Bargaining for bribes: The role of moral costs and imperfect information*

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Abstract

A corrupt transaction is often the result of bargaining between the parties involved. This paper models bribery as a double auction where a private citizen and a public official strategically interact as the potential buyer and the potential seller of a corrupt service. Individuals differ in the internalized moral cost generated by corruption. Additionally, the total cost associated with corruption is subject to strategic complementarities. We ask under which conditions we can observe honesty or systemic corruption in equilibrium, or multiple equilibria, when individuals have either perfect or imperfect information with respect to the "intrinsic corruptibility" of their corruption partner. We find that corruption is lower when potential bribers and potential bribees are uncertain regarding the corruptibility of their opponent. This paper therefore provides theoretical support to anti-corruption strategies, such as staff rotation in public offices, aimed at decreasing the social closeness of bribers and bribees.

JEL Classification: D72, D82, Z13
Key words: bribery, moral cost, double auction, imperfect information, multiple equilibria

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1 Introduction

Corruption is usually defined as the "abuse of public power for private gain". Bribery, the most common form of corruption, is referred to as illegal provision of public services or goods in exchange for private monetary compensations[1]. It follows that the potentially corrupt people in a society are, by definition, public officials. This explains why economic theories of corruption have mainly focused on the supply side of the corruption market, either looking at ways to control the moral hazard of public servants in principal-agent-client models [following Becker and Stigler (1974), Rose-Ackerman (1978) and Klitgaard (1988)][2] or, more recently, modelling corruption as a frequency-dependent phenomenon, subject to strategic complementarities in the public officials' economic incentives[3]. These theories do not usually take into account the role that intrinsic motivations or moral costs may play on one's decision to act corruptly; when they do [Klitgaard (1988) and Andvig and Moene (1990)] they focus on the supply side of the market only.

Intrinsic motivations result from the internalization of social norms, *i.e.* behavioral rules enforced internally by feelings of guilt and externally by social disapproval and sanctions leading to feelings of shame, through primary and secondary socialization[4]. Given that bribery involves not only public officials, *i.e.* the sellers of illicit public services or goods, but also private citizens (or firms), *i.e.* the buyers of the illicit services or goods, and given that each individual is exposed, to some extent, to behavioral rules and socialization processes, intrinsic motivations are likely to affect not only the supply side but also the demand side of any corrupt transaction. Moreover, like economic incentives, intrinsic motivations may also be subject to strategic complementarities: the more people obey a norm, the more likely it is

[1] Typical forms of corruption are: bribery, embezzlement, fraud and extortion (see Klitgaard, 1988 among the others). In this work I especially refer to petty corruption, i.e. bribery transactions which are likely to occur in every day life and involve relatively small amounts of money.

[2] These models assume a benevolent principal and suggest various policies to control the behaviour of the potentially corrupt agent. However, in real life those in power, i.e the principals, are usually not as benevolent as these models suggest, since they are often those who benefit most from corruption.

[3] When corruption is widespread, the likelihood for a public official to act corruptly is relatively higher, due to the lower cost of being caught and punished, and the higher chance of finding corruption partners. See Andvig and Moene (1990), Cadot (1987) and Lui (1986) among the others. Bardhan (1997) provides a review of the most recent theories of corruption.

[4] See Benedict (1934), Parsons (1967), Grusec and Kuczynski (1997).

for an individual to internalise that norm[5].

This work focuses on the demand and the supply side of the corruption market by: 1) investigating the decision to engage in corruption of both public officials (potential bribees) and private citizens (potential bribers) and 2) allowing for the presence of strategic complementarities in the extrinsic incentives and the intrinsic motivations of potential bribers and bribees.

Recent empirical micro-evidence (Svensson, 2003, and Reinikka and Svensson, 2004) suggests that the amount of the bribe paid by a citizen or a firm is often the result of bargaining between the parties[6]; this would explain within-country and within-sector variations in both the frequency of corrupt transactions and the amount bribed in exchange for a certain service. Svensson (2003), for instance, using Ugandan firms' micro-data finds that the amount of the bribe firms pay, if any, depends on both their "ability to pay" and their "refusal power". Reinnika and Svensson (2004) study the amount of funding received by Ugandan schools from the district governments (out of the amount sent by the central government). Given the observed variation in both the number of schools that received grants and the amount they received, the authors suggest that the interaction between local officials and schools might be studied as a bargaining game[7].

Following these recent empirical findings, the present work models bribery as a double auction where a private citizen and a public official strategically interact as the potential buyer and the potential seller of a corrupt service. This setting also makes it possible to explore the micro-determinants of corruption without having to assign the role of "initiator" of the transaction to either the briber or the bribee. Instead, we can investigate the conditions under which both parties are willing to engage in or abstain from corruption. We first look at the strategic interaction between a typical citizen and a typical public official; we then turn to society as a whole and ask if and when honesty or systemic corruption could be sustain as an equilibrium, and when we could observe multiple equilibria.

Finally, we investigate the role that imperfect information with respect to the moral cost associated with corruption plays on one's willingness to

[5] For formal models see: Akerlof, G. (1980), Cavalli-Sforza, and Feldman (1981), and Boyd and Richerson (1985). Tirole (1996) also studies corruption as a "societal phenomenon" (page 2), however he adopts a multi-generational approach where one's decision to act corruptly positively depends on the level of corruption among the elder members of the same group due to inherited reputation in matters of corruption.

[6] This seems to be especially true where corruption is not yet systemic, or not "organized". See Shleifer and Vishny (1993).

[7] Richer schools, in well-endowed areas, were able to secure more grants because of their higher bargaining power.

engage in bribery, and, consequently, the equilibrium level of corruption in the society. Models of corruption with strategic complementarities typically maintain the assumption of perfect information among the parties. On the contrary, principal-agent-client models of corruption always point at imperfect information as an important cause of corruption, however they only refer to imperfect information on the part of the principal with respect to the actions and/or morality of the agent (Klitgaard,1988). Empirically, a few recent micro-based studies of corruption have shown that imperfect information on the demand side – typically on the form of uncertainty with respect to the amount to be bribed – has a negative impact on the probability for a firm to pay a bribe (Herrera and Rodriguez, 2003[8]) and a country's overall level of corruption (Lambsdorff, 2007). We address this issue theoretically.

Our findings can be summarized as follows. First of all, honesty (corruption) can be sustained as an equilibrium when: 1) the benefit that corruption generates on the briber is small (large), 2) the administrative cost required in order to provide the corrupt service is large (small), and 3) the distribution of the moral cost associated with corruption in the society is such that the lowest possible moral cost is relarively large (small). We can observe multiple corruption equilibria when, while the benefit generated by corruption is low and the administrative cost associated with the corrupt service is large, the highest possible moral cost associated with corruption in the society is small and the lowest possible moral cost associated with corruption in the society is large.

Second, when agents are uncertain about the intrinsic corruptibility of their potential corruption partner, they are less likely to engage in corruption. This translates into a lower probability for society to end up in a systemic corruption "trap". Additionally, any anti-corruption policy is more effective in reducing the equilibrium level of corruption. This is especially true when the briber and bribee differ in their bargaining power over the amount to be bribed.

