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Does Transparency Reduce Corruption ?

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Abstract:
Does a better monitoring (transparency) of officials lowers the incidence of corruption ? Using a common agency game with imperfect information, we show that the answer depends on the measure of corruption that one uses. More transparency lowers the prevalence of corruption but it may raise the average bribe as it motivates the corruptor to bid more aggressively for the agent's favour. We show that transparency affects the prevalence of corruption at the margin through a competitive effect and an efficiency effect.

Keywords:
Corruption, Transparency, Common Agency

Classification JEL: D73, D80

1. Introduction

Democratic political systems provide the citizen effective means to observe and to influence the politicians' decisions. Yet, assuming that these decisions always reflect the voters' preferences is overly optimistic. Every now and then the medias report cases of policies that hardly maximize any kind of social welfare function: contracting public procurements at exorbitant prices, supporting hazardous economic activities in environmentally protected areas, providing useless public facilities, are just a few examples. Although mostly a secret phenomenon, corruption is sometimes exposed during spectacular judicial inquiries.

It is often claimed that improving the transparency of the decision process is a cure to corruption (see Transparency International, 2003). In this paper, we study that claim. What we find is that although more transparency would lower the prevalence of corruption, it might actually lead to more money being poured in corruption bribes.

In an opaque system, the public has little incentive to influence the politicians. As a result, the corruptors don't have to do much to influence them: corruption is widespread but the bribes are low. Improved transparency empowers the public who then fight more aggressively to counteract the influence of the corruptors. But the corruptors fight back and the bribes increase.

Our point is not that improved transparency is a bad policy. We show that transparency augments expected welfare. But it also augments the shadow value of the official's power. The expected bribe increases because the corruptor is now ready to pay more to influence that power.

We make our point with a common agency model in which the *public* and the *corruptor* (the principals) try to influence the choice of an action by an *agent* (the politician or official). The principals favor different policies; yet, although the public's preferred policy would lead to a greater increase in total welfare, the corruptor may get a better deal by bribing the agent to implement his preferred policy.

We innovate by introducing an information gap between the principals: while the corruptor always observes the agent's action, the public does so with some probability and has to trust the agent's word otherwise. In this setting, the celebrated efficiency result of the common agency model (there is always an equilibrium with bribes where the agent chooses the efficient action favoured by the public) holds if the information gap between interest groups is small.

When there is a sufficient chance for the agent to have her cake and eat it too by pretending to act in the public interest while accepting a bribe from the corruptor to do otherwise, this result vanishes. In equilibrium, both principals compete in mixed strategies by varying their compensation offers to the agent. As a result, the corruptor's offer sometimes surpasses that of the public and the agent willingly accepts the bribe.

The concept of political corruption has significantly changed over time (see Heidenheimer and Johnston, 2002). Besley (2006) defined political corruption as: "a situation where a monetary payment – a bribe – is paid to the policy maker to influence the policy outcome". As helpful as it is, this definition raises further questions. For one, who gains from influencing the policy outcome? In other words, whose welfare is altered by the policy? Almost any decision of an official affects the welfare of more than one interest group. Awarding a government contract, for example, affects the welfare of the firm executing the contract, but also that of the taxpayer who ultimately foots the bill. Hence, when analyzing political corruption, we must presume that there are at least two interest groups in presence.

Furthermore, are bribes any different from legitimate political contributions? The above definition states that a monetary transfer from an interest group to an agent is a bribe if it is *contingent* on the agent's action. This is not the sole characteristic of bribes, though. Corruption is famously a secret phenomenon. If a firm pays a bribe to an official to get a government contract, they will keep the deal secret. We see two reasons why both the corruptor and the agent want the bribe to be *a hidden, private payment.* First, when the corruptor favours an inefficient policy, political corruption destroys surplus and would not survive a round of public renegotiation with all the parties involved. Second, both the corruptor and the agent gain at the expenses of the public in a manner that might be deemed illegal.

Since the development of the Principal-Supervisor-Agent model (hereafter PSA; see Tirole, 1986), the microeconomic formalization of corruption has reached undisputed success. Besley and McLaren (1993), Mookherjee and Png (1995) or Acemoğlu and Verdier (2000), among others, bring useful insights into this phenomenon and at the same time relate to its essential characteristics. Aidt (2003) suggests as well that, by setting up an agency framework in which one benevolent principal (the policy-maker) tries to prevent the collusion between a corrupt supervisor (the bureaucrat) and a corrupt agent, the PSA model turned out to be a powerful tool for analyzing corruption. Unfortunately, though, the PSA model applies *only* to bureaucratic corruption. Probably because in the microeconomics of corruption literature the line between political and bureaucratic corruption is often fuzzy, this important clarification is overlooked.

We argued above that a model of political corruption should feature at least two interest groups and an agent. Since it features only one principal and the role of the policy-maker is basically inverted, the PSA model doesn't have any chance to fit the realities of political corruption.

Paradoxically, the success of the PSA model has left a gap in the formalization of political corruption. To fill this gap, two models of the political economy literature may be considered. They are not models of political corruption *per se*, but they do include rents or monetary transfers associated with political corruption.

