \frac{(e_1 + e_2)^2}{2} + (1-\rho)\, z e_2 R \geq 0 \tag{PCa}$$

$$ye_1 - (\alpha + \beta e_1) + z \; \{ \; G - [\rho + (1-\rho)\, e_2] \;\; F \; \} \geq (1-\rho)\,(\; G - \rho F \;) \tag{PCp}$$

Where the CC is the offender's effort reaction curve with respect to the agent's effort devoted to gathering crime evidence ('crime constraint').

In what follows I solve the principal-agent problem for the optimal effort choices obtained in section 5.1. To do it, first, I solve the optimal contract for a 'semi-constrained' problem with out the PCp. Then, I check whether the PCp holds at this optimal contract.

Plugging equations (3), (4) and the PCa binding into the principal's objective function, and solving for β:

$$\beta^* = \varphi \; \left\{ \; y + k \; \left[\; (1-\rho)\,(G-F) + (1-\rho)^2\, R \; \right] \; \right\} \tag{5}$$

where $k = -\frac{\partial e_2}{\partial \beta} / \frac{\partial e_1}{\partial \beta} = \frac{1}{1+(1-\rho)^2 R}$, and φ is a positive multiplier with $\frac{\partial \varphi}{\partial R} < 0$ and $\lim_{R \to \infty} \varphi = 1$.

Equation (5) shows agent's marginal payment for e_1 given by both effort's marginal contributions to principal's utility. In braces, the first term is e_1's marginal contribution to production (y). The higher e_1's marginal contribution to production the more interested is the principal in e_1, and so the higher the β he is willing to pay for it.

The second term in braces is e_2's marginal contribution to principal's utility given by G, F and R; it can be positive or negative. Inside brackets: The higher the payoff G, the higher is the principal's benefit from crime, and so the higher the β he is willing to pay to reduce e_2. The higher the corporate fine F, the lower is the principal's benefit from crime, and so the lower the β he is willing to pay to increase e_2. Finally, the higher the reward R, the higher the level of e_2 the agent is willing to make, and so also the higher the probability of detection (and paying F), hence the higher the β the principal is willing to pay to reduce e_2. Outside brackets it is the coefficient k, measuring principal's capability to distort agent's effort allocation with β.

Equation (5) is an interior solution for $\beta^* \in [\beta_0, \beta_1]$. In terms of R:

Lemma 2 *There exists $R_0 < R_1$, such that: For $R < R_0 \Leftrightarrow \beta^* > \beta_1$, and for $R > R_1 \Leftrightarrow \beta^* < \beta_0$; so that β^* holds for $R \in [R_0, R_1]$.*

Lemma 4 characterizes β^* in terms of R and G:

Lemma 3 *There exists $\tilde{G} \in \Re$ such that for $G > \tilde{G}$ effort devoted to production is overpaid with respect to the benchmark case ($\beta^* > y$), and a reward increase reduces β^*. Otherwise, effort devoted to production is underpaid with respect to the benchmark case ($\beta^* < y$), and a reward increase makes β^* to go up. For both cases, $\lim_{R \to \infty} \beta^* = y$.*

The intuition behinds β^*'s behavior with respect to R is the following: Consider a reward increase: As R goes up, the principal wants to increase β to bias agent's effort allocation towards production (the term in brackets in (5) goes up). But, at the same time he loses capability to govern over agent's effort allocation through β^* (k goes down). This second effect dominates and so e_1's marginal contribution to production (y) wins weight in determining β^*. Hence, if before the reward increase, effort e_1 was being overpaid ($\beta^* > y$), the reward increase makes this payment to go down, and vice verse. The same intuition holds for a reward reduction.

For $R \notin [R_0, R_1]$, there is no optimal contract profitable to both principal and agent with β^* and $e_1, e_2 \in (0, 1)$. Nevertheless, both parties can still find profitable to celebrate a contract with $(\underline{e}_1, \overline{e}_2) = (0\ ,\ \beta_0)$, or $(\overline{e}_1, \underline{e}_2) = (1\ ,\ \beta_1 - 1)$.

In the former case, $R > R_1$ and the principal hires the agent only to gather crime evidence. As $\underline{e}_2$ does not depend on the particular value that β takes on the interval $[0, \beta_1)$, we can set $\beta = 0$. Hence, in terms of the principal-agent problem described above, the principal looks for the value of α that solves the problem for $e_1 = \beta = 0$, let's call this value α_1.

