

# Committing to Transparency to Resist Corruption \*

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## Abstract

This paper studies firms' incentives to commit to transparent behavior in a competitive procedure modeled as an asymmetric information beauty contest managed by a corrupt agent. In his evaluation of firms' offers for a public contract the agent has some discretion to favor a firm in exchange of a bribe. While unilateral commitment to transparency is never incentive compatible, under some circumstances a voluntary but *conditional* commitment mechanism can eliminate corruption. A low quality firm may prefer not to commit only when the agent's discretion is strong and the market's profitability is small. In that situation, the high quality firms commit when commitment decisions are kept secret, but some conditions on firms' beliefs are required when commitment decisions are publicly announced. A mechanism combining both conditionality and a reward (a transparent selection advantage that needs not be large) has the potential to fully eliminate corruption.

*"Few issues are more cross-cutting and more relevant to a wide array of corruption challenges than the question of how business around the world can ensure that it performs under highest standard of integrity and does not become party to or facilitator of corrupt transactions."*

H. Labelle Chair of Transparency International.<sup>1</sup>

*"Business should work against corruption in all its form including, extortion and bribery."*

United Nation Global Compact.<sup>2</sup>

## 1 Introduction

Corruption in competitive procedures for public contracts is an issue in both developed and developing countries. The stakes involved in many public contracts (e.g., in the construction of infrastructure or in the extractive industry) can be huge, and the highly specific character of these large markets leaves significant room for discretion to the agents who administer the procedures. This discretion can be abused in corruption at large costs for the national economy (see, for instance, Mauro, 1995, Bardhan, 1997, and Robinson and Torvick, 2005). The consequences are

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<sup>1</sup>See introduction to the Global Corruption Report 2009 "Corruption and the Private Sector".

<sup>2</sup>Principle 10 of the UN Global Compact is a commitment to combat corruption.

most serious in developing countries where government accountability is low. Great efforts have been exerted by international organizations (e.g., the World Bank or the European Community) to improve the legislation in developing countries. Many countries adopted a new procurement legislation (satisfying international standards), started deep going reforms of the public administration, introduced conflict of interests laws, etc. Yet, there is by now a consensus that good laws alone are not sufficient to combat corruption.

At the same time, the business case for fighting corruption has never been so strong. It is now recognized that at the level of the individual firm corruption raises costs, introduces uncertainty, reputational risks, vulnerability to extortion and it also makes capital more expensive. Among the instruments that are being developed by the business community, we have seen a proliferation of codes of conducts and ethical standards. The discussion of how the private sector can contribute to anti-corruption has also been taken forward under the umbrella of the G20.<sup>3</sup> The anti-corruption community has since many years developed a variety of commitment mechanisms aimed at curbing corruption in competitive procedures. Among them of particular interest are the Integrity Pact<sup>4</sup> (which come in several variants) and the Extractive Industries Transparency Initiative (EITI).<sup>5</sup> The United Nation Convention Against Corruption also calls for the private sector to adopt standards of transparency that precludes bribery.<sup>6</sup>

Yet, to the best of our knowledge, the properties of all these instruments have not been investigated in a strategic perspective. Our paper contributes to filling this gap. We are interested in the properties of simple and voluntary mechanisms aimed at combating corruption in competitive procedures, in particular in the procurement of concessions in the exploitation of natural resources.<sup>7</sup> A central lesson from the 500 pages long 2009 Global Report collecting the research of experts and scholars from around the world is that “more of the same will not do” there is a need “to take advantage of a new generation of innovative tools”. The commitment mechanisms that we propose in this paper are such innovative tools. They can be operated by a electronic devise and would rely on a novel independent audit structure. Our main results suggest that conditional commitment has a significant potential to reduce corruption. If conditional commitments do not fully eliminate corruption, which may be the case when the discretion of procurement officials is strong, the low quality firm has a lower cost and the market profitability is small, then adding a transparent selection advantage for commitment will work.

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<sup>3</sup>On April 27-28, 2011 the G20 and the OECD held a conference "Joining forces against corruption, G20, Business and Government".

<sup>4</sup><http://transparency.org>.

<sup>5</sup><http://eititransparency.org>.

<sup>6</sup>Chapter 2, article 12: “(f) Ensuring that private enterprises, taking into account their structure and size, have sufficient internal auditing controls to assist in preventing and detecting acts of corruption and that the accounts and required financial statements of such private enterprises are subject to appropriate auditing and certification procedures.”

<sup>7</sup>We know from the latest EITI reports ( xxx give ref. xxx ) that the governance of natural resources is an issue of paramount importance for the development of many LDC which makes the development and investigation of the property of new tools aimed at reducing corruption in the management of natural resources of central interest for the development community.

We model competition for a public project as an asymmetric information beauty contest with two firms. An example would be in the extractive industry when the government of the Republic of Congo wants to allocate extraction rights and the government values the contribution of the firm to the development of the industry's infrastructure a lot. More generally a beauty contest is an allocation procedure where the price is either fixed or plays a minor role in competition. Instead, firms compete in "quality". This procedure can be motivated when firms' private value is viewed as a poor proxy of the social economic value of the allocation. Another case is when there are fears that the cost of price competition reduces the winning firm's capacity to undertake social economic efficient investments. The allocation of 3G cell phone licenses in Europe offers a recent well-documented case where beauty contests were used. Some countries, like France and Sweden, opted for a beauty contest (see, e.g., Andersson et al., 2005) and others, like England and Germany, for auction. A main critic against the beauty contest is that the evaluation of offers is less transparent than in a first price auction (see, e.g., Binmore and Klemperer, 2002). Therefore it opens the way for favoritism and corruption. We view this vulnerability as special reason for investigating the potential of commitment to transparency to reduce corruption in beauty contests.