The first one is the political agency model (Barro, 1973; Ferejohn, 1986; Persson and Tabellini, 2000; Besley, 2006). It explains the behavior of officials facing elections. In its simplest form the political agency is a principal-agent model: a decision affecting the welfare of the citizen (the principal) is delegated to an agent. The agent may "shirk" and acquire a rent. The citizen's only mean of disciplining the agent is to vote him out of office.

Focusing on the electoral process, the political agency model proposes a fairly simple type of rents which can be interpreted as corrupt gains[2]. However, they do not correspond to the definition of political corruption used here because they are not monetary transfers contingent on agent's action. More precisely, in the political agency model the potential rents are

[2] In a famous definition, corruption is "an abuse of public office for private gain".

settled at the beginning of the elections and the agent can decide to get (a part of) them by risking her office. In this respect these rents resemble rather the embezzlement of public funds than actual political bribes.

The second one is the common agency model first devised by Bernheim and Whinston (1986b,a) and further developed as a branch of the lobbying literature by Grossman and Helpman (1994, 2001), Le Breton and Salanié (2003) and Martimort and Semenov (2007). Within a common agency, many principals (the interest groups) compete to influence an agent. As Harstad and Svensson (2011) mention, there is something puzzling about the lobbying literature, though: the monetary transfers from the interest groups towards the agent are frequently called bribes but that creates confusion between lobbying and political corruption. This puzzle is easy to solve if one considers the distinction between bribes and political contributions we made earlier. The lobbying models built on common agency feature equilibrium transfers that are known by all the players. Therefore, these payments should be interpreted as legitimate political contributions. Bribes are hidden, private payments and the current applications of the common agency to lobbying fall short of reflecting this reality.

The remainder of the paper is organized as follows. The model is very simple: we outline it in the next section. We then solve it in section 3 first when transparency is high enough to prevent any corruption and then when there is some prevalence of corruption in equilibrium. We pursued in section 4 the comparative statics effect of transparency on both the prevalence of corruption and on bribes. We sum up our result in the conclusion. There is an extensive mathematical appendix where we compute an explicit formula for the prevalence of corruption in our model.

2. The Model

Consider a common agency game with a single agent and two principals: the public and the corruptor. The agent chooses an action within the set $\{1, 2\}$. The principals have opposite preferences over this set: the public prefers the first action and the corruptor the second one (the agent has no preference over this set). Without loss of generality, we normalize at zero the expected utility of each principal for his least-preferred action; we normalize at 1 the expected utility for the public of pursuing the first action; and we let ϵ denotes the expected utility for the corruptor of pursuing the second action. We assume that $0 < \epsilon < 1$, so that undertaking the first action is the efficient move: undertaking the inefficient action entails a loss of $1 - \epsilon$ in welfare. Hence, a high value of ϵ indistinctly means a *strong* minor interest (a high corruptor's stake) and/or a low potential loss in welfare.

Both the public and the corruptor bid simultaneously to influence the agent. The public offers to pay the agent an amount u if she chooses the first action and the corruptor offers to pay her a bribe b if she chooses the second action. Payments must be non negative and offering the smallest possible payment if their preferred action is not chosen is a weakly dominating strategy for both principals. So both principals offer nothing in that event.

Our analysis of political corruption rests on imperfect monitoring of the agent's action by the public. The corruptor always observes the agent's action while the public does so with probability $\theta \leq 1$. The public may renege on paying u only if the agent has undertaken the second action in that latter event.

A "corruptor" is then someone *i)* who has a private minor interest $\epsilon < 1$; and *ii)* who is better than the public at monitoring the agent (since $\theta \leq 1$). The probability θ is our measure of transparency.

3. Competition and Efficiency Effects

When $\theta = 1$, we have a special instance of the common agency model developed by Bernheim and Whinston (1986b) with full monitoring of the agent's action. In that case, there exists a unique *truthful* Nash equilibrium[3] where the corruptor tries to bribe the agent with $b = \epsilon$, but the public matches the bribe with $u = \epsilon$ and the agent chooses the efficient action. So, in equilibrium, the corruptor gets nothing, the public gets $1 - u = 1 - \epsilon > 0$ and the agent gets $u = \epsilon$, which is at least as good to what she would have get by accepting the bribe.

In the other polar case $\theta = 0$, the public is powerless to monitor the agent. It is then useless to match the corruptor's bribe since the agent would only *pretend* to choose the efficient action and would pocket the corruptor bribe anyway by choosing the latter preferred action. Consequently, the corruptor has little incentive to offer a big bribe. Indeed, this game has a unique subgame perfect equilibrium where both principals offer nothing and

[3] Truthfulness is a refinement that excludes equilibria where the principals promise unreasonable transfers for actions that are not undertaken in equilibrium. See Bernheim and Whinston (1986b).

the agent chooses the inefficient action[4]. Both the public and the agent get nothing and the corruptor gets ϵ.