For the former case, $R < R_0$ and the principal hires the agent to make productive activities, regardless of the agent's activities to gather crime evidence. As $\overline{e}_2$ does not depend on the particular value that β takes beyond β_1, the principal looks for the value of α that solves the principal-agent problem for $e_1 = 1$ and $\beta = \beta_1$; let's call this value α_0

Finally, it is time to consider the principal's participation constraint:

Proposition 3 *With rewards on whistle-blowing, there exist $R_0 < R_1$, G_0, G_1, G_a, $G_b \in \Re$, with $G_a < G_b$, and $\hat{y}$, such that for:*

- *$R \in [R_0, R_1]$ and $y > \hat{y}$, or if $y < \hat{y}$ but $G \notin (G_a, G_b)$;*
- *$R < R_0$ and $G < G_1$; and*
- *$R > R_1$ and $G < G_0$;*

the principal's participation constraint holds.

For $R \in [R_0, R_1]$, high values of y make a contract over e_1 profitable to the principal regardless of e_2. Instead, low values of y , makes a contract over e_1 profitable to the principal if $G < G_a$ or $G > G_b$. Negative payoffs from crime (or small positive payoffs if $G_a > 0$), make deterrence desirable to the principal, and he is willing to hire the agent regardless of the negative effect that e_2 has on production. High positive payoffs from crime ($G > G_b$), make deterrence not desirable to the principal, but such a big payoffs allow him to settle β big enough to reduce e_2 the most, and so hiring the agent is still profitable to the principal.

For $R \notin [R_0, R_1]$, β does not depend on y, $\beta = \{0, \beta_1\}$, and for the PCp to hold it is only required G small enough. Let's see the intuition behind this: For $R > R_1$ the agent only gathers crime evidence, and this is desirable to the principal only if the payoff that he gets from crime is small enough (expected to be negative). For $R < R_0$, the agent's supply for e_1 is inelastic at 1 and the principal has not instrument to govern over e_2 (e_2 only depends on R). Hence, the principal hires the agent only if the payoff he gets from crime is small enough (expected to be negative).

5.3 The Optimal Contract

Proposition 4 *With rewards on whistle-blowing, there exist* $R_0 < R_1$, G_0, G_1, G_a, $G_b \in \Re$, *with* $G_a < G_b$, *and* $\hat{y}$, *such that:*

- *For* $R < R_0$ *and* $G < G_1$, *the optimal contract is* (α_1, β_1), *and it entails efforts* $(e_1, e_2) = (1\ ,\ \underline{e}_2)$, *with* $\underline{e}_2$ *increasing in* R.
- *For* $R \in [R_0, R_1]$ *and* $y > \hat{y}$ *or if* $y < \hat{y}$ *but* $G \notin (G_a, G_b)$, *the optimal contract is* (α^*, β^*), *and it entails efforts* $e_1^*, e_2^* \in [0, 1]$, *with* e_1^* *increasing in* β *and* e_2^* *decreasing in* β.
- *For* $R > R_1$ *and* $G < G_0$, *the optimal contract is* $(\alpha_0, 0)$, *and it entails efforts* $(e_1, e_2) = (0, \overline{e}_2)$, *with* $\overline{e}_2$ *increasing in* R.

The values of α^*, α_0 *and* α_1 *are settled such that the principal gets all agent's surplus.*

Corollary 3 *Rewarding whistle-blowers improves deterrence, with respect to the benchmark case, if it is profitably to the principal to hire the agent and the optimal contract implies* $e_2 > 0$.

Two main results arise from this game. First, the optimum might be no contract between principal and agent. We should expect this from the conjunction of a low e_1's marginal productivity and G not an extreme-value. If this is not the case, the optimal contract may be defined over e_1 or e_2. In the former case, production may co-exits with gathering crime evidence activities $(e_1, e_2 > 0)$. In the latter case, there are only gathering evidence activities ($e_1 = 0$ and $e_2 > 0$). Besides, for the general case productive effort is overpaid or underpaid with respect to the benchmark case, so that productive efficiency is rarely found (Figures 4 and 5).

In terms of deterrence, rewards on whistle-blowing improve deterrence when $e_2 > 0$, but at the expense of compromising productive efficiency and at the risk of no contractual relationship among the principal and the agent. Indeed, defining d the percentage change of the probability of crime existence with respect to the benchmark case, $d = \frac{z^B - z}{z^B} = e_2$, there is a deterrence improvement for $e_2 > 0$.