The competitive procedure is managed by an agent who may be corruptible. Corruption is modeled as an auction game where the firms compete in the bribes they offer to the agent in exchange for a selection advantage in the evaluation of submitted projects. In equilibrium, bribery is either pure extortion, i.e., it does not affect the allocation of the contract, or it is accompanied by social economic inefficiency: the bad project wins.

We introduce a commitment mechanism which allows firms to credibly commit not to bribe. The starting point for the analysis is that no firm has any incentive to commit unilaterally. Therefore, we first consider a mechanism where commitment is *conditional*: the commitment of one firm is valid only if the other firm also commits (Section 3.1 extensively discuss how such commitments can be implemented in practice). We find that this conditional commitment mechanism can eliminate corruption when the corrupt agent's discretion is weak, i.e., too small to secure the gain of a low quality type against a high quality type,<sup>8</sup> or when discretion is strong but the high quality firm type has low costs. Otherwise when the high quality firm has high costs, the low quality type may prefer not to commit, in which case corruption obtains in equilibrium. This happens when the market is not so profitable and/or the probability that the contestant is of the low quality type is not sufficiently large. The low quality firm has then better prospects to win with corruption against a high quality type.

When conditional commitment by all firms' types is not possible in equilibrium there still exists an equilibrium in which only firms of the high quality type commit provided the commitment decisions are not observable by the other firm. In such a case the conditional commitment mechanism allows to eliminate corruption when two high quality firms meet. Publicly announcing the firms' commitment decision either has no impact on behavior or is detrimental, i.e., it induces more

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<sup>8</sup>Corruption determines allocation in case of tie only.

corruption than if commitment decisions were kept secret.

Next, we consider a mechanism of unilateral commitment rewarded with a *bonus*, i.e., an official selection advantage. We find that it generally performs less well than conditional commitment. Under weak discretion, it eliminates corruption only when the bonus is larger than the selection advantage available through corruption. Under all other cases, only firms of the high quality type have an incentive to commit provided that the probability that it faces another high quality type is sufficiently small.

Finally, we devise a new mechanism of *conditional commitment with bonus* that performs better than the two earlier investigated mechanisms. A main result is that corruption can be fully eliminated for a bonus that is smaller than the selection advantage in corruption provided only that the bonus is large enough to secure win for the committing firm of the high quality type against a corrupt firm of the low quality type.

*Related Literature.* Corruption in competitive procedures has been studied in a few papers including, e.g., Burguet and Che (2004), Celentani and Ganunza (2002), Compte et al. (2005). These papers focus on incentives to bribe a corruptible agent in an auction context and study the impact of corruption on social economic efficiency. Typically, the impact depends on the type of discretion that the agent can abuse. In this paper we are interested in the agent's discretion to favor a firm in the evaluation of offers. Favoritism has been addressed in Burget and Che (2004) and more recently in Kosenok and Lambert-Mogiliansky (2009). While Burget and Che's main result is to demonstrate that corruption can result in allocation inefficiency, Kosenok and Lambert-Mogiliansky show how favoritism and collusion between firms can complement each other. In this literature corruption deterrence (if considered at all) is most often captured by an expected punishment cost. Simple comparative statics results on the magnitude of the punishment costs are derived. In contrast, we focus on corruption deterrence appealing to simple voluntary commitment mechanisms. For that reason we depart from the earlier mentioned literature and model the competitive procedure that allocates the project as a beauty contest (rather than an auction), while the bribing game is modeled as an auction in bribes.

Our approach allows to focus on the impact of commitment and brings us to a recent literature in game theory including Kalai et al. (2010) who characterize equilibrium payoffs that can be achieved in a game when allowing for conditional strategies. Bade et al. (2009) and Renou (2009) study the impact on equilibrium outcomes when players can commit unilaterally to some subspace of strategies. These papers address games with complete information while our application involves asymmetrically informed players. Recently, Kalai and Kalai (2010) provide a cooperative and non-cooperative approach to conditional commitment in games with incomplete information. Contrary to our setting, they allow players to sign more general binding agreements, including payoff transfers and information sharing.

*Organization of the paper.* In the next section we present the model and the benchmark equilibria

are characterized with and without corruption. In section 3 we introduce commitment. First, we discuss the practical aspects of implementing a commitment mechanism. We next turn to mechanisms with no reward for commitment. After briefly addressing unilateral commitment we consider the impact of a conditional commitment mechanism and characterize the conditions under which corruption is deterred. We thereafter move to mechanisms that reward commitment with a bonus. We revisit the unilateral commitment mechanism and describe the conditions under which it reduces corruption. Finally, we investigate a conditional mechanism with bonus and characterize an equilibrium that fully eliminates corruption. The last section concludes and discuss the policy implications of the results.