Going from the asymmetric information case just described (with $\theta = 0$) to the complete information case described above (with $\theta = 1$) — an increase in transparency — the incidence of political corruption goes from widespread (the agent always chooses the corruptor's preferred action) to none, and the level of bribes offered rises from zero to ϵ. If we measure political corruption by the likelihood that the agent will choose the corruptor's preferred action, then transparency *reduces* corruption. But if we measured it by the level of bribes, it rises as transparency improves; hence transparency *increases* corruption. As for the *expected* or *average* bribe actually paid, it is zero in both these extreme cases.

We shall now analyze the equilibrium in the intermediate cases $\theta \in (0, 1)$ and proceed the same comparative statics exercise. In particular, we want to confirm the intuition expressed above that an increase in transparency leads to less instances of political corruption yet to higher bribes. In addition, we want to establish that an increase in transparency enhances welfare and to check whether it leads or not to higher *expected* accepted bribes.

A (behavioural) best-response for the agent resumes to a correspondence ϕ that associates to every pair (u, b) a subset of $\{1, 2\}$. Given a pair of bids (u, b), choosing the first action is rational for the agent if

$$u \geq (1 - \theta)u + b$$

that is if the public's bid covers the corruptor's bid plus her expected gain if the public fails to monitor her action. Hence,

$$\phi(u, b) = \begin{cases} \{2\} & \text{if } \theta u < b \\ \{1, 2\} & \text{if } \theta u = b \\ \{1\} & \text{if } \theta u > b \end{cases}$$

Recall that when $\theta = 1$, the public can match the corruptor's bribe $b = \epsilon$, ensure that the agent will undertake the first action and still obtain a gain

[4]Suppose there is a subgame perfect equilibrium where the corruptor offers a positive bribe. Then the agent surely plays the second action. It follows that the corruptor would strictly increase his payoffs by halving his bribe. This implies that the bribe should vanish but a null bribe would not belong to an equilibrium strategy profile if the agent did not choose the second action.

since $1-\epsilon > 0$. Now, we show that as long as θ is no less than ϵ, the public can still deter the agent from the second action. So assume that $1 > \theta \geq \epsilon$. Offering $u = \epsilon$ would no longer do because $\phi(\epsilon, b) = \{2\}$ if $\theta\epsilon < b$ so that the corruptor could compel the agent into choosing the inefficient action by offering a bribe $b \in (\theta\epsilon, \epsilon)$ and still make a profit $\epsilon - b > 0$.

Imperfect transparency lessens the potency of the public's incentive. In equilibrium, we find that $u = \epsilon/\theta$, $b = \epsilon$ and that the agent rationally chooses the efficient action since $1 \in \phi(\epsilon, \epsilon/\theta)$. This is an equilibrium since the corruptor would loose by offering a higher bribe and the agent would reverse her choice should the public reduce marginally u, at a loss for the latter. We sum things up so far in the first proposition.

Proposition 1. *When $\theta \geq \epsilon$, there is a pure strategy equilibrium where the public offers $u = \epsilon/\theta$, the corruptor offers $b = \epsilon$ and the agent plays $i \in \phi(u, b)$ if $\theta u \neq b$ and $i = 1$ otherwise. In equilibrium, the public gets $1 - \epsilon/\theta$, the corruptor gets 0 and the agent gets ϵ/θ.*

Proof. We refer the reader to the discussion above. Notice that the agent must choose the efficient action whenever she reaches an indifference point so that the public has no incentive to increase slightly his bid beyond that point. □

In the light of proposition 1, a (preliminary) discussion about the effect of transparency upon corruption would conclude that it shifts surplus from the agent toward the public: as θ increases, the agent's payoff ϵ/θ decreases and the public's payoff $1 - \epsilon/\theta$ increases. Besides, as ϵ increases, the value of the agent's action on the corruption market increases so that her payoff increases and that of the public decreases. In both comparative static analysis, the corruptor's payoff stays constant at zero but that is no surprise since no corruption actually takes place in this equilibrium!

A classic proposition of corruption literature states that a better paid agent is less likely to accept a bribe. Accordingly, the public should pay the agent no less than her "value" on the corruption "market". We argue that this logic describes competition, not corruption. Corruption is a phenomenon that arises under low transparency. No agent in her right mind would willingly admit that she is corrupted. Corruption involves a form of deception where a venal agent publicly pretends to do something but actually does something else. Proposition 1 establishes that this is a loosing strategy if transparency is high enough.

Suppose now that $\theta < \epsilon$. This will result in an inherently unstable situation. On one hand, the corruptor may counter any rational attempt by the public to obtain the agent's favor. Yet, if the agent is to be corrupted anyway, there is no rational for the public to pay her anything. On the other hand, if the public does not compete, the corruptor should economize on the bribe; but if the bribe is low, the public should compete for the agent's favour. So no pure strategy equilibrium exists in this case.

We shall identify the mixed strategies equilibrium where both the public and the corruptor bid for the agent's favour. There is then a strictly positive probability P that the corruptor's bid will beat the public's bid in equilibrium. That probability shall be our measure of the *prevalence* of corruption: if our theory is right, then out of a hundred audited agents with similar characteristics, we would expect a number $100 \times P$ of them to be corrupted.