6 Conclusion

Whistle-blowers play an important role in exposing fraud and other improper activities by companies and the government, including fraud against the government. But the exposure of corporate crime is not free of consequences, and

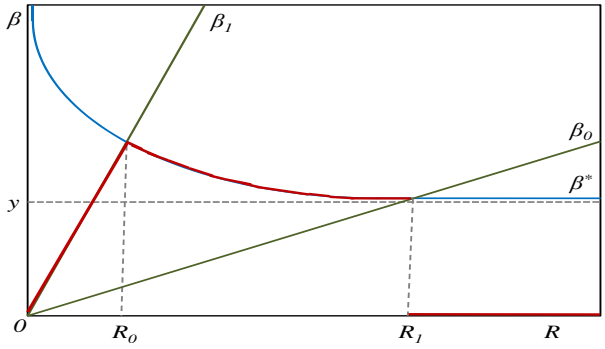

Figure 4: Given contract, productive effort can be overpaid or underpaid with respect to the benchmark case. Boundaries β_0 and β_1 in green, and the interior solution β^* in blue. The optimal marginal payment to productive effort is highlighted in red.

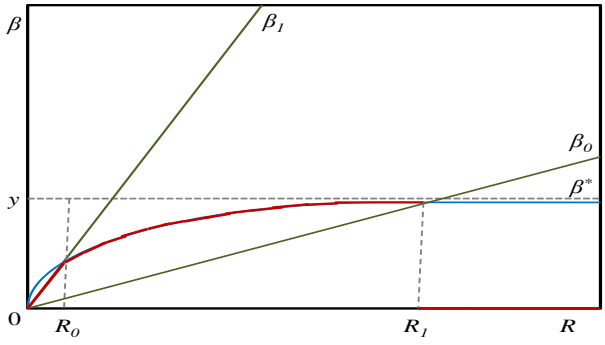

Figure 5: Given contract, productive effort is underpaid with respect to the benchmark case. Boundaries β_0 and β_1 in green, and the interior solution β^* in blue. The optimal marginal payment to productive effort is highlighted in red.

it is rare the case in which employers and/or fellow workers do not take adverse actions against the whistle-blower as a retribution or retaliation for the public exposure of the wrongdoing. That is why to encourage whistle-blowing most whistle-blower legislations contain protection clauses against retaliation for blowing the whistle. The USA legislation goes far away by also offering a reward for the exposure of the corporate wrongdoing.

Rewards on whistle-blowing legislation put a serious challenge to the economic theory of enforcement. While they can improve deterrence on corporate misconduct, they can also create a non desired hunt bounty environment in the corporations that may distort employees' attention from productive activities.

By considering that rewards create a decision problem to employees on how to allocate effort among production and gathering crime evidence activities, I develop a model that shows the effects that rewards on whistle-blowing programs have on deterrence and on optimal contracts among non offenders.

I show how rewards distort the optimal contract for productive activities that governs among the principal (firm owner) and an agent that can become in a whistle-blower (non offender employee). Productive effort is overpaid or underpaid with respect to a set-up with no rewards, depending on the externalities that the crime creates to the principal and the size of rewards. Besides, I show how low reward levels it is possible to get an equilibrium in which the optimal contract only allows for effort to gather crime evidence. This last case arises when crime creates high negative externalities to the principal, so that he is more interested in an agent making effort to discover crime (regardless of the corporate liability that this may entail) than in an agent making productive activities.

For deterrence, I show how deterrence is improved as well as rewards do not run out the principal's interest in hiring the agent (i.e., when there exists a contractual relationship between the principal and the agent), and that the contract that governs they working relationship implies $e_2 > 0$.

Besides, for the case in which the principal gets all agent's surplus, rewards on whistle-blowing affects the principal and the offender's utilities only. While the offender's utility is non-positively related to rewards, the principal's utility may be positively or negatively related to them. This result goes in line with the literature on public policy and corporate liability that considers that efficient and effective anti-crime policies should affect the utility of all those who can prevent the crime, in this case the offender and the principal.

One final comment goes in line with the figure of a 'new inspector' that rewards create. It reminds me the literature of corrupt inspectors that may justify a second inspection to improve deterrence (two inspectors increase bribery costs, and so it reduces crime profits goes). But, while a policy with two inspectors multiplies by two the social costs in terms of salaries, rewards on whistle-blowing

imply low reward payments under program success. Nevertheless, the reward policy creates firm's inefficiencies that a two-inspectors policy don't. A detailed analysis comparing these two policies may give some light on which one is less costly to society.

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