## 2 The Model

### 2.1 Benchmark: No Corruption

Consider a situation where the state looks for a firm to exploit its oil resources. Firms are differentiated with respect to their technology: firms make more or less valuable investments in the public infrastructure. The winning firm will be paid a fixed amount  $P$  (e.g., the right to sell a given amount of the oil) in exchange for the proposed development of the infrastructure.

We model this situation as a beauty contest with two firms,  $i = 1, 2$ . Firm  $i$ 's quality for the project is denoted by  $q_i \in \{\underline{q}, \bar{q}\}$ , with  $\bar{q} > \underline{q}$ . With probability  $\rho$  the technology of firm  $i$  allows for a realization of the high quality version of the project ( $q_i = \bar{q}$ ) and with probability  $1 - \rho$  it only allows for the low quality version ( $q_i = \underline{q}$ ).<sup>9</sup> The qualities of the firms are drawn independently. To realize its project a firm incurs some cost  $\bar{c}$  when its quality type is high ( $\bar{q}$ ), and  $\underline{c}$  when its quality type is low ( $\underline{q}$ ). Notice that we may have  $\underline{c} < \bar{c}$  or  $\underline{c} > \bar{c}$ , but we always assume that  $P > \max\{\underline{c}, \bar{c}\}$ , i.e., the government always wants to realize the project. For simplicity we let  $q_i$  correspond to a given technology so that we do not consider firms' choice in this respect.<sup>10</sup> In particular, the high quality firm cannot produce the lower valued version of the project. At the end of the section we briefly address the case in which the high quality type can also offer and deliver the low quality project.

Each firm is privately informed about its quality. As a simple benchmark, assume that the government can directly observe the quality of the firms' project offer. Equivalently, a government official (his agent) can evaluate the projects and his incentives are perfectly aligned with the interests of the government. The government simply chooses the firm with the highest quality, and selects either firm with equal probability in case of tie. Note that for  $\bar{q} - \bar{c} > \underline{q} - \underline{c}$ , which we shall assume, the beauty contest selects the socially efficient project.

<sup>9</sup>Firms are ex-ante symmetric, which is useful for deriving equilibrium strategies with bribery.

<sup>10</sup>Alternatively, we could consider that firms choose their technology strategically, but the resulting qualities and costs would still remain random variables that firms cannot fully control. With symmetric firms, the model would be strategically equivalent.

If a firm can deliver the highly valuable project  $\bar{q}$ , its expected profit is given by

$$\Pi^N(\bar{q}) = \left( \frac{1}{2}\rho + (1 - \rho) \right) (P - \bar{c}). \quad (1)$$

It wins the contest when the other firm's type is low or with probability 1/2 when the contestant's type is also high. The gain is simply the fixed price minus the cost for delivering the high quality project. On the other hand if the firm is of the low quality type  $\underline{q}$ , its expected profit is

$$\Pi^N(\underline{q}) = \frac{1}{2} (1 - \rho) (P - \underline{c}). \quad (2)$$

It only wins with probability 1/2 when the contestant's type is low as well.

## 2.2 Equilibrium with Corruption

Suppose now that the government cannot observe the quality of the firms' project and must rely on an agent whose incentives are not aligned with the interests of the government. The evaluation process is pretty involved and therefore not fully transparent to the government. This means that the agent has some discretion in evaluating the quality of the projects  $q_1$  and  $q_2$ . More precisely, we assume as in Burguet and Che (2004) that the agent can upscale the quality of a firm's project with a magnitude of  $m > 0$ .<sup>11</sup> If  $m < \bar{q} - \underline{q}$  he cannot strictly affect the selection, he can only favor a firm in case of tie (*weak discretion*). But if  $m > \bar{q} - \underline{q}$  he can always choose the winner (*strong discretion*). The corrupt agent will try to money his discretion, accepting bribes in exchange of adding  $m$  to the submitted quality.

Firms are willing to offer bribes  $(b_1, b_2) \in \mathbb{R}_+^2$  in exchange of the favor. The bribe is only paid if the firm wins the contest, and the agent only derives utility from bribes.<sup>12</sup> More precisely, the rules of the game with corruption are as follows. First, each firm  $i \in \{1, 2\}$  privately learns its type  $q_i \in \{\underline{q}, \bar{q}\}$ , and then submits an offer  $b_i$ , where  $b_i \geq 0$ . The agent observes firms' qualities,  $(q_1, q_2)$ , the submitted bribes,  $(b_1, b_2)$ , and selects firm  $i$  if either  $b_i > b_{-i}$  and  $q_i + m > q_{-i}$ , or  $b_i < b_{-i}$  and  $q_i > q_{-i} + m$ .<sup>13</sup> Finally, the submitted bribe is paid by the winner (whether corruption was actually needed or not).

Appendix A.1 characterizes the Nash equilibria of the game with corruption in the different configurations. The key determinants of the corruption outcome is the extent of discretion (i.e., the magnitude of  $m$  relative to  $\bar{q} - \underline{q}$ ) and the relative costs of the firms ( $\bar{c} > \underline{c}$  or  $\bar{c} < \underline{c}$ ). We obtain the following propositions:

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<sup>11</sup>We assume that he cannot downscale the quality presumably because the firm would then complain.