Yet the prevalence of corruption does not resume alone its incidence. We shall be interested in the average bribe β paid in corruption deals. That is, out of a hundred audited agents with similar characteristics, we would expect to observe an amount $100 \times \beta$ in exchanged bribes.

Proposition 2. *Let $\theta < \epsilon$ and consider the distribution functions F and G over $\mathbb{R}_+$ such that*

$$F(u) = \begin{cases} \dfrac{\epsilon - \theta}{\epsilon - \theta u} & \text{if } u \leq 1 \\ 1 & \text{otherwise;} \end{cases} \tag{1}$$

$$G(b) = \begin{cases} \dfrac{1-\theta}{\theta} \dfrac{b}{1-b} & \text{if } b \leq \theta \\ 1 & \text{otherwise.} \end{cases} \tag{2}$$

There is an equilibrium where the public plays F, the corruptor plays G and the agent plays $i \in \phi(u, b)$ if $u > 0$ and $i = 2$ otherwise. As transparency θ increases, both u and b get stochastically larger.

Let P be the equilibrium probability that $b \geq \theta u$ and β be the average value of b in that event. Then the equilibrium payoffs are 0 for the public, $\epsilon - \theta$ for the corruptor and

$$\pi = 1 - P + \beta \tag{3}$$

for the agent.

Proof. The agent always chooses her action from her best-response correspondence. To prove that we have an equilibrium, we need only to verify that both principals do so as well. Suppose that the corruptor plays G. Given the public's bid u, the probability that the agent selects the efficient action is $\text{Prob}\,(\theta u > b) = G(\theta u)$. By bidding $u \in [0,1]$, the public then gets a zero expected payoff

$$G(\theta u)(1-u) - (1-G(\theta u))(1-\theta)u = 0 \tag{4}$$

independent of u (the second additive term on the left accounts for the possibility that the public pays the agent but receives nothing in return because it fails to observe the latter's move). Besides, increasing its bid beyond 1 could only result in a loss. It follows that bidding over $[0,1]$ is a best response to G for the public. Likewise, if the public plays F, then $\text{Prob}\,(\theta u \leq b) = F(b/\theta)$ and, if he bids $b \in [0,\theta]$, the corruptor gets an expected payoff

$$F(b/\theta)(\epsilon - b) = \epsilon - \theta > 0 \tag{5}$$

independent of b. If he bids more, that is $b > \theta$, he surely wins but he ends up with $\epsilon - b < \epsilon - \theta$. Hence, bidding over $[0,\theta]$ is a best response to F for the corruptor.

The agent selects the second action if the public offers nothing. This is to ensure that the support of the corruptor's strategy is compact: since the public offers zero with a positive probability, the corruptor would never offer zero if there was any chance the agent could select the first action in case of a tie at zero.

Both distributions F and G strictly decrease with θ over their respective supports. So a larger value of θ induces an increasing first-order stochastic dominance: both random bids become stochastically larger and their expected values increase[5].

Equation (3) is a decomposition of the agent's expected payoff into the expected shares that she gets from each principal of the total realized surplus. That decomposition accounts for the expected payment β she gets from the corruptor. From the public, she gets u unless she performed the second action and her bad deed is exposed. That relationship generates one unit of surplus whenever the agent chooses the first action, so $1-P$ in expected term. Since

[5]All others being equal, say G_1 and G_2 denote the corruptor' mixed strategies σ_1 and σ_2 respectively when $\theta = \theta_1$ and $\theta = \theta_2$ with $\theta_2 > \theta_1$. Then $G_2(b) \leq G_1(b)$ for all $b \in [0,\theta_2]$, so σ_2 first-order stochastically dominates σ_1. First-order stochastic dominance implies dominance in expected values.

the public gets none of it on average, that amount resumes the agent's share. Stated differently, $1-P$ equals the expected value of the public's bid adjusted for the likelihood that the public does not pay because the agent chose the second action and her action was exposed. □

When the transparency problem is severe enough to make full deterrence a loss-making option, political corruption randomly occurs when the corruptor's bribe beats the (discounted) public reward ($b > \theta u$). We contend that this mixed strategies equilibrium captures the essence of the political corruption phenomenon.

An improvement in transparency increases the competition between the principals who both increase their bids for the agent's attention. A reduction of ϵ has a similar effect on the public's bid (as F increases with ϵ) but no effect on the corruptor's bid.

The corruptor's expected payoff $\epsilon - \theta$ increases with efficiency ϵ and decreases with transparency θ. The effect of these parameters on the agent's expected payoff $1 - P + \beta$ is mediated through the endogenous prevalence P and the average bribe β which we analyze in proposition 3 below. Since the public gets zero, total expected surplus sums these payoffs and depends also on both P and β. Yet, there is an alternative representation: total surplus amounts to 1 with probability $1 - P$ and ϵ with probability P; subtract the corruptor's share $\epsilon - \theta$ to get that of the agent

$$\begin{aligned}\pi &= 1 - P + P\epsilon - (\epsilon - \theta) \\ &= \theta + (1 - P)(1 - \epsilon). \end{aligned} \tag{6}$$

Hence, the effect of transparency on both the agent expected payoff and total expected surplus is mediated through the prevalence P. In proposition 3, we show that the prevalence decreases as transparency improves.

