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Bonus payments as an anti-corruption instrument: A theoretical approach

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HIGHLIGHTS

- We set-up a game-theoretic model of a corruption situation.
- We confirm that high wages or high fines reduce corruption.
- We introduce bonus payments for honest officials as an anti-corruption measure.
- We derive the optimal bonus payment and show that it benefits the government.

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ABSTRACT

We analyse bonus payments for officials, who transfer payments truthfully to the government rather than collecting bribes. We show that optimised bonus payments are always beneficial to the government, making them a more effective anti-corruption measure than simple wage increases.

1. Introduction

A standard solution for the information problem in principal–agent relationships is the introduction of performance-based incentives (Holmstrom, 1979). Basically, a principal pays the agent according to the final output, if he is not able to observe his agent's work effort. If we think of policemen in charge of controlling speed limits, we can also translate their work into such a principal–agent problem. For example, it is the responsibility of each street policeman (agent) to report cars exceeding the speed limit to the government (principal). Consequently, the driver of the car will have to pay a penalty to the government, if he is reported. However, in many developing countries, policemen offer to ignore the offence in exchange for a small direct payment by the driver (Faull, 2007; Andvig and Fjeldstad, 2008).[1] For policemen taking bribes can be attractive because policemen are paid a fixed wage in a lot of countries (Andvig and Fjeldstad, 2008). However, this is clearly not in the government's interest because corruption in the public sector is in many cases the main obstacle to development (Kaufmann, 1997).

Silva et al. (2007) mention that it might be worth considering a contract including incentives for truthful actions. We adapt this idea and study the effect of bonus payments for honest officials on their behaviour. We derive the optimal bonus payment under full information and show that it results in a monetary advantage for the government. We therefore conclude that implementing bonus

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[1] According to Faull (2007), traffic fines are by far the department where bribes are most frequently asked for (29% of all citizens asked reported that).

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Table 1
Payouts of the simple corruption game.

Situation	π_O	π_G
No corruption	$+w$	$-w+f$
Undetected corruption	$+w+b$	$-w$
Detected corruption	$-s_O$	s_O

payments of this type can in theory be an efficient way of reducing corruption.

For the related setting of officials granting licences (driving licences, sales permissions), Guriev (2004) studied a similar approach. Following the idea of Banerjee (1997), he introduced bonus payments for correctly assigned licences and a fine for wrongly assigned licences. In the setting with officials supervising transfer payments, however, such a bonus payment for honest officials has not been fully analysed. Hindriks et al. (1999) studies commission for tax inspectors but only if they report high incomes to be taxed. Mishra (2002) studies rewards and penalties for officials but focuses on the effect of different hierarchical structures.

2. The model

Let us consider a situation, where a citizen **C** is stopped during a police control and is charged a fine $f > 0$. **C** negotiates this service with a government official **O** (e.g. a policeman). **O** is paid a fixed wage w by the government and in a non-corrupt system the fee f is transferred back to the government.

However, **O** can choose to be corrupt and offer a bribery deal to **C**, requiring **C** to pay an amount $b \leq f$ directly to **O** and thereby surpass the government. On the other hand, we assume that bribery is detected with a probability $p \in [0, 1]$, in which case the wage w is withheld from **O** and he is fined an amount s_O payable to the government. We assume that all players can estimate the risk p adequately and we see player **C** as a passive part of the game—one could imagine a tourist who does not have much insight into the ongoings. The payouts in all three situations can be seen in Table 1.

We start our analysis of this game by finding the critical wage w_{crit} below which the official **O** accepts bribery.

Theorem 1. *For the simple corruption game defined through the payouts in Table 1, player* **O** *accepts bribery by a citizen* **C** *only if his wage w is below a critical wage w_{crit} that depends on s_C, b and p.*

Proof. **O** accepts bribery if his expected outcome is higher than his wage w. This can be formulated in the condition

$$(w+b)(1-p) - s_O p > w \Leftrightarrow w < -s_O + b\frac{1-p}{p} = w_{\text{crit}}. \qquad (1)$$

If **O**'s wage is smaller than w_{crit}, he will accept bribery, whilst a wage higher or equal to w_{crit} renders corruption as too dangerous. □

Remark 1. In the case of very high penalties s_O, w_{crit} can become negative, which means that **O** would never accept bribery. Therefore, sufficiently high penalties can in theory prevent corruption. However, in practice such high penalties can only rarely be applied and enforced (Becker and Stigler, 1974).