<sup>12</sup>**Modelling bribery competition as a first-price auction in which the bribe is only paid by a winning firm is standard in the literature (see, for example, Burguet and Che, 2004). Notice that this auction format might not always maximize the agent's bribe revenue when he has full commitment on the auction mechanism (e.g., if he can commit not to take any bribe under some threshold); however, under other mechanisms in which the levels of bribe would be higher our results would be reinforced since firms would have even more incentives to commit to transparency.**

<sup>13</sup>To ensure existence of an equilibrium, the selecting rule is endogenous when  $b_1 = b_2$  (See Simon and Zame, 1990). Alternatively, one may consider a discrete, fine enough, bribing strategy space.

**Proposition 1**

- *With weak discretion the winner of the contest is a firm of the high quality type (when it exists) whatever its cost.*
- *With strong discretion the winner of the contest is a low cost firm whatever its quality.*
- *In equilibrium both firm types offer strictly positive bribes.*

**Proof.** See Appendix A.1. ■

Proposition 1 tells us that allocation is efficient with respect to the beauty contest whenever the agent's discretion is weak. Corruption is then only a distribution issue, i.e., the agent appropriates some of the winner's rents. In contrast, when the agent has strong discretion, the covert competition in bribes is the effective selection rule instead of the official beauty contest. Corruption has an impact on the allocation of the contract: the bad quality firm wins whenever its cost is lower. Finally, we note that in the presence of a corruptible agent both firm types engage in bribery in equilibrium. This holds true even if both firm types would prefer the no corruption regime as the next proposition shows.

**Proposition 2** *The no-corruption equilibrium payoffs dominate for both firm types the equilibrium payoffs in the game with corruption in the following situations:*

- (i) *Weak discretion;*
- (ii) *Strong discretion and the high quality firm type has a lower cost;*
- (iii) *Strong discretion, the low quality firm type has a lower cost and*

$$\rho \leq \frac{P - \underline{c}}{P - \underline{c} + 2(\bar{c} - \underline{c})}. \quad (3)$$

**Proof.** See Appendix A.1. ■

Under conditions (i) and (ii) equilibrium corruption has no impact on the allocation of the contract, i.e., corruption boils down to pure extortion. This means that no firm type benefits from it, so they both prefer the no corruption regime. Under condition (iii), corruption has the potential to affect selection but competition in bribes for the project is very costly. Consider the case where competition eliminates all the rents, i.e.,  $\bar{c} = \underline{c}$  (so profits are null). Then any  $\rho \leq 1$  satisfies the condition and the no corruption regime always dominates. On the other hand when the low quality type's profit-if-win from corruption is equal to his profit-if-win from the contest without corruption, i.e.,  $P - \underline{c} = \bar{c} - \underline{c}$ , the probability that the other firm is a high type (i.e., that the corruption gain can be realized) must be  $\rho \geq 1/3$  to secure the dominance of the no-corruption regime.

As already mentioned, we assume that firms do not choose the quality of the project they offer. If instead the high quality type could mimic the low quality type and offer the low quality project at low cost, then corruption never benefits the firms. To see this we recall from Proposition 2 above that the only case when the corruption payoff may dominate the no corruption payoff is for the low quality type when it also has low costs and  $\rho$  is large. The low quality type can then win with positive profit in the corruption regime. With corruption, bribe competition is the effective selection mechanism and from Proposition 1 we know that all that matters for selection is the costs of the firm. Clearly, if the high quality type can choose between  $\bar{q}$  and  $\underline{q}$  with the associated costs, it will choose  $\underline{q}$  at cost  $\underline{c}$ . This means that in the presence of a corruptible agent, both firm types offer  $\underline{q}$ , they have the same costs  $\underline{c}$  and they compete in bribes until full rent extraction so profit are null. Condition (iii) from Proposition 2 is always fulfilled ( $\rho = 0$ ) and both firm types always prefer the no corruption regime.

The fact that under conditions (i), (ii) and (iii) firms can be trapped into unwanted competition in bribes can be exploited to combat corruption. We shall see that the more interesting situations arise when at least one firm type may benefit from corruption, i.e., under the maintained assumption that firms do not choose the quality.

From a welfare point of view corruption is unambiguously associated with social economic losses when it affects the selection of the project (the bad quality is selected when the high quality is available). When corruption boils down to extortion, we are dealing with a pure transfer of money from MNC to corrupt officials. One could argue that corruption serves as a mechanism of international redistribution from rich MNC to poor LDC. To the best of our knowledge there exists no evidence that corruption ever contributed to the development in LDC. Rather the contrary, the so called "resource curse" is an example where large corrupt transfers (often from efficient MNC) are benefiting the ruling elite but this is systematically linked with very poor development performances.<sup>14</sup> Hence, we want to argue that in our context, the reduction and complete elimination of corruption and bribery is desirable from a social economic point of view.

### 3 Committing to Transparency

In this section we first introduce the mechanisms we shall study in the concrete context of practical implementation. Thereafter, we address the potentials and limitations of two basic mechanisms whereby firms commit not to bribe: unilateral and conditional commitment. Finally, we introduce a reward for commitment, revisit the two mechanisms and derive a result about full corruption deterrence.

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<sup>14</sup>See, e.g., Réseau mondial Caritas, Février 2011: "Congo Brazzaville: Le pétrole ne coule pas pour les pauvres", <http://www.secours-catholique.org>.