Recall that under perfect information, the value of the agent's action induced by the competition between the principals equals ϵ/θ and peaks at 1 when $\theta \to \epsilon$. Under imperfect information, equation (6) offers an interesting decomposition into two effects of that value. The first part, θ, reflects the *competition effect*: as $\theta \to \epsilon$, the moral hazard problem disappears and the value of the agent's action increases (toward ϵ). The second part $(1-P)(1-\epsilon)$ reflects the *efficiency effect*: corruption destroys surplus and whatever is saved, that is $1 - \epsilon$ with probability $1 - P$, accrues to the agent; as $\theta \to \epsilon$, corruption disappears and the agent's total payoff tends to $\theta + 1 - \epsilon \sim 1 \sim \epsilon/\theta$; that is, to its value under the pure strategy equilibrium.

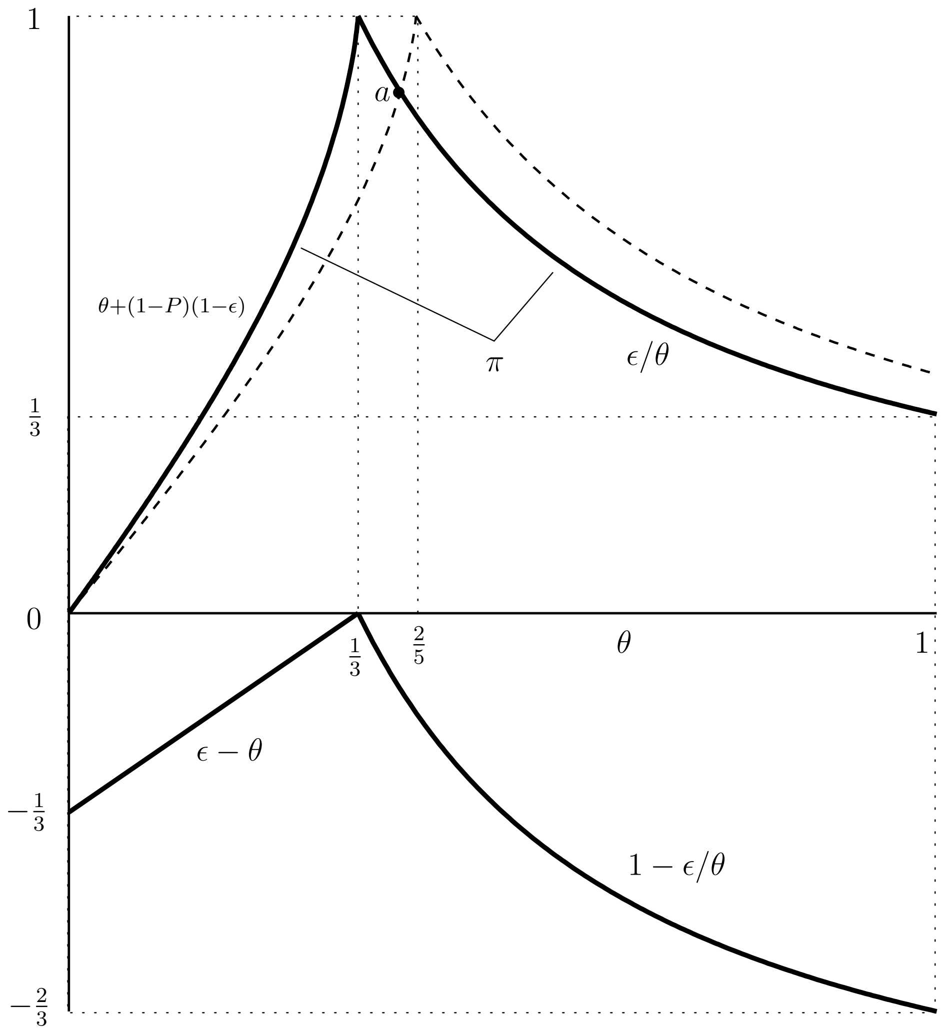

Figure 1: The players' payoffs as a function of θ.

Propositions 1 and 2 reveal the structure of payoffs as a function of θ and ϵ. When $\theta < \epsilon$, there is corruption and the total expected surplus is shared between the corruptor and the agent. When $\theta \geq \epsilon$, there is no corruption and the unitary surplus is shared between the agent and the public. The corruptor's share $\epsilon - \theta$ decreases from ϵ to zero as transparency improves from $\theta = 0$ to $\theta = \epsilon$. The public's share $1 - \epsilon/\theta$ increases from 0 to $1 - \epsilon$ as transparency improves from $\theta = \epsilon$ to $\theta = 1$. The agent's share is spike-shaped: from (6), it increases from 0 to 1 as θ increases from 0 to ϵ; it then follows $\pi = \epsilon/\theta$ and decreases from 1 to ϵ as transparency increases from ϵ to 1.