It is reasonable to think that bribers and bribees who do not know each other are more likely to be uncertain about their opponent's intrinsic corruptibility. Thus, our finding of lower corruption under uncertainty provides theoretical support to anti-corruption strategies, such as staff rotation in public offices, aimed at decreasing the social closeness of bribers and bribees[9].

[8] Using firm-level data from the Business Environment Survey they show that "predictable and effectual corruption regimes increase the frequency of bribery and the total monetary cost of corruption to firms".

[9] Staff rotation has been recently presented as an effective anti-corruption measure. See

The paper is organized as follows. Section 2 presents our double auction model of bribery and Section 3 derives the corruption equilibria under perfect information. Section 4 introduces imperfect information with respect to one's opponent's moral cost and compares the results obtained under perfect and imperfect information. Section 5 concludes with a summary of the main findings and policy implications.

2 A double auction model of bribery

Two agents, a private citizen and a public official, have to decide whether or not engage in corruption. A corrupt transaction would involve the payment of a bribe by the private citizen in exchange for the provision of an illicit service by the public official. Citizen and official have independent private valuations for the corrupt service. The citizen's private valuation is equal to the monetary benefit generated by the service minus the total cost associated with corruption, where the total cost is equal to the expected cost of being caught and punished plus the moral cost generated by corruption. The official's private valuation for the corrupt service is equal to the cost he would have to sustain in order to provide the service, plus the expected cost of being caught and punished and the moral cost generated by corruption.

Citizen and official simultaneously decide the amount of the bribe, if any, that they would be willing respectively to pay and take in order for the corrupt transaction to occur. These bribes correspond to sealed bids in a traditional double auction, where the private citizen is the buyer and the public official is the seller of the service. I will use the suffixes b and s for the variables referring respectively to the citizen and the official.

A corrupt transaction occurs if and only if the bribe "submitted" by the private citizen, b_b, is higher than or equal to the bribe "submitted" by the public official, b_s[10]. If the conditions for a transaction to take place

Ali (2000) for a successful example of reduction in corruption following the introduction of staff-rotation in Singapore. Staff-rotation is usually thought of as a way to break long-term corruption relationships between regular bribers and bribees and introduce uncertainty about the trustworthiness of one's potential corruption partner. Using data from a bribery experiment, Abbink (2004) shows that staff rotation could indeed be an effective way to control corruption in situations where briber and bribee repeatedly interact. Our approach is partially different, as we focus on one-shot bribery transactions. Here, the potential relevance of staff rotation in public officices relies on the possibility to introduce uncertainty regarding the intrinsic corruptibility of one's potential corruption partner, keeping the assumption that if a bribe is paid the corrupt service is delivered.

[10] Note that in this setting we exclude the possibility for a corrupt official to take the bribe without providing the corrupt service. In this way we are able to focus on the

are met, the citizen and the public official negotiate the final amount of the bribe in the range of mutually agreeable bribes. The final bribe is equal to $b = kb_b + (1-k)b_s$, with $0 \leq k \leq 1$ (see Chatterjee and Samuelson, 1983). The parameter k represents the bargaining power of the private citizen relative to the bargaining power of the public official. When $k = 1$ we can think of a situation where the private citizen initiates the transaction by offering a bribe b_b which the public official can only decide to accept or reject. If instead $k = 0$ we can think of a situation where the public official initiates the transaction by asking for a bribe b_s which the private citizen can only decide to pay or not pay. It is reasonable to assume that k negatively depends on the total number of citizens demanding the service relative to the total number of public officials supplying the service. In other words, the bargaining power of each private citizen is likely to be smaller the higher the competition for the service among the citizens and the lower the competition for the service delivery among the public officials.

If corruption takes place each agent i suffers a cost c_i, which we define as:

$$c_i(x) = a_i - x,$$

where: x is the proportion of corrupt people in the population, *i.e.* the people who actually paid or received a bribe in exchange for a corrupt service, with $0 \leq x \leq 1$, whereas a_i represents an internalized moral cost, which is acquired through primary and secondary socialization, and we assume is uniformly distributed over the interval $[1, \overline{a}]$. Therefore the total cost associated with corruption c_i takes into account both the guilt which an individual may feel if acting corruptly and the strategic complementarities associated with corruption – the more people are corrupt, the lower the probability of being caught and sanctioned and the lower the feeling of shame activated by social disapproval[11]. It follows that corruption has no cost for an individual if and only if he is intrinsically corrupt and the whole society is corrupt, *i.e.,* $a_i = 1$ and $x = 1$.

As previously stated, the private citizen's net valuation for the corrupt service, v_b, is equal to the monetary benefit generated by the corrupt service, y, minus the cost associated with corruption, c_b:

private citizen's decision to act corruptly unconditional on the level of trust he has on his corruption partner. Trust represents an additional "corruption issue" which especially applies to grand corruption, where corrupt agreements are more likely to have a long-term nature and tend to repeatedly take place among the same corruption partners.

[11] Note that expected punishment enters the cost function through the endogeneous variable x, due to our assumption of strategic complementarities.

$$v_b = y - a_b + x,$$

with $y \geq 1$. Note that v_b also represents the citizen's "reservation bribe" for the corrupt service, *i.e.* the highest bribe that he/she is willing to pay in exchange for the service. Therefore the bribe that the citizen declares to be willing to pay, b_b, cannot exceed his/her private valuation of the service:

$$b_b \leq y - a_b + x = v_b.$$

We now turn to the public official. His private valuation for the corrupt service, v_s, which also corresponds to the lowest bribe he is willing to take in exchange for the corrupt service, is equal to the administrative cost of providing the service, q, plus the cost associated with corruption, c_s:

$$v_s = q + a_s - x.$$

Note that the administrative cost to provide the corrupt service, for instance the cost of falsifying/ hiding documents, is likely to be lower the higher the discretionary power of the official, and the more vague or complex the rules and the regulations associated with the service. The bribe that the official declares to be willing to take in exchange for the provision of the service, b_s, needs to be larger than or equal to his private valuation for the service:

$$b_s \geq q + a_s - x = v_s.$$

If $b_b \geq b_s$ the transaction occurs and the citizen pays the final bribe $b = kb_b + (1-k)b_s$ to the official. If $b_b < b_s$, the transaction does not occur.

We first investigate the equilibrium levels of corruption when citizens and officials have perfect information about each other's intrinsic moral cost (Section 3), and then introduce imperfect information in one's opponent's moral cost (Section 4).