### 3.1 Commitment in Practice

There exists a rich body of domestic legislations (pioneered by the Foreign Corrupt Act in the US) and international agreements and conventions (including OECD' convention against the bribery of foreign officials, the United Nation Convention Against Corruption (UNCAC) just to name a few) that outlaws corruption of foreign officials in LDC in the context of international public procurements. A German multinational corporation (MNC) like, e.g., Siemens, should not be engaged in corruption, by force of the OECD convention alone. Yet, recently it was found guilty and convicted for corruption.<sup>15</sup> Other MNC like Total and Haliburton are the subject of multiple corruption investigations.<sup>16</sup> This suggests that the actual deterrence power of the legal framework is not sufficient to effectively preclude corruption. Yet, many MNC are aware that corruption is a costly business but they feel trapped because they expect competing MNC and local firms to engage in corruption. This is why MNC have an interest in developing instruments including commitment mechanisms which, as Rose-Ackerman (1999, p. 190) puts it, "can credibly change their expectation on the behavior of other firms". As mentioned in the Introduction, the last decade has seen a rapid development of Codes of Conducts and Standards of Ethics as well as commitment mechanisms promoted by the anti-corruption community. They are all to some extent aimed at affecting expectation in that meaning (see Alan Knight in the Glocal Corruption Report 2009, p. 99). In particular, the UN Global Compact includes a voluntary commitment not to engage in corruption.<sup>17</sup>

The mechanisms that we investigate only engage firms, i.e., not the government. This is in contrast with earlier mentioned EITI for which the commitment of the government is a central feature.<sup>18</sup> This "firm-only" feature of the mechanisms that we study brings us closer to Codes of Conducts and Standards of Ethics which are voluntary and only engage the firms that adopt them — irrespective of what other players do. As we shall see unilateral commitment has limited efficiency.<sup>19</sup> The mechanism that we propose is made out of two elements. The first is related to the firms' commitment decisions and the second element deals with the enforcement of transparency. Very concretely, the first element would be an electronically managed device. The firms send their message: yes/no to commitment. The message sent back by the device depends on the particular mechanism chosen. For instance when commitment is conditional and public, the mechanism sends

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<sup>15</sup>See Tribune de Genève 20/04/10, "Corruption chez Siemens: prison avec sursis pour deux ex-dirigeants" (Corruption at Siemens: two former managers convicted to prison)

<sup>16</sup>L'Expansion 20/10/06 "Le n°2 de Total mis en examen pour complicité de corruption" (Number 2 at Total accused of complicity in corruption).

<sup>17</sup>See [www.unglobalcompact.org](http://www.unglobalcompact.org).

<sup>18</sup>In the EITI a key to the mechanism is the so called reconciliation between the data on payments made submitted by the firms and the data on payments received submitted by the government. A central feature of EITI is to force government to transparency so people learn the magnitude of the public incomes from extraction. Even if all that income is legal, EITI has a point. It makes the government accountable of how that income is used. So in a sense it also targets corruption further down the line.

<sup>19</sup>Moreover in practice, Codes of Conduct often lack credibility as they are not associated with a reliable monitoring and auditing mechanism.

a public message that no commitment is in force whenever not all firms commit. If all firms commit the public message is that commitment is in force implying an obligation for the firm to timely provide information about its transactions and accounts. This information is audited by internationally recognized professional auditors known for their integrity - this is the second element of the mechanism.<sup>20</sup> If the auditors suspect that bribery has occurred they address an international recognized court that has the authority to investigate and prosecute MNC. The assumption we make is that the proposed verification detects actual bribery with high probability.

Note that by using a electronic device we need not worry about incentives in the processing of firms' messages which is done mechanically.<sup>21</sup> It also makes it very easy to tailor variants of the mechanism in response to the firm's demand. For instance, firms' messages may be kept secret or made public, commitment is associated with a (transparent) reward or not. The idea with the reward is simple and already in use. In some context when it is considered desirable to favor local firms, e.g., for social reasons related to employment, the competitive procedure includes a (transparent) bias in favor of local firms. This does not affect the principle of competition per se. In our case, the quality of a firm's project is measured and generates a score. Best score competitive procedures are common place today as soon as not only price matters to selection. The bonus we have in mind translates into additional points that are added automatically to the score if the firm commits. In particular, such a bonus is not connected with any payment or direct cost for the government. However, it is clear that the government's agreement is necessary. The government must accept that the evaluation of the offers accounts for the bonus. The procedure is however fully transparent. The electronic device delivers an unambiguous message: which firms have won a bonus. So in particular, there is no discretion left to the corrupt procurement official in that respect. He simply includes the bonus to the score.

### 3.2 Conditional Commitment (CC)

We start with a remark that follows from our results in Proposition 1.

**Remark 1** *Unilateral commitment to transparency is never incentive compatible.*

Indeed, we know from Proposition 1 that zero bribe is not part of any equilibrium of the beauty contest game with corruption: if one firm commits, the other firm strictly prefers not to commit and pay a very small bribe since it wins for sure if  $m > \bar{q} - \underline{q}$  or  $q_i = \bar{q}$ , and it wins with probability  $(1 - \rho)$  instead of  $1/2(1 - \rho)$  otherwise. This implies that, in this context, no firm will

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<sup>20</sup>One idea is to create an International Office of Auditors from members of the Supreme Audit Institutions of all countries that ratified UNCAC. Upon request, a number of the Supreme Audit Institutions selected randomly or by rotation, must delegate one of their officials to participate to the mechanism.