Figure 1 provides an illustration for the case $\epsilon = \frac{1}{3}$. The line in the upper quadrant is the agent's expected payoff (6) as a function of θ. It rises from 0 to 1 as θ increases over $[0, \epsilon]$. It then decreases to ϵ as θ reaches 1, following $\pi = \epsilon/\theta$. In the lower panel, where the curves are drawn upside down, we have first the corruptor's payoff which decreases linearly from ϵ to 0 over $\theta \in [0, \epsilon]$. Then, we have the public's payoff which starts positive at ϵ and increases toward $1 - \epsilon$ as θ reaches 1 along $1 - \epsilon/\theta$. The distance between the curve in the upper panel and that in the lower panel equals total expected surplus: it starts at ϵ in $\theta = 0$ and plateaus at 1 in $\theta = \epsilon$ when corruption vanishes. Improved transparency beyond that point amounts to a simple reallocation of surplus from the agent to the public; the total remaining fixed at 1.

4. Comparative Statics

Our theory of corruption combines two features: competing principals and observability of actions which we dubbed transparency. We started from a multiprincipal model with imperfect information. We showed that when transparency was an issue, the agent could be corrupted: she might accept a bribe to implement the inefficient action. Corruption is then a form of moral hazard where the value of the outside option (the bribe) results from the competition between the principals for the agent's services.

The corruptor's expected payoff $\epsilon - \theta$ decreases with transparency θ and the agent's expected payoff is mediated in (6) through the prevalence P. Hence, to establish that increased transparency reduces corruption we will show that it reduces the prevalence. For a start, we have already shown in proposition 1 that corruption vanishes when $\theta \geq \epsilon$. But the prevalence is one among several measures of corruption. For instance, we have shown in proposition 2 that an increase in transparency leads the corruptor to increase on average his bid for the agent favour's. Should we conclude on that basis that transparency worsens corruption?

It is very unlikely that we may ever obtain data about the corruptor's bid: like a corrupted agent, a corruptor has every incentive to keep his moves private. At best, we could obtain truncated data about the bribes *accepted* by corrupted agents, that is about β. That measure depends on transparency in more complex way: a corruptor may increase his bid but if the agent is not tempted, the incidence of political corruption remains low. As attested by (3), both P and β tell us something about the incentive of the agent to accept a bribe. Proposition 3 details the functional relationship between these endogenous variables and the parameters θ and ϵ.

Proposition 3. *Consider the equilibrium prevalence of corruption P and the average bribe β as functions of θ and ϵ over the set $S = \{(\theta, \epsilon) : 0 \leq \theta < \epsilon \leq 1\}$. Then P is a strictly concave and strictly decreasing function of θ and a strictly increasing function of ϵ. Furthermore, its cross-derivative with respect to θ and ϵ is strictly positive and it has the following limits:*

$$\lim_{\theta \to 0} P = 1 \qquad \lim_{\theta \to \epsilon} P = 0 \qquad \lim_{\theta \to 0} \frac{\partial P}{\partial \epsilon} = 0 \quad \lim_{\theta \to \epsilon} \frac{\partial P}{\partial \epsilon} = \infty$$

Besides, β, as a function of θ, is hump-shaped and strictly concave over $[0, \epsilon]$ and it equals zero at both ends.

Proof. Establishing the analytical properties of P involves quite cumbersome mathematics which we have relegated in the appendix. To prove the last statement, combine (3) and (6) to get

$$\beta = P\epsilon - (\epsilon - \theta)$$

This expression states that the average bribe equals the expected surplus created when dealing with the corruptor minus the latter's share. Given the limits of P computed above, we get $\lim_{\theta \to 0} \beta = \lim_{\theta \to \epsilon} \beta = 0$. Since P is strictly concave in θ so is β. It follows that β has a hump-shaped form as a function of θ over $(0, \epsilon)$. □

The opportunity of corruption is not a boon for the agent: it creates moral hazard and lowers the value of her services. She gets paid less by the public, so the corruptor can secure her services for less. From her point of view, $\theta = \epsilon$ is an ideal point since she then gathers all the surplus (see figure 1). She benefits from a high surplus environment because there is no corruption and from a high transfer from the public because of the tough potential competition from the corruptor. If transparency is low ($\theta < \epsilon$), the agent would support an effort to improve it. If it is high, she would advocate relaxing it: doing so would not increase corruption but would increase her transfer from the public.

The effect of a change in ϵ is more ambiguous. Starting from $\epsilon < 1$, a marginal increment in efficiency increases the agent's expected payoff (6) by

$$-(1-P) - (1-\epsilon)\frac{\partial P}{\partial \epsilon} \tag{7}$$

Using the limits given in proposition 3, this derivative reaches 0 when $\theta \to 0$ and diverges toward $-\infty$ when $\theta \to \epsilon$. Taking the cross-derivative yields

$$\frac{\partial P}{\partial \theta} - (1-\epsilon)\,\frac{\partial^2 P}{\partial \theta \partial \epsilon} < 0$$

It follows that (7) is negative over $(0, \epsilon]$. When $\theta \geq \epsilon$, with no corruption, we have shown that the agent's payoff ϵ/θ increases with ϵ. That conclusion is reversed here for the cases $\theta < \epsilon$ where this is a strictly positive prevalence of corruption.