Remark 2. The critical wage depends strongly on the risk p as well as the penalty s_O. In a low-risk situation ($p \ll 1$) it is almost always advantageous for **O** to be corrupt, whilst a high risk decreases the critical wage.

Whilst it is a well-known and intuitively clear idea that a low salary leaves an official prone to corruption (Aidt, 2003), it might not necessarily be in the interest of the government to raise his salary above the critical value, because the additional income f might not outweigh the raise in wages. According to the payouts presented in Table 1, **G** has two possible moves:

(i) It pays **O** the minimum possible wage $w_{\min} < w_{\text{crit}}$ and accepts corruption.
(ii) It decides to fight corruption and pays **O** the wage w_{crit} as defined in (1), in which case it incurs the additional income f from the honest official.

If we assume for simplicity that no minimum wage exist, i.e. $w_{\min} = 0$, we can formulate a condition for the government to fight corruption.

Theorem 2. *For the simple corruption game defined through the payouts in Table 1, a critical risk p_{crit} exists above which it is advantageous for the government to fight corruption by increasing the wage of* **O** *to the critical value w_{crit} defined in (2).*

Proof. **G**'s payoff for each of its two possible moves can be calculated to

$$\mathbb{E}\left[\pi^{(G)}_{(\text{i})}\right] = p\, s_O, \qquad \mathbb{E}\left[\pi^{(G)}_{(\text{ii})}\right] = 1 - w_{\text{crit}}.$$

We can easily convince ourselves that it is advantageous for the government to fight corruption if $f > p\, s_O + w_{\text{crit}}$, which is equivalent to

$$-p^2 s_O + p(f + s_O + b) - b > 0.$$

The two solutions of the quadratic equation are

$$p_{1,2} = \frac{1}{2s_O}\left[\pm\sqrt{(f+s_O+b)^2 - 4s_O b} + s_O + f + b\right].$$

It is easy to see that for positive f, s_O and b both solutions are real and that the bigger of the two solutions is greater than 1. Additionally, one can show that the smaller solution lies between 0 and 1 and is in fact smaller than $\frac{b}{b+f}$, which is the critical probability for the case that $s_O = 0$. We therefore obtain that a critical risk

$$p_{\text{crit}} = \frac{1}{2s_O}\left[-\sqrt{(f+s_O+b)^2 - 4s_O b} + s_O + f + b\right] \leq \frac{b}{b+f} \leq \frac{1}{2}$$

exists above which it is advantageous for the government to raise the officials' wage to w_{crit} and thereby wipe out corruption. □

Remark 1. We have shown that depending on the risk taken by accepting bribery, it can be advantageous for the government to ignore corruption, whilst on the other hand situations exist, where a pay-rise above the threshold value can lead to a positive net-income for the government and hence corruption is not a stable situation.

Remark 2. One can now imagine a situation in which the government can influence the risk p itself. One example would be to allow the government to spend a certain amount a on anti-corruption campaigns and thereby defining the risk $p \equiv p(a)$ as a function of these spendings. It will then be possible to calculate the optimal a depending on the exact functional form of $p(a)$.

3. Introducing a bonus for honest officials

Assuming that the penalty s_O cannot be increased indefinitely, the government **G** merely played an observer role until now. It compares its two playing options and adjusts the wage of the officials accordingly. We now want to adjust the payment system slightly in order to give the government a more active role. We thereby assume that honest officials get rewarded with a part $\beta \in [0, 1]$ of the fees they handed to the government. The adjusted payouts are presented in Table 2.

Table 2
Payouts of the corruption game with bonus payments.

Situation	π_O	π_G
No corruption	$+w+\beta f$	$-w+f(1-\beta)$
Undetected corruption	$+w+b$	$-w$
Detected corruption	$-s_O$	s_C+s_O

Using a similar analysis to Theorem 1, we can calculate the new critical wage for the officials as follows:

$$w_{\text{crit}} = -s_O + b\frac{1-p}{p} - \beta\frac{f}{p}, \tag{2}$$

which is hence decreased in comparison to the simple situation for $\beta > 0$. The situation for the government changes significantly in that it can now fight corruption even for very low detection probabilities by adjusting the bonus payment β accordingly. Note that w_{crit} as formulated in (2) can become negative if $\beta f > (1-p)b - p\,s_O$. In the purely game theoretic setting a negative wage is not uncommon in the form of an entry fee (Becker and Stigler, 1974), but in the practical application for government officials we assume it to be not common or not possible. We will therefore assume that $w \geq 0$, which implies the condition

$$\beta f \leq (1-p)b - p\,s_O. \tag{3}$$

The main result is formulated in the following

Theorem 3. *For every value of the detection probability p and for $s_O \leq b\frac{1-p}{p}$, an optimal $\beta_{\text{opt}} \in [0,1]$ exists, such that it is advantageous for the government to fight corruption in the adjusted payment scheme presented in Table 2 of the corruption game.*