<sup>21</sup>This means that the role of the intermediary is much reduced; it registers the device outcome which can presumably also be verified. This solution is in line with the development of e-procurement and e-government in a bid to reduce discretion.

ever choose to *unilaterally* commit to transparency. This supports the common perception that Codes of Conduct precluding corruption are “empty words”.<sup>22</sup>

In the rest of this subsection we study the properties of a commitment to transparency that is conditional on whether the other firm also commits to transparency. If both firms commit they are informed that their commitment is in force. Otherwise, they are informed that they are not bounded by additional obligations (in excess of legal ones). Whether or not they are informed about the rival’s decision (for the case they don’t commit) depends on whether the conditional commitment device is private or public.

The timing of the beauty contest game with interim<sup>23</sup> conditional commitment is as follows. First each firm  $i \in \{1, 2\}$  privately learns its type  $q_i \in \{\underline{q}, \bar{q}\}$ , and then decides whether to make a conditional commitment to transparency or not. The commitment decisions are either publicly announced or the commitment decisions are kept private (but a firm that committed learns whether its commitment is in force or not). Thereafter, each firm  $i$  submits an offer  $b_i$  under the constraint that  $b_1 = b_2 = 0$  if both firms committed to transparency. Finally, the agent observes  $(b_1, b_2)$  and  $(q_1, q_2)$  and selects firm  $i$  if  $b_i = b_{-i} = 0$  and  $q_i > q_{-i}$  or if  $b_i > b_{-i}$  and  $q_i + m > q_{-i}$ , or  $b_i < b_{-i}$  and  $q_i > q_{-i} + m$ .

### 3.2.1 Full Interim Commitment

We are first interested in equilibria in which firms commit whatever their type. Then, we study equilibria with partial commitment, i.e., equilibria in which only some firm types commit. Finally, we analyze equilibria when firms are able to commit at the ex-ante stage, before learning their type.

Clearly, if the no-corruption payoff dominates for both firms’ types (i.e., condition (i), (ii) or (iii) of Proposition 2 is satisfied), then they have an incentive to commit jointly to transparency (whether commitment decisions are publicly observed or not). Such an equilibrium is easily sustained, e.g., with passive beliefs off the equilibrium path: in case one of the firm deviates and does not commit, the other firm’s keeps his prior belief about the deviant’s type. It is also easy to verify that a *necessary* condition for full commitment is that the no-corruption payoff dominates for both firms’ types, even if we allow arbitrary beliefs off the equilibrium path. To see this, assume on the contrary that the corruption payoff dominates for the low quality and low cost type, i.e., assume that none of the conditions of Proposition 2 holds, which we shall refer to as condition (iv):

$$(iv) \quad m > \bar{q} - \underline{q}, \quad \bar{c} > \underline{c} \text{ and}$$

$$\rho > \frac{P - \underline{c}}{P - \underline{c} + 2(\bar{c} - \underline{c})} \iff \rho(\bar{c} - \underline{c}) > \frac{1}{2}(1 - \rho)(P - \underline{c}).$$

Whatever the other firm’s belief, a firm of type  $\underline{q}$  who does not commit gets a profit at least equal

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<sup>22</sup>According to our results no firms type would commit unilaterally. The commitments that we observe would partly reflect the fact that those commitments are not associated with a reliable verification technology.

<sup>23</sup>See Subsection 3.2.2 for ex-ante conditional commitment, in which case firms decide to commit *before* learning their types.

to  $\rho(\bar{c} - \underline{c})$  which is larger than the commitment payoff  $\frac{1}{2}(1 - \rho)(P - \underline{c})$ . But that contradicts the initial hypothesis that commitment is an equilibrium strategy for all firm types. Note that the reasoning above does not depend on whether the commitment decision is publicly observable or not.

**Proposition 3** *There exists an equilibrium of the beauty contest game with conditional commitment in which firms commit to transparency whatever their types if and only if conditions (i), (ii) or (iii) of Proposition 2 are satisfied (whether commitments are publicly observable or not).*

The intuition is straightforward. The conditional commitment mechanism provides firms with a means to cooperate to achieve the higher no corruption payoffs. An interesting analogy can be made with collusion in a price cartel. In our context, the commitment mechanism provides the firms with an instrument to collude against the agent so as to avoid costly competition in bribes.

What determines the power of the CC mechanism to deter corruption is revealed by Equation (3). The more profitable the market (large  $P$ ) and/or the more fierce competition between high and low cost types ( $\bar{c} - \underline{c}$  small), the more likely CC eliminates corruption. Another important parameter is  $\rho$ , the probability that the low quality type's contestant is a high quality type. This probability should not be too small. The intuition is simple. Under the no corruption regime the low quality type only wins against another low quality type, so the expected gain decreases in  $\rho$ . On the other hand, since the low quality firm always wins in bribes against a high quality type, the corruption payoff increases in  $\rho$ . This means that if the market is characterized by a large share of low quality firms, conditional commitment is likely to be an effective tool to combat corruption.