In figure 1, the agent's payoff π, as a function of θ, is drawn with a full line for the case $\epsilon = \frac{1}{3}$ and with a dashed line for the case $\epsilon = \frac{2}{5}$. The two curves cross at point a which would be close to the unique spike if that was a marginal change. Given θ, an increase of ϵ decreases the agent's payoff when there is corruption on the left side of $\frac{1}{3}$ and increases it when there is no corruption on the right side of $\frac{2}{5}$.

The last part of proposition 3 establishes the somewhat paradoxical result that an improvement in transparency could lead to an increase in corruption as measured by the average bribe β. Hence, given ϵ and as θ increases over $[0, \epsilon]$, the average bribe β goes from nil to positive and back to nil when the prevalence of corruption vanishes at $\theta = \epsilon$.

Hence, improving transparency increases corruption when transparency is so low that the corruptor does not have to bid aggressively to secure the agent's favour. As transparency improves, the value of the agent's services increases and the corruptor increases his bid accordingly. Observing more money into corruption is not necessarily a sign that corruption worsens: it may signal that the corruptor has a harder time than before to secure his influence.

5. Conclusion

Improved transparency reduces the prevalence of corruption but it may lead to more money being poured into corruption. Like in any moral hazard setting, the agent suffers from the opportunity of getting corrupted as it lowers the expected value of her services: she should welcome any reduction of its prevalence. Yet, she benefits from the potential presence of a passive corruptor whose presence compels the public to pay her competitive benefits. As a result, the agent will favour the lowest transparency regime compatible with a zero prevalence of corruption.

There are two effects at play in the corruption game. Both depend on the ability of the public to monitor the agent's action. First, there is a competition effect previously identified in the literature: to prevent corruption, the public must match the value of the agent's action from the corruptor's point of view. Imperfect information lowers the effectiveness of the public incentives but these get better as transparency improves. Second, there is an efficiency effect: as transparency improves, the agent is more likely to choose the efficient action; there is thus more monetary incentives available to influence her to do so. The latter effect only occurs in a (inefficient) mixed strategy equilibrium.

Our theory of corruption explicitly relies on imperfect information. When transparency is low, bouts of corruption actually happen in equilibrium if the corruptor offers the agent a better deal than the public. It is only when $\theta \geq \epsilon$ that we get a pure strategy equilibrium with no corruption; then imperfect information has only a competitive effect upon the sharing of total surplus between the public and the agent. Yet, we have assumed throughout that the corruptor could perfectly monitor the agent. When we relax that assumption, we can show that there is never an equilibrium in pure strategies. Hence, both the competitive and efficiency effects are expected to be at play in a more general setting.

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Appendix A.

Proof. Proof of Proposition 3

The following inequalities hold for $x > 0$.

$$\frac{x}{1+x/2} < \ln(1+x) < \frac{x(1+x/2)}{1+x} \tag{A.1}$$

The first one is established by Love (1980). To prove the second one, let $f(x) = \dfrac{x(1+x/2)}{1+x} - \ln(1+x)$. Notice that $f(0) = 0$ and consider that its derivative

$$f'(x) = \frac{1}{2}\left(\frac{x}{1+x}\right)^2$$

is null in $x = 0$ but strictly positive for $x > 0$.

1. Let $P : S \to [0, 1]$ denotes the function that yields the equilibrium probability of political corruption as a function of (θ, ϵ). Let

$$x = \theta\,\frac{1-\epsilon}{\epsilon-\theta}$$

Then,

$$\begin{aligned}
P(\theta,\epsilon) = \text{Prob}\,(b \geq \theta u) &= \int_0^\theta F(b/\theta)\frac{\partial G}{\partial b}(b)db \\
&= (\epsilon-\theta)\,\frac{1-\theta}{\theta}\int_0^\theta \frac{1}{\epsilon-b}\,\frac{1}{(1-b)^2}db \\
&= \frac{\epsilon-\theta}{1-\epsilon}\left(\frac{1}{1-\epsilon}\,\frac{1-\theta}{\theta}\,\ln\left(\epsilon\,\frac{1-\theta}{\epsilon-\theta}\right) - 1\right) \\
&= \frac{\theta}{\epsilon\, x}\left(\frac{1+x}{x}\,\ln(1+x) - \epsilon\right) \qquad \text{(A.2)}
\end{aligned}$$

2. P strictly decreases with θ and strictly increases with ϵ.
Let

$$A = \frac{1+\theta}{\epsilon-\theta^2}\,\frac{2\epsilon-\theta-\theta\epsilon}{2}$$

The partial derivative of P with respect to θ is

$$\frac{\partial P}{\partial \theta} = \frac{\epsilon-\theta^2}{\theta^2(1-\epsilon)^2}\left(\frac{x}{1+x/2}\,A - \ln(1+x)\right) \tag{A.3}$$

Given that $1 > \epsilon > \theta > \theta^2 > 0$, the sign of this expression is the same of that of the term with parentheses. Given the first inequality in (A.1), we establish that (A.3) is negative by showing that $A < 1$.