Proof. The governmental payout in the case of fighting corruption can be calculated as follows:

$$E\left[\pi^{(G)}_{(\text{ii})}\right] = -w_{\text{crit}} + (1-\beta)f,$$

where w_{crit} is given in (2). Substituting in, we get

$$E\left[\pi^{(G)}_{(\text{ii})}\right] = s_O - b\frac{1-p}{p} + f + \beta f\frac{1-p}{p}.$$

In particular, we can see that this payout increases monotonically with β, which means that a higher β implies a higher governmental payout. Using the condition (3) for a non-negative critical wage, we can therefore calculate β_{opt} to be

$$\beta_{\text{opt}} = \frac{b(1-p) - p\,s_O}{f} \leq \frac{b}{f}(1-p) \leq 1-p. \tag{4}$$

We can see that for all $p \in [0,1]$ and all $s_O \in \left[0, b\frac{1-p}{p}\right]$ we have $\beta_{\text{opt}} \in [0,1]$. The governmental payout for $\beta = \beta_{\text{opt}}$ can be calculated to

$$\begin{aligned} E\left[\pi^{(G)}_{(\text{ii})}\right] &= f - b(1-p) + p\,s_O \geq f\,p + p\,s_O \geq p\,s_O \\ &= \mathbb{E}\left[\pi^{(G)}_{(\text{i})}\right]. \end{aligned}$$

Hence, for the choice of $\beta = \beta_{opt}$, it is always advantageous for the government to fight corruption. □

Remark 1. The major result of Theorem 3 is that the government can always adjust β in a way that it gains money through anti-corruption measures. Interestingly the optimal case is the case where $w_{\text{crit}} = w_{\min}$ and therefore means that government does not actually need to increase salaries, it just needs to introduce bonus payments.

Remark 2. It might be the case that the government cannot rely on actually receiving the penalty payments, which is equivalent to setting $s_O = 0$. In this case (4) simplifies to $\beta_{\text{opt}} \approx 1-p$ if one assumes $b \approx f$.

4. Discussion and conclusion

Our results indicate that performance-based incentives in the public sector can be beneficial for the government in increasing revenues and decreasing corruption. This effect is empirically supported by Kahn et al. (2001), where incentivised bonus payments for Brazilian tax collectors are shown to cause a significant increase in overall tax revenue.

One might argue that the main flaw in the presented solution is that it does not resolve the problem of incentivising extensive fines given by police officers, as they earn more money the more fines they give. Silva et al. (2007) point out that this might create incentives for the supervisors to exaggerate the number of reported citizens. Note that this is obviously also the case for a corrupt officer. However, the advantage now is that the money flows through the hands of the government which ensures a certain level of control. Citizens might have the option to appeal against unrightful fines and fines are no longer completely arbitrary like they can be in a corrupt system.

Our model serves as a theoretical benchmark for the idea of bonus payments for honest officials. The basic model provides a starting point for future research and allows for certain extensions to cover a more comprehensive picture of a corruption situation. Our approach for example assumes that all economic subjects are purely driven by incentives, we do not allow for per se honest officials. In an extension of our model, however, it is possible to assume that a bribed **O** incurs non-monetary moral cost, similar to the idea presented in Andvig and Moene (1990).

In reality, a government that aims to fight corruption is faced with an even more complex problem. As Holmstrom and Milgrom (1991) show, it is not necessarily optimal to offer performance-based contracts to agents who perform multiple tasks. The prevalence of corruption in hierarchical systems additionally complicates anti-corruption policies (Carrillo, 2000; Mishra, 2002). Moreover, Bardhan (2006) argues that besides offering economic incentives, educating the public moral is very important. If people can be educated to realise the long-term pro-social benefits of a corruption free-system, their moral cost will increase. Vollaard and van Ours (2011), for example, show that large-scale government interventions can have a positive effect on crime rates.

In the end, the question remains whether it is actually possible to implement a system like this in practice. However, bonus payments for honest officials provide an additional approach for fighting corruption and add to the solution of job entry fees for officials (Becker and Stigler, 1974) and infinitely high fines in case of detected corruption (Silva et al., 2007). An experimental study could provide further insights as regards the corruption-reducing effect of performance-based incentives for officials.

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