Conversely, the conditional commitment mechanism will not work well if the market is not sufficiently profitable, if firms' cost types are far apart, and if the low quality type believes there is very little chance that the other is of low quality type. In particular we see immediately that the mechanism does not prevent corruption under complete information when the firms are of different quality type. The firm of the low quality (and low cost) type wins for sure with corruption.

### 3.2.2 Ex-ante Commitment

We have assumed that the commitment choices are made after firms have been privately informed of their type, as it would be the case when firms commit in connection with a specific project. Alternatively, they may commit to transparency for a period of time within their field of activity. This is the case of the UN Global Compact and of EITI (while the Integrity Pact applies to specific markets). Clearly, if the no-corruption regime dominates the corruption regime for both types of the firm, then they also have an incentive to commit ex-ante, but the reverse is not true. To see that, consider the situation in which there is strong discretion ( $m > \bar{q} - \underline{q}$ ) and the low quality firm type is the cost efficient firm type ( $\bar{c} > \underline{c}$ ). We show below that the condition on the parameters for the no-corruption regime to dominate ex-ante is strictly weaker than the interim condition

(Condition (iii) in Proposition 2). The ex-ante expected payoff of a project without corruption is a convex combination of (1) and (2):

$$E\Pi^N = \rho\Pi^N(\bar{q}) + (1 - \rho)\Pi^N(\underline{q}) = \rho \left[ \left( \frac{1}{2}\rho + (1 - \rho) \right) (P - \bar{c}) \right] + \frac{1}{2}(1 - \rho)^2 (P - \underline{c}).$$

The ex-ante expected payoff with corruption is (see Appendix A.1)

$$E\Pi^C = \rho\Pi^C(\bar{q}) + (1 - \rho)\Pi^C(\bar{q}) = (1 - \rho)(\bar{c} - \underline{c})\rho$$

We have  $E\Pi^N > E\Pi^C$  iff  $3\rho^2(\bar{c} - \underline{c}) - 4\rho(\bar{c} - \underline{c}) + P - \underline{c} > 0$ . This inequality is always satisfied when  $\rho$  tends to 0 since  $P - \underline{c} > 0$ . It is also always satisfied when  $\Delta \equiv 4(\bar{c} - \underline{c})(4\bar{c} - \underline{c} - 3P) < 0$ , i.e.,

$$P > \frac{4\bar{c} - \underline{c}}{3}.$$

As in the interim case when  $P - \bar{c}$  is large compared to  $\bar{c} - \underline{c}$ , no corruption always dominates. In particular, when  $\bar{c} \rightarrow \underline{c}$ , meaning that the firms are close bribe competitors, the agent extracts all the rents and the no corruption regime dominates for any value of  $\rho$ . Notice that when  $P = \bar{c}$  we have  $\Pi^C(\bar{q}) = 0 = \Pi^N(\bar{q})$  so in that situation conditions for ex-ante commitment are equivalent to conditions for interim conditions and reduce to  $\rho < 1/3$ , but they are strictly weaker when  $P > \bar{c}$ .

Not surprisingly, it is easier to secure firms' incentives for full commitment ex-ante. However, the interim approach allows for *partial* commitment which can achieve valuable improvements when full commitment is not incentive compatible as we show next.

### 3.2.3 Partial Commitment

Beside equilibria where all firm types commit, it is interesting to consider situations where some of the types commit but not others.<sup>24</sup> We show below that even with partial commitment the CC mechanism has a potential to reduce corruption. When none of the conditions of Proposition 2 are satisfied (i.e., under condition (iv), so full commitment does not obtain in equilibrium), there may exist a partial commitment equilibrium in which only the high quality firms' types choose to commit. In such an equilibrium, the observability of the commitment decisions turns out to play an important role because the decision to commit or not may signal information about its quality to another firm who is also involved in the competition. Two cases are possible. In the first case the commitment decisions are publicly observable by both firms. In the second case the decisions are not publicly observable but since commitment is conditional, a firm that made a commitment always learns the commitment decision of the other. Indeed it must know whether its own commitment is in force before making the subsequent decisions. In contrast, when a firm does not commit, it never learns the commitment decision of the other. We denote that case as private conditional commitment.

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<sup>24</sup>This would be even more relevant in an extended model with more firm types, where the conditions for full commitment, by all firm types, would be more demanding.

We note that whether commitment is observable or not, type  $\bar{q}$  never has a strict incentive to deviate and refrain from committing since it gets a zero payoff in the beauty contest with corruption. But the condition for not committing to be part of an equilibrium strategy for type  $\underline{q}$  depends on the extent of observability of the firms' commitment decisions. We have the following result.

**Proposition 4** *Under condition (iv) we have:*

- *If conditional commitment decisions are publicly observable, there exists a partial commitment equilibrium in which only the high types commit provided  $\rho \geq 1/2$ .*
- *If conditional commitment decisions are kept secret, there always exists a partial commitment equilibrium in which only the high types commit.*

**Proof.** See Appendix A.2. ■

Proposition 4 establishes that observability of conditional commitment decisions induces more corruption than when commitment decisions are not observed. Indeed under public observability deviating from separation and committing allows to fool the other firm which maybe profitable. It allows to reduce the cost of competition in bribes with a low quality contestant because the latter is fooled to believe it faces a high quality type. When that is profitable (i.e., for  $\rho < 1/2$ ) no partial commitment equilibrium exists.<sup>25</sup> When commitment decisions are not observed, there exists no such opportunity because the non committing low quality contestant does not observe the other firm's decision. A partial commitment equilibrium always exists (under condition (iv)) thus securing that when two high quality types meet, commitment is in force and there is no corruption in equilibrium.