$$\begin{aligned} \theta^2(1-\epsilon) &< \theta(1-\epsilon) \\ \theta\epsilon - \theta^2\epsilon - \theta &< -\theta^2 \\ (2\epsilon - \theta^2) + \theta\epsilon - \theta^2\epsilon - \theta &< (2\epsilon - \theta^2) - \theta^2 \\ (1+\theta)(2\epsilon - \theta - \theta\epsilon) &< 2(\epsilon - \theta^2) \\ A &< 1 \end{aligned}$$

The partial derivative of P with respect to ϵ is

$$\frac{\partial P}{\partial \epsilon} = \frac{1-\theta}{\theta} \frac{1+\epsilon-2\theta}{(1-\epsilon)^3} \left(\ln(1+x) - B \frac{x}{1+x/2} \right) \tag{A.4}$$

where

$$B = \frac{1+\epsilon}{\epsilon} \frac{1}{1+\epsilon-2\theta} \frac{2\epsilon - \theta - \theta\epsilon}{2}$$

Notice that $1 > \epsilon > \theta$ implies that $1 + \epsilon - 2\theta > 0$. Given the first inequality in (A.1), we establish that (A.4) is positive by showing that $B < 1$.

$$\begin{aligned} 2\epsilon(1-\theta+\epsilon) &< 2\epsilon(1-\theta+\epsilon) + \theta(1-\epsilon)^2 \\ 2\epsilon(1-\theta+\epsilon) - \theta - \theta\epsilon^2 &< 2\epsilon + 2\epsilon^2 - 4\theta\epsilon \\ (2\epsilon - \theta - \theta\epsilon)(1+\epsilon) &< 2\epsilon(1+\epsilon-2\theta) \\ B &< 1 \end{aligned}$$

3. The second derivative with respect to θ can be written as

$$\frac{\partial^2 P}{\partial \theta^2} = \frac{2\epsilon}{\theta^3(1-\epsilon)^2} \left(\ln(1+x) - \frac{x(1+x/2)}{1+x} \right) < 0$$

which is negative because of the second inequality in (A.1). So P is strictly concave in θ.

4. To establish that $\lim_{\theta\to 0} P = 1$ and that $\lim_{\theta\to\epsilon} P = 0$, use (A.2). In the latter case, the limit reduces to that of $-(\epsilon - \theta)\ln(\epsilon - \theta)$ when $\theta \to \epsilon$, which is that of $-y\ln(y)$ when $y \to 0$, which is zero. The same applies to the limits of derivatives.

5. P is strictly supermodular.
   First, a few preliminary definitions.
   - Define $Q = 1 + \epsilon - 2\theta^2$. We have $1 - \theta^2 > \epsilon - \theta^2 > 0$. Summing these inequalities yields $Q > 0$.
   - Define $R = 1 + x/2 + (1-\epsilon)(x/Q)\left(\frac{1}{2} - \theta\right)$ so that $\theta \leq \frac{1}{2}$ implies that $R \geq 1 + x/2$.
   - The function $2s^2/(2s-1)$ is greater than 2 on $(\frac{1}{2}, 1)$. The function $s(1+s)$ is lesser than 2 on the same open interval. With $\frac{1}{2} < \theta < \epsilon < 1$, it follows that

$$\begin{aligned} \frac{2\theta^2}{2\theta - 1} &> 2 > \epsilon(1+\epsilon) \\ 1 &> \frac{2\theta - 1}{2\theta^2}\epsilon(1+\epsilon) \\ 1 + \epsilon - \theta &> \frac{2\theta - 1}{2\theta^2}\epsilon(1+\epsilon) \\ 2\theta^2(1 + \epsilon - \theta) &> (2\theta - 1)\epsilon(1+\epsilon) \end{aligned}$$

   Define $S = 2\theta^2(1 + \epsilon - \theta) - (2\theta - 1)\epsilon(1+\epsilon)$. We have just shown that $S > 0$ when $\theta > \frac{1}{2}$.

   Direct derivation yields

$$\frac{\partial P}{\partial\theta\partial\epsilon} = \frac{Q}{\theta^2(1-\epsilon)^3}\left(\frac{x}{1+x}R - \ln(1+x)\right) \tag{A.5}$$

   If $\theta \leq \frac{1}{2}$ then $R \geq 1 + x/2$. Using the r.h.s. of (A.1)

$$\frac{\partial P}{\partial\theta\partial\epsilon} > \frac{Q}{\theta^2(1-\epsilon)^3}\left(\frac{x(1+x/2)}{1+x} - \ln(1+x)\right) > 0$$

To establish that the derivative remains positive for higher values of θ, we show that the bracketed term in (A.5) increases with θ. Since (A.5) holds in $\theta = \frac{1}{2}$, then

$$\frac{x}{1+x}R - \ln(1+x) > 0 \tag{A.6}$$

holds as well in $\theta = \frac{1}{2}$. When $\theta > \frac{1}{2}$, the derivative of (A.6) with respect to θ equals

$$\frac{1}{\theta^2}\frac{x}{1+x}\left(\frac{x}{Q}\right)^2 S > 0$$

It follows that (A.6) holds also for $\theta > \frac{1}{2}$ and that (A.5) is positive for these values. $\square$