3 Bribery under perfect information

Consider a society where everybody knows how beneficial a certain corrupt service would be to any private citizen, and how difficult it would be for any official to provide the service, given the specific regulations and the control system associated with it, *i.e.* y and q are perfectly known. Moreover, the actions as well as the intrinsic motivation of every individual are perfectly observable. It follows that every time a citizen and a public official meet and have to decide whether act honestly or corruptly, they can perfectly observe their opponent's private valuation for the corrupt service. Consequently, each citizen knows the minimum bribe that his opponent would be willing to take in exchange for the corrupt service, and each official knows the maximum bribe that his opponent would be willing to pay in exchange for the corrupt service. For a corrupt transaction to take place under perfect information the private citizen's valuation for the corrupt service needs to be larger than the public official's valuation:

$$v_b = y - a_b + x \geq q + a_s - x = v_s.$$

If the above condition is met, any bribe b such that $v_s \leq b \leq v_b$ can be sustained as an equilibrium bribe, *i.e.* there are multiple equilibrium bribes**.**

Rearranging the condition for corruption to take place, we get:

$$a_s + a_b \leq y - q + 2x. \tag{1}$$

Those private citizens and public officials whose combined moral costs are lower than the total gains from corruption, agree on a corrupt transaction. This is more likely to happen the larger the monetary benefit that the private citizen receives from the transaction, the lower the administrative cost the public official needs to sustain to provide the corrupt service (higher discretionary power) and the higher the level of corruption in the population, as the probability of being detected and formally or informally punished is relatively lower.

Define A as the sum of the citizen's and the official's moral costs, *i.e.* $A = (a_s + a_b)$. As the intrinsic moral costs of citizen and official are independently distributed according to a uniform distribution over the interval $[1, \overline{a}]$, it follows that A is distributed according to a triangular distribution over the interval $[\underline{A}, \overline{A}]$ where $\underline{A} = 2\underline{a} = 2$ and $\overline{A} = 2\overline{a}$. Then the proportion of corrupt people, or corrupt transactions, in the population, x, is implicitly defined as:

$$x = F[y - q + 2x] \tag{2}$$

where F is the cumulative distribution of a triangular distribution defined over the interval $[2, 2\overline{a}]$, and with median equal to $\overline{a} + 1$.

3.1 Possible equilibria under perfect information

The proportion of corrupt transaction or corrupt people that we observe in equilibrium depends on: the distribution of the internalized moral cost a_i over the population of citizens and officials, the lowest and highest values that a_i can assume, the benefit that corruption generates on the citizen, y, and the administrative cost that the official needs to sustain to provide the corrupt service, q. We can distinguish four cases.

Case 1) *Systemic corruption*: The situation where everybody is corrupt, $x = 1$, can be sustained as an equilibrium if:

$$\overline{A} \leq y - q + 2, \tag{3}$$

that is, even the moral costs of the "most intrinsically honest" citizen-official pair in the society are not large enough to oppose the incentives associated with corruption when the whole population is behaving corruptly. The condition above suggests that we are more likely to observe $x = 1$ in equilibrium when the net benefit generated by corruption $(y-q)$ is relatively large, *i.e.* when the administrative cost to provide the service is relatively small (the discretionary power on the public official is relatively high) and/or the benefit to the private citizen is relatively large. Society is also more likely to be trapped in a systemic corruption equilibrium when the highest possible moral cost generated by corruption in the society is relatively small.

Case 2) *Honesty*: The situation where everybody is honest, *i.e.* $x = 0$, can be sustained as an equilibrium if:

$$\underline{A} = 2 \geq y - q. \tag{4}$$

that is, even the moral costs of the "most intrinsically corrupt" citizen-official pair, those with the moral cost equal to $\underline{a}$ =1, are larger than or equal to the net benefit associated with corruption when everybody in the population is behaving honestly. The condition for honesty suggests that we are more likely to observe $x = 0$ in equilibrium when the net benefit generated by corruption $(y - q)$ corruption is relatively small, *i.e.* when the administrative cost to provide the service is relatively large (the discretionary power on the public official is relatively small) and/or the benefit to the private citizen is relatively small. Society is also more likely to permanently stay in a honesty equilibrium when the lowest possible moral cost associated with corruption is relatively large.

Case 3) *Honesty, systemic corruption and interior equilibria*: We have both a corruption and a honesty equilibrium iff:

$$\overline{A} - 2 \leq y - q \leq 2. \tag{5}$$

Moreover, if (5) is satisfied we also have *at least one* interior corruption equilibrium x^* which satisfies:

$$x^* = F[y - q + 2x^*]. \tag{6}$$

Condition (5) suggests that we are more likely to observe multiple equilibria when the highest possible moral cost generated by corruption, $\overline{a}$, is relatively small and when the net benefit from corruption $(y - q)$ is also relatively small.

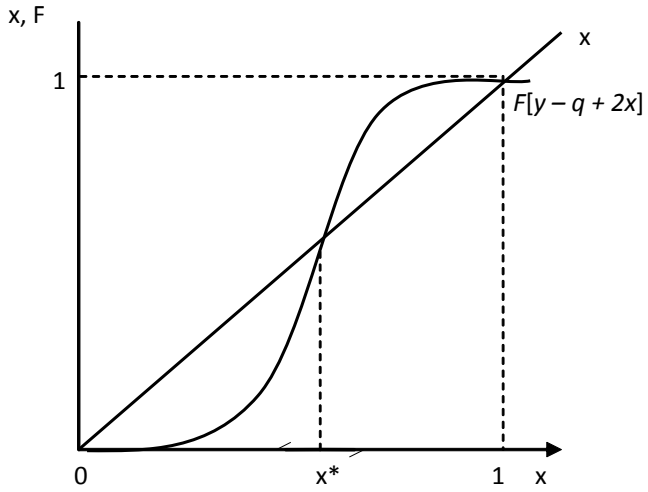
Figure 1 illustrates the three corruption equilibria, $x = 0$, $x = 1$, and $x = x^*$, keeping our assumption of $f(\cdot)$ being a triangular distribution[12].

It is straightforward to see that the interior equilibrium is unstable in the following sense: if the proportion of corrupt people is larger than x^*, the process converges to the systemic corruption equilibrium, whereas if the proportion of corrupt people is smaller than x^* the process converges to the honesty equilibrium. To see why, assume that $x = x^* + \theta$, for small positive θ. Since due to strategic complementarities a higher proportion of corrupt people in the population lowers the total cost associated with corruption, the probability for a corrupt transaction to take place, $F(y - q + 2x)$, is

[12] Note that our results hold for any bell-shaped distribution function.

now greater than the actual proportion of corrupt people, x. This causes the proportion of corrupt people to increase. The process continues until x reaches the systemic corruption equilibrium. A similar process, in the opposite direction, holds if $x = x^* - \theta$.

Figure 1



Case 4) *Interior corruption equilibria*: Neither "honesty" nor "systemic corruption" can be sustained in equilibrium iff:

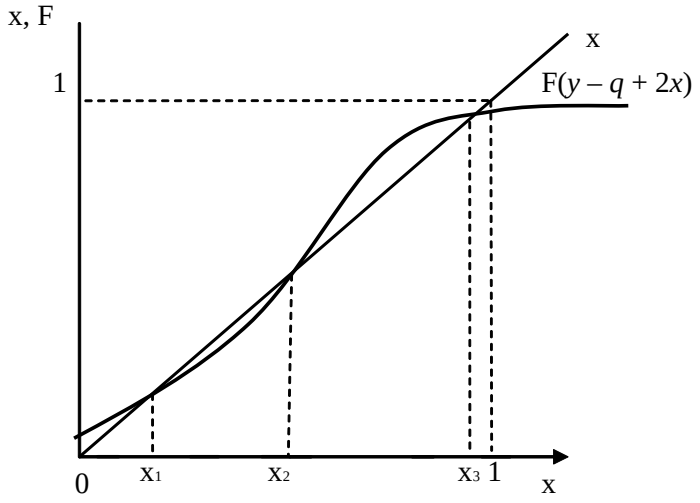
$$\overline{A} - 2 > y - q > 2, \tag{7}$$

If the above condition is satisfied we have at least one interior corruption equilibrium x^* which satisfies:

$$x^* = F[y - q + 2x^*]$$

Figure 2 shows that when $x = 1$ the $F[y - q + 2x]$ curve is now below the 45 degree line. This is because $\overline{A} > y - q + 2$, which means that at least the most intrinsically honest citizens and public officials now abstain from corruption even when $x = 1$. On the other hand, when $x = 0$, the $F[y - q + 2x]$ is now above the 45 degree line. This is because $2 < y - q$, which means that at least the most intrinsically corrupt citizens and public officials now engage in corruption even when $x = 0$.