The existence of partial commitment equilibria is a significant result because conditional commitment is akin a unanimity rule. But it is important to notice that the unanimity does not apply to firm types but to the firms that actually meet. Under the assumption of incomplete information, there is some probability that the two firms are of the high type in which case both firms (secretly) commit, commitment is binding and it precludes corruption.

While observability plays no role for our results in Proposition 2, a detrimental effect arises under the conditions of Proposition 4 because of the conjunction of asymmetric information between firms which creates an opportunity of signalling and the conditionality of the commitment which secures that the commitment is not effective against another (non committing) low quality firm.

### 3.3 Rewarding Commitment

In this section we consider a modified beauty contest game such that the selection rule favors firms that commit. The selection rule is altered by a bonus  $a_i \in \{0, h\}$  for some  $h \geq 0$ , where

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<sup>25</sup>It can also be checked that there is no equilibrium in which only the low quality firm type commits. The high quality type gets zero if it does not commit, while it earns a strictly positive profit if it commits.

$a_i = h$  when firm  $i$  commits and  $a_i = 0$  otherwise,  $i = 1, 2$ . Importantly, the selection advantage is awarded to any firm that commits whether the commitment is actually in force or not. Hence, for the case commitment is unilateral,  $a_i = h$  implies  $b_i = 0$  but that is not always the case when commitment is conditional. Whether commitment is unilateral or conditional, the agent selects firm  $i$  if  $b_1 = b_2 = 0$  and  $q_i + a_i > q_{-i} + a_{-i}$ , or  $b_i > b_{-i}$  and  $q_i + m + a_i > q_{-i} + a_{-i}$ , or  $b_i < b_{-i}$  and  $q_i + a_i > q_{-i} + m + a_{-i}$ .

### 3.3.1 Unilateral Commitment with Bonus (UCB)

For some trivial values of the bonus, the beauty contest with UCB is easy to characterize:

#### Proposition 5

- *If  $h > m$  both firm types unilaterally commit.*
- *If  $h + \bar{q} < m + \underline{q}$  no firm type unilaterally commits.*

The proof of the statements in Proposition 5 is immediate. In the case when  $h > m$ , committing is always better than bribing. It secures the largest selection advantage at no cost. Committing is a dominant strategy for both types under all circumstances (weak or strong discretion,  $\bar{c} < \underline{c}$  or  $\bar{c} > \underline{c}$ ).

When  $h + \bar{q} < m + \underline{q}$ , even a high type who commits cannot win against a low type that does not commit, he can only win against a high type that also commits, i.e., with probability 1/2. But if the high type contestant commits, it is worthwhile deviating and paying an infinitesimal bribe to win for sure against a high type contestant. A fortiori this is true for the low type who can win with corruption for sure against a committing contestant. If the contestant does not commit, he loses for sure if he commits while it can win with probability 1/2 against another low type. So we are back in the corruption equilibrium described earlier.

The more interesting intermediary cases are characterized by  $h < m$  and  $\bar{q} + h > \underline{q} + m$ , i.e., the official selection advantage is smaller than the one available through corruption but it is sufficient to secure that a high quality type who commits wins against a low quality type who bribes. We have the following results

**Proposition 6** *When  $h < m$  and  $h + \bar{q} > m + \underline{q}$  there is no equilibrium in which low firms' types commit. In addition, we have:*

- *With weak discretion the unique equilibrium yields firms of both types choosing not to commit.*
- *With strong discretion and  $\bar{c} > \underline{c}$  there exists a partial commitment equilibrium in which only the high types commit if and only if  $\rho \leq \frac{2}{3}$ .*
- *With strong discretion and  $\bar{c} < \underline{c}$  there exists a partial commitment equilibrium in which only the high types commit if and only if*

- *Commitment decisions are publicly observable and  $\rho \leq \frac{P-\underline{c}}{P-\underline{c}+\frac{1}{2}(P-\bar{c})}$ , or*
- *Commitment decisions are not observable and  $\rho \leq \max\left\{\frac{2}{3}, \frac{P-\underline{c}}{\frac{1}{2}(P-\bar{c})}\right\}$ .*

**Proof.** See Appendix A.3. ■

Proposition 6 shows that unless the bonus is larger than the selection advantage available in corruption (Proposition 5), the beauty contest with UCB is characterized by more corruption than the beauty contest with CC (Propositions 3 and 4). In particular, it does not succeed in having firms to cooperate to avoid pure extortion, i.e., under weak discretion. The UCB never provides incentives for low quality firms to commit. And it only partially allows the high quality type to avoid extortion under strong discretion, even when commitment decisions are not observable and the high quality type is cost efficient.

### 3.3.2 Conditional Commitment with Bonus (CCB)

In this section we investigate a mechanism of commitment such that commitment is binding only if both firms commit as in the CC mechanism, but also such that the decision to commit is rewarded with a bonus as in the UCB mechanism. Compared with the conditional commitment scheme, the