Figure 2



We could still have multiple equilibria, as shown in Figure 3, however the equilibria would all be interior. Moreover, as in *Case 3*, only the highest and lowest corruption equilibria (x_1 and x_3 in the figure) would be stable.

3.2 Comparative statics

As seen in equations (1) to (7) the values of y, q, a_s and a_b, as well as the initial level of corruption, determine the corruption equilibrium society will end up in. From equation (1) we saw that the greater the monetary benefit to the briber, y, the smaller the administrative cost required to provide the corrupt service, q, the smaller the moral costs of briber and bribee, a_s and a_b,the lower the proportion of corrupt people in the population, x (as this affect the total cost associated with corruption), the more likely is for a corrupt transaction to take place. We can now investigate which policies could be effective in reducing corruption.

First of all, acting on the severity of the penalty or the probability for a corrupt pair to be discovered would not be necessarily effective in our framework. Recall that the expected cost of formal and informal punishment enters the cost function through the proportion of corrupt people, x, due to the presence of strategic complementarities in both the extrinsic incentives and the intrinsic motivations associated with corruption. Our setting implies that the effectiveness of anti-corruption policies aimed at increasing

the probability for a corrupt citizen (briber) or a corrupt official (bribee) to be discovered and severily punished depends on how corrupt society already is. If the level of corruption is high, increasing the penalty associated with corruption is likely to be ineffective. This is due to the fact that potential bribers and bribees would still believe that the likelihood for them to be discovered is very low and that, even in the unlikely case of detection they could still escape the severe sanction through bribery. Similarly, increasing the probability for corrupt people to be detected, for example by increasing the number of officials in charge of vertical and horizontal controls in public offices, is also likely to prove ineffective when the level of corruption is high, since potential bribers and bribees would expect the inspecting officials to be willing to accept bribes themselves, in exchange for turning a blind eye.

Our setting suggests that an effective anti-corruption measure would be to increase the administrative cost of providing the corrupt service, for example by lowering the discretionary power of the public officer. Indeed, equation (1) suggests that an increase in q would reduce the likelihood for a corrupt agreement to take place. The increase in q could make at least the most intrinsically honest citizens and officials in the population turn from corruption to honesty.

Figure 3

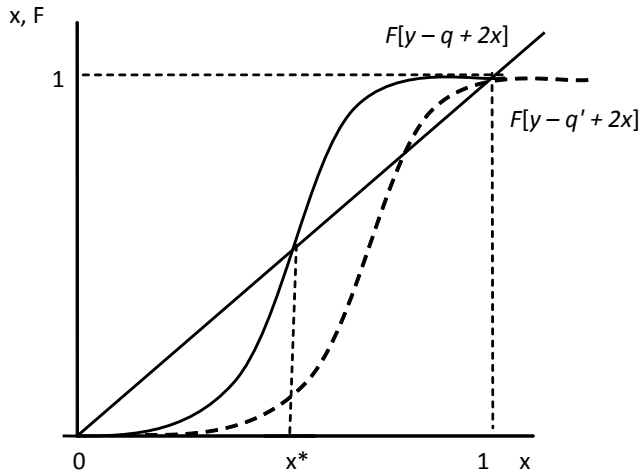


Figure 3 shows how, in a situation of multiple corruption equilibria, an increase in q would shift the $F[y - q + 2x]$ curve to the right, causing the unstable interior equilibrium to increase, that is reducing the "jump" needed in order for society to move from the systemic corruption to the honesty

equilibrium. A large enough increase in q could ultimately eliminate both the systemic corruption equilibrium and the interior unstable equilibrium, by making it optimal for all the citizen-official pairs in the society to behave honestly.

Figure 4

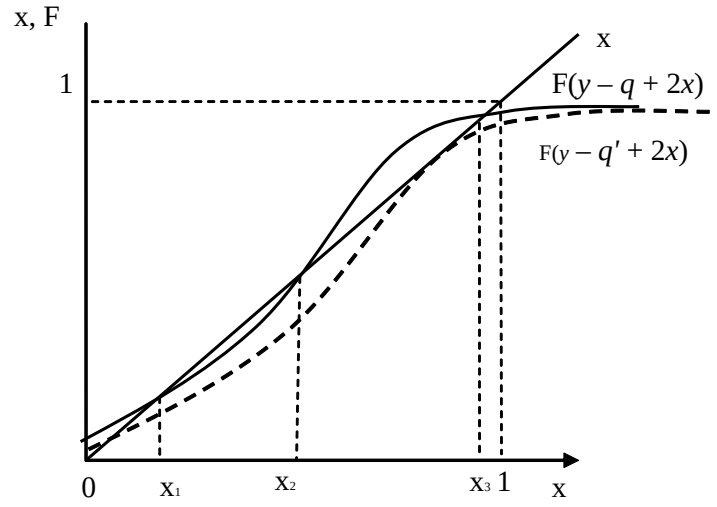


Figure 4 shows the effect of an increase in the administrative cost of providing the corrupt service in the presence of multiple interior corruprion equilibria. The shift of the $F[y-q+2x]$ curve to the right would in this case move the highest corruption equilibrium further from $x = 1$ and the lowest corruption equilibrium closer to $x = 0$, and could ultimately eliminate the high corruption equilibrium.

An alternative or complementary way of escaping a high corruption trap would be to modify the distribution of the moral cost associated with corruption in the society, such that for any given level of y, q and x, the monetary incentives of fewer briber-bribee pairs will be high enough to compensate for the higher intrinsic costs generated by corruption. For instance, public awareness campaigns and educational programs able to increase the moral cost a_i of any individual i in the population by a positive fraction z, would shift the cumulative distribution function of $(a_s + a_b)$, in a similar way as depticted in Figure 3 and Figure 4, for any given y, q and x. This would result in either a higher unstable interior corruption equilibrium, *i.e.* a

smaller "jump" required to move from the high corruption to the low corruption equilibrium, or, if z is large enough, in the elimination of the high corruption equilibrium.

3.3 Summary of results under perfect information

1) A situation where everybody behaves honestly can be sustained as a stable equilibrium only if the lowest possible moral cost generated by corruption in the society is relatively large and the net benefit from corruption - the monetary payoff to the citizen minus the administrative cost sustained by the official to provide the service - is relatively small.

2) A situation where everybody acts corruptly can be sustained as a stable equilibrium, *i.e.* a "corruption trap", only if the highest possible moral cost generated by corruption in the society is relatively small and net benefit from corruption-the monetary payoff to the citizen minus the administrative cost sustained by the official to provide the service- is relatively large.

3) When both the net benefit from corruption and the highest possible moral cost generated by corruption in the population are especially small, society could end up either in a situation where everybody behaves honestly or in a situation where everybody behaves corruptly. The final equilibrium will depend on the initial proportion of corrupt people in the population being larger or smaller than a critical value, x^*. Intuitively the "initial" proportion of corrupt people could be seen as the expectation that citizens and officials have with respect to the level of corruption in society. Recall that x affects one's decision to act corruptly by entering the cost associated with corruption negatively, as the more people are corrupt the lower the probability of being caught and being formally or informally punished. If, for instance, citizens and officials expect many others to be corrupt, they will be more likely to act corruptly themselves; by increasing the proportion of corrupt people this will in turn lower others' expected cost associated with corruption and therefore their likelihood of acting corruptly. The process continues until society reaches the systemic corruption equilibrium.

4) When the net benefit from corruption and the highest possible moral cost associated with corruption in the population are especially large, society could end up either in a situation where "most people" behave honestly or in a situation where "most people" behave corruptly. The final equilibrium will depend on the initial proportion of corrupt people in the population being larger or smaller than a critical value (x_2 in our example).

5) The proportion of corrupt people in equilibrium could be reduced by either increasing the administrative cost associated with the delivery of the

corrupt service (decreasing the discretionary power of the public official) or by implementing education programmes able to change the distribution of the moral cost in the population so that the intrinsic costs associated with corruption of every individual will be higher.

4 Bribery under imperfect information

Consider a society where, as before, everybody knows how beneficial a certain corrupt service would be to any private citizen, and how difficult it would be for any official to provide the service. While each individual is aware of how costly it would be for him to be involved in corruption, there is uncertainty with respect to the moral cost that his opponent would suffer if they engage in corruption. It follows that citizens and officials do not perfectly know the extent to which their opponent is corruptible. Both agents now face a trade-off between acting aggressively on the one hand - *i.e.* "submitting" a low bribe for the citizen and "submitting" a high bribe for the official in order to make higher profits in case of agreement - and, on the other hand, lowering the risk of disagreement - *i.e.* "submitting" a bribe close to the reservation bribe.

We ask whether uncertainty regarding the "intrinsic corruptibility" of one's potential corruption partner increases or decreases the likelihood for a bribery transaction to take place, and, consequently the overall level of corruption in the society.

Formally, we now assume that each individual knows his own total and intrinsic costs associated with corruption, yet he only knows the distribution of his opponent's intrinsic moral cost over the interval $[1, \overline{a}]$. This implies that each agent is aware that his opponent's total cost associated with corruption is uniformly distributed over the interval $[1-x, \overline{a}-x]$, for any given x. We set $1-x=\underline{c}$ and $\overline{a}-x=\overline{c}$ for convenience.

An individual i's Bayesian strategy b_i is defined as $b_i = B_i(c_i)$, indicating that for any given y and q the bribe that an agent declares to be willing to pay or take depends on his own intrinsic moral cost, *i.e.* his "type", as c_i determines the reservation price v_i. An agent i's strategy b_i constitutes a *best response strategy* if for any c_i the "submitted" bribe b_i is a best response to his corruption partner's Bayesian strategy. Any pair of best response strategies constitutes a Bayesian Nash Equilibrium.

The citizen-official game has many Bayesian Nash equilibria. However, we are ultimately interested in the equilibrium level of corruption in the society as a whole. Therefore a "corruption equilibrium", x^*, in our model

is defined as the fraction of corrupt citizen-official pairs/transactions which satisfies the following two conditions:

1) In the citizen-official Bayesian game, given x^*:

(i) the citizen plays a *best response strategy* to the official's Bayesian strategy;

(ii) the official plays a *best response strategy* to the citizen's Bayesian strategy;

2) The induced proportion of corrupt citizen-official pairs in the population, is consistent with x^*, $x = Prob[(\text{citizen bribes}|x^*) \cap (\text{official takes a bribe}|x^*)]$.

We investigate the corruption equilibria when the private citizen and the public official "submit" their bribes, b_b and b_s, by adopting linear strategies in their private valuations of the corrupt service[13], as follows:

1) $b_b = \alpha + \beta(v_b) = \alpha + \beta(y - c_b)$

2) $b_s = \gamma + \delta(v_s) = \gamma + \delta(q + c_s)$

The private citizen chooses b_b to maximize his expected gain from corruption, U_b, which is equal to the monetary gain he would get from corruption minus the (expected) final bribe that he would have to pay in case of agreement with the official, times the probability for an agreement to be reached:

$$U_b(b, c_b, y) = Pr(b_b \geq b_s)[y - c_b - kb_b - (1 - k)E(b_s|b_s \leq b_b)].$$

Note that $E(b_s|b_s \leq b_b)$ represents the bribe that the citizen expects the official to ask, conditional on this asked bribe being lower than what the citizen would be willing to pay, *i.e.* the condition for a transaction to occur needs to be met. Recall that c_s is uniformly distributed over the interval $[\underline{c}, \overline{c}]$. It follows that b_s is uniformly distributed over the interval $[\gamma + \delta(q + \underline{c}), \gamma + \delta(q + \overline{c})]$, which gives:

$$U_b(b, c_b, y, q) = \frac{b_b - \gamma - \delta(q + \underline{c})}{\delta(\overline{c} - \underline{c})}[y - c_b - kb_b - (1 - k)\frac{\gamma + \delta(q + \underline{c}) + b_b}{2}].$$

By setting $\frac{\partial U_b}{\partial b_b} = 0$ and solving for b_b, we obtain the best response strategy of the private citizen:

[13] Myerson and Satterthwaite (1983) show that adopting linear strategies in a standard double auction generates the highest probability for trade to occur under imperfect information. By assuming linear strategies in our double auction model of bribery we are therefore considering the worst case imperfect-information scenario with respect to the resulting level of corruption.

$$b_b = \frac{k}{k+1}[\gamma + \delta(q + \underline{c})] + \frac{1}{k+1}(y - c_b). \tag{8}$$

We now turn to the public official. He chooses b_s to maximize his expected gain from corruption, U_s, which is equal to the (expected) final bribe that he/she would receive in case of agreement minus the administrative cost he would have to sustain to provide the service, times the probability for an agreement to be reached:

$$U_s(b, c_s, y, q) = Pr(b_b \geq b_s)[(1-k)b_s + kE(b_b|b_b \geq b_s) - c_s - q].$$

As before, $E(b_b|b_b \geq b_s)$ represents the bribe that the official expects the citizen to offer in exchange for the corrupt service, conditional on this offer being larger than the bribe the official would be willing to take. Since c_b is uniformly distributed over the interval$[\underline{c}, \overline{c}]$, then b_b is uniformly distributed over the interval $[\alpha + \beta(y - \overline{c}), \alpha + \beta(y - \underline{c})]$, which gives:

$$U_s(b, c_s, q) = \tfrac{\alpha+\beta(y-\underline{c})-b_s}{\beta(\overline{c}-\underline{c})}[(1-k)b_s + k\tfrac{\alpha+\beta(y-\underline{c})+b_s}{2} - c_s - q].$$

Setting $\frac{\partial U_s}{\partial b_s} = 0$ and solving for b_s, we obtain the best response strategy of the public official:

$$b_s = \frac{1-k}{2-k}[\alpha + \beta(y - \underline{c})] + \frac{1}{2-k}(q + c_s). \tag{9}$$

From (8) and (9), solving for α and γ, we derive the equilibrium linear strategies of the citizen and the public official:

1) $\quad b_b = \alpha + \beta(v_b) = \frac{k(1-k)}{2(k+1)}(y - 1 + x) + \frac{k}{2}(q + 1 - x) + \frac{1}{k+1}(y - c_b),$

2) $\quad b_s = \gamma + \delta(v_s) = \frac{k(1-k)}{2(2-k)}(q + 1 - x) + \frac{1-k}{2}(y - 1 + x) + \frac{1}{2-k}(q + c_s),$

and the condition for a bribery agreement to take place:

$$a_b + \frac{k+1}{2-k}a_s \leq \frac{1+k}{2}(y - q) + (1+k)x + \frac{k^2 - k + 1}{2-k}. \tag{10}$$

In order to explore the implications of (10) with respect to the proportion of corrupt people which we could now observe in equilibrium, we focus on two special cases: 1) equal bargaining power of citizen and official with respect to the bribery transaction, *i.e.* $k = 1/2$, and 2) asymmetric bargaining power, when the citizen has no power, *i.e.*. $k = 0$. Results for the case $k = 1$ are symmetric to the results obtained for case 2.

4.1 Imperfect information with $\mathbf{k = 1/2}$

When $k = 1/2$ the private citizen and the public official have equal bargaining power in negotiating the amount of the bribe, which implies that the final bribe paid by a corrupt citizen and received by a corrupt official is equal to $b = \frac{1}{2}b_b + \frac{1}{2}b_s$. From (10) a corruption agreement takes place if and only if:

$$a_b + a_s \leq \frac{3}{4}(y - q) + \frac{3}{2}x + \frac{1}{2}, \tag{11}$$

which implicitly defines the proportion of corrupt citizen-official pairs in the population as:

$$x = F[\frac{3}{4}(y - q) + \frac{3}{2}x + \frac{1}{2}]. \tag{12}$$

Recall that F is the cumulative distribution function of $A = (a_b + a_s)$, and A is distributed according to a triangular distribution over the interval $[2, 2\overline{a}]$.

A comparison of the equilibrium levels of corruption under perfect and imperfect information, *i.e.* equations (2) and and (12), suggests that the proportion of corrupt citizen-official pairs in the society is **lower** under imperfect information as long as $2 < y - q + 2x$, *i.e.* the most intrinsically corrupt citizen and official in the population (those with $a_b = a_s = 1$) find it optimal to agree on a corrupt exchange, for any given x**.**

We now look at the possible corruption equilibria under imperfect information.

1) *Systemic corruption*, $x = 1$, can now be sustained as an equilibrium if:

$$\overline{A} \leq \frac{3}{4}(y-q)+2. \tag{13}$$

The comparison between conditions (13) and (3) suggests that the likelihood for society to be trapped in a systemic corruption equilibrium is relatively lower when the agents do not have perfect information about each other's "intrinsic corruptibility" (and have equal bargaining power).

2) *Honesty*, $x=0$ can be sustained as an equilibrium if:

$$2 \geq \tfrac{3}{4}(y-q)+\tfrac{1}{2},$$

or, equivalently,

$$2 \geq (y-q),$$

which is the same as condition (4). It follows that the likelihood for honesty to be an equilibrium does not seem to depend on the agents' information about their opponent's corruptibility.

3) *Honesty, systemic corruption and interior equilibria.* Honesty and systemic corruption can now be observed in equilibrium iff:

$$\frac{4}{3}(\overline{A}-2) \leq y-q \leq 2. \tag{14}$$

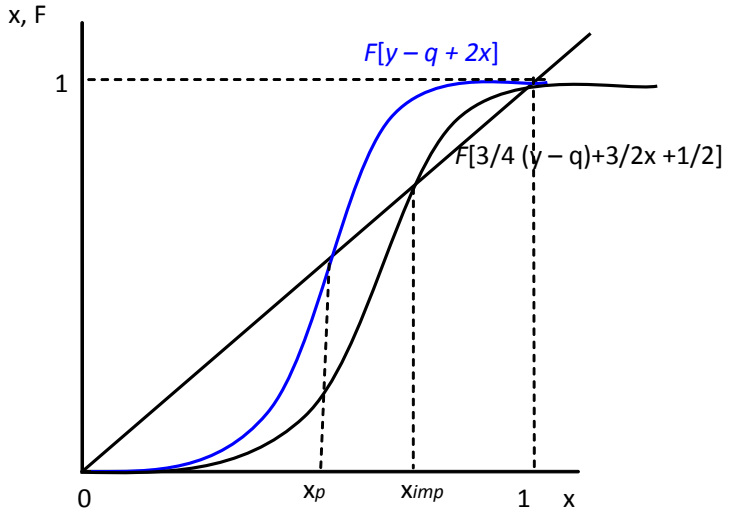
Comparing conditions (14) and (5) suggests that when individuals are uncertain about their opponent's intrinsic corruptibility (and have equal bargaining power), society is less likely to be characterized by multiple corruption equilibria. Note that the interior unstable equilibrium x^* now satisfies:

$$x^* = F[\tfrac{3}{4}(y-q)+\tfrac{3}{2}x^*+\tfrac{1}{2}]$$

Figure 5 shows the three corruption equilibria under perfect and imperfect information, given that $\frac{4}{3}(\overline{A}-2) \leq y-q \leq 2$. Although the $F[\frac{3}{4}(y-q)+\frac{3}{2}x+\frac{1}{2}]$ and the $F[y-q+2x]$ curves both intersect the 45 degree line at $x=0$ and $x=1$, the $F[\frac{3}{4}(y-q)+\frac{3}{2}x+\frac{1}{2}]$ is weakly below

the $F[y-q+2x]$ curve when it crosses the 45 degree line[14]. It follows that the interior unstable equilibrium under imperfect information, x_{imp} in the figure, corresponds to a larger proportion of corrupt people compared to the interior equilibrium under perfect information, x_p in the figure. However, as the interior equilibria are unstable, x_{imp} greater than x_p implies that when society is trapped in the systemic corruption equilibrium, a relatively smaller "jump" is required in order for the process to converge toward the honesty equilibrium.

Figure 5



Equivalently, a relatively smaller increase in the administrative cost q and a smaller positive shift of the distribution of the moral costs of citizens and/or public officials is required in order to eliminate the systemic corruption equilibrium and ultimately the interior corruption equilibrium.

4) *Interior corruption equilibria.* At least one interior equilibrium can now be observed if:

$$2 < y - q < \frac{4}{3}(\overline{A} - 2) \tag{15}$$

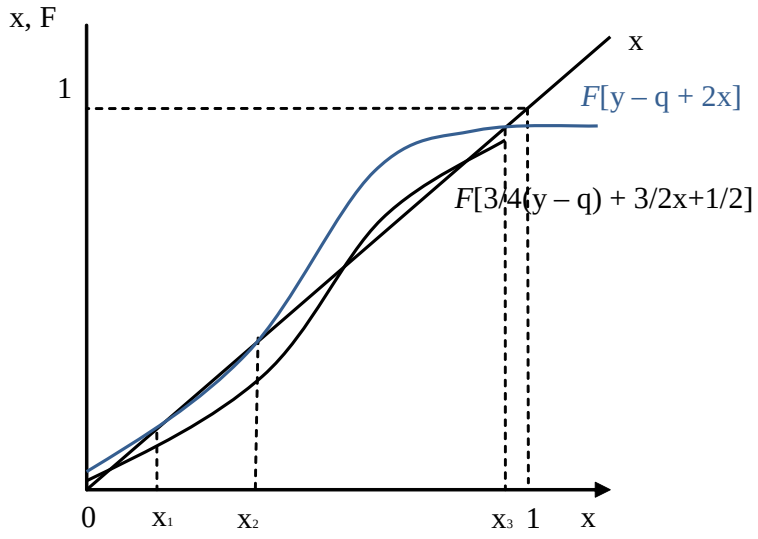
[14] In fact the $F[y-q+2x]$ curve can be above the $F[\frac{3}{4}(y-q)+\frac{3}{2}x+\frac{1}{2}]$ curve for small values of x and large values of $(y-q)$.

whereas under perfect information the condition for interior equilibria was $2 < y - q < \overline{A} - 2$, which suggests that imperfect information about one's opponent intrinsic moral cost associated with corruption increases the likelihood for society to end up in a situation where "most people" are either corrupt or honest. Interior equilibria, x^*, now satisfy:

$$x^* = F[\tfrac{3}{4}(y - q) + \tfrac{3}{2}x^* + \tfrac{1}{2}]$$

Figure 6 shows multiple interior equilibria under perfect and imperfect information, given that $2 < y - q < \overline{A} - 2$ is satisfied.

Figure 6



Three results clearly emerge from Figure 6. First of all, the high corruption equilibrium society could be trapped in is always lower under imperfect information than under perfect information. Secondly, the low corruption equilibrium which society could be driven to is always lower under imperfect information than under perfect information. Finally, the unstable corruption equilibrium, *i.e.* the critical proportion of corrupt people below which the process would converge to the low corruption equilibrium, is larger under imperfect information, suggesting that it is relatively easier/less costly for society to escape the high corruption equilibrium when agents are uncertain about each other's moral costs generated by corruption. Additionally, any

policy aimed at reducing corruption, for instance by decreasing the discretionary power of the public official or shifting the distribution of the moral costs of citizens and/or officials, would be relatively more effective under imperfect information than under perfect information.

4.2 Imperfect information with k = 0

We now investigate the decision of citizens and officials to engage in bribery when the private citizen has no bargaining power with respect to the amount of the bribe. In this setting, the official asks for a specific bribe and the citizen can only decide whether or not to pay that specific amount in exchange for the corrupt service. The official asks for a bribe b equal to b_s:

$$b = b_s = \tfrac{1}{2}(y + q + a_s - 1)$$

The bribe asked by the official is therefore higher the higher the monetary benefit generated to the citizen, the higher the administrative cost associated with the provision of the corrupt service, and the larger the official's intrinsic moral cost. A corruption agreement takes place if and only if the citizen's private valuation of the corrupt service is larger than or equal to the bribe required by the official:

$$v_b = y - a_b + x \geq b$$

which gives the condition for a corrupt transaction to take place as follows:

$$2a_b + a_s \leq y - q + 2x + 1 \tag{16}$$

which implicitly defines the proportion of corrupt citizen-official pairs in the population as[15]:

$$x = \Psi[y - q + 2x + 1] \tag{17}$$

where $\Psi(\cdot)$ is the cumulative distribution function of $E = (2a_s + a_b), i.e.$ the cumulative distribution of a triangular distribution over the interval $[3, 3\overline{a}]$, with median $\frac{3(\overline{a}+1)}{2}$.

Recall condition (3) for a corruption agreement to take place under perfect information:

[15] Note that under imperfect information and no bargaining power on the citizen's side, the intrinsic moral cost of the private citizen plays a relatively larger role in the bribe-agreement process.

$$a_b + a_s < y - q + 2x$$

Comparing conditions (3) and (16) suggests that a bribery agreement is less likely to take place under imperfect information (and all the bargaining power on the official's side) than under perfect information if and only if the private citizen's intrinsic moral cost is larger than the lowest possible moral cost in the society, *i.e.* $a_b > \underline{a} = 1$, which is always true. A comparison of the conditions for corruption to take place under imperfect information with equal bargaining powers, $a_b + a_s \leq \frac{3}{4}(y - q) + \frac{3}{2}x + \frac{1}{2}$, and under imperfect information with asymmetric bargaining powers, $2a_b + a_s \leq y - q + 2x + 1$, does not provide us with straighforward insights, and requires a deeper look at the specific distribution functions.

We now look at the possible corruption equilibria under imperfect information and $k = 0$.

1) *Systemic corruption*, $x = 1$, can now be sustained as an equilibrium if:

$$3\overline{a} \leq y - q + 3 \tag{18}$$

Under perfect information the condition for systemic corruption to be an equilibrium was $2\overline{a} \leq y - q + 2$, whereas under imperfect information and equal bargaining power between the parts the condition for systemic corruption was $2\overline{a} \leq \frac{3}{4}(y - q) + 2$. This suggests that society is least likely to be trapped in a systemic corruption equilibrium when the agents have imperfect information about each other's intrinsic willingness to act corruptly and the bargaining power is placed on one side of the market only.

2) *Honesty*, $x = 0$ can be sustained as an equilibrium if:

$$3 \geq y - q + 1$$

or, equivalently,

$$2 \geq y - q$$

which is the same condition for a honesty equilibrium to be sustained under both perfect information and imperfect information with $k = 1/2$.

3) *Multiple equilibria.* Honesty and systemic corruption can now be both observed in equilibrium iff:

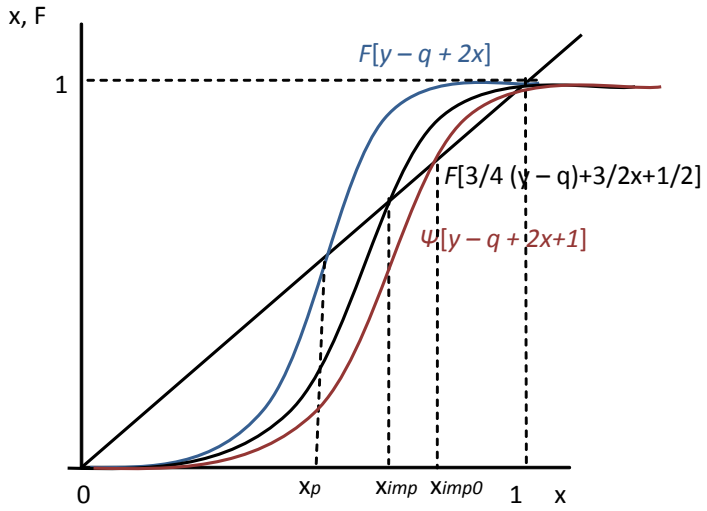
$$3\overline{a} - 3 \leq y - q \leq 2. \tag{19}$$

A comparison with conditions (5) and (14) suggests that society is least likely to be characterised by multiple corruption equilibria when individuals have imperfect information about each other's corruptibility and the bargaining power over the amount to be bribed is perfectly asymmetric. Note that the interior unstable equilibrium x^* now satisfies:

$$x^* = \Psi(y - q + 2x^* + 1)$$

Figure 7 illustrates three corruption equilibria under perfect information, imperfect information with $k = 1/2$ and imperfect information with $k = 0$, assuming that $3\overline{a} - 3 \leq y - q \leq 2$. Although honesty and systemic corruption are both sustained as equilibria in the three cases, the interior unstable corruption equilibria significantly differ. As we already pointed in Section 4.1, when potential bribers and bribees have only imperfect information about each other's corruptibility, society is characterized by a higher interior corruption equilibrium than under perfect information.

Figure 7



Moreover, Figure 7 shows that the interior equilibrium under imperfect information is higher the more asymmetric the bargaining power between

the briber and the bribee, which implies that escaping from a systemic corruption trap is relatively easier or less costly when individuals are uncertain about each other's intrinsic corruptibility and all the bargaining power is placed on one side of the market only.

4) *Interior corruption equilibria.* At least one stable interior corruption equilibrium can now be observed iff:

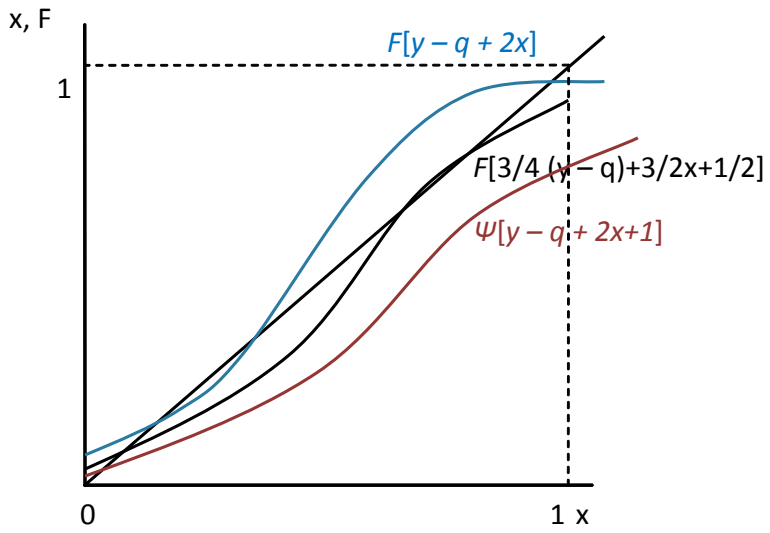
$$2 < y - q < 3\overline{a} - 3. \tag{20}$$

Comparing condition (20) with conditions (7) and (15) suggests that society is most likely to end up in an interior corruption equilibrium under imperfect information and perfectly asymmetric bargaining power. The interior equilibria, x^*, satisfy.

$$x* = \Psi[y - q + 2x* + 1] \tag{21}$$

Figure 8 shows the interior corruption equilibria in the three cases.

Figure 8



Once again, the figure suggests that it is relatively easier or less costly for society to move from a high corruption to a low corruption interior equilibrium in the presence of imperfect information, and even more so when the bribee (or the briber) has full bargaining power over the amount to be bribed.

5 Concluding remarks

The present contribution uses a simple double auction model to study the strategic interaction between potential bribers and potential bribees and the resulting corruption equilibria. We assume that the decision to engage in bribery is subject to strategic complementarities and individuals are heterogeneous with respect to the intrinsic moral cost associated with corruption. The double auction framework allows us to look at the corruption decision making of both the briber and the bribee rather than focusing only on one side of the market, as traditionally done in the literature.

Moreover, we investigate how uncertainty regarding the intrinsic corruptibility of one's potential corruption partner affects the decision to engage in bribery and the resulting overall level of corruption.

Our model suggests that, when bribers and bribees strategically interact over the illicit provision of a corrupt service or good, society is more likely to be trapped in a high corruption or systemic corruption equilibrium when: 1) the benefit that corruption generates to the briber is relatively large, 2) the administrative cost to provide the service is relatively small (the discretionary power of the public official is relatively high), and 3) the distribution of the moral cost in the society is such that the highest possible moral cost associated with corruption is relatively small. Society could be characterized by multiple corruption equilibria when the benefit that corruption generates to the private briber is relatively small (large) and the administrative cost to provide the service is relatively large (small), yet both the highest possible moral cost associated with corruption is especially small (large) and the lowest possible moral cost associated with corruption is large (small).

The proportion of corrupt people in equilibrium could be reduced by increasing the administrative cost associated with the delivery of the corrupt service (decreasing the discretionary power of the public official) or through educational programmes aimed at changing the distribution of the moral cost associated with corruption so that the intrinsic costs which oppose corruption would be higher for every individual in the society.

Finally, we found that when individuals have imperfect information with respect to their opponent's intrinsic corruptibility, they are less likely to engage in corruption. Imperfect information reduces the likelihood for society to end up in a systemic corruption trap and increases the likelihood for society to be characterized by multiple interior equilibria, *i.e.* by "most people" being either honest or corrupt. The lowest probability for society to end up in a "corruption trap" corresponds to a situation where citizens and officials

have imperfect information about each other's corruptibility and all the bargaining power is placed on either the official's or the citizen's side. Moreover, when society is characterized by multiple equilibria, imperfect information makes it relatively easier for society to "jump" from a high corruption to a low corruption or honesty equilibrium. This implies that any reduction of the equilibrium proportion of corrupt people can be achieved at a lower cost. This is especially true when the briber and bribee differ in their bargaining power over the amount to be bribed.

Our findings have interesting policy implications. First of all, it is reasonable to believe that uncertainty is lower in environments where the social distance among bribers and bribees is relatively small, *i.e.* where bribers and bribees are more likely to personally know each other or have indirect information about each other's corruptibility (see Tanzi, 2005). Our results therefore suggest that corruption can be lowered by increasing the social distance between briber and bribee, and therefore provide theoretical support to anti-corruption interventions, such as staff-rotation in public offices, aimed at making bribers and bribees as uncertain as possible about each other's corruptibility.

Fisman and Gatti (2007) have recently underlined how uncertainty can negatively affect the *efficiency* of existing bribe transactions by increasing the time spent bargaining for bribes. In this sense, uncertainty is "bad". On the contrary, our findings suggest that uncertainty is "good", as it reduces the overall level of corruption in society. Although an assessment of the "net effect" of uncertainty was not among the aims of this study, we believe that such an assessment is needed and should be pursued by future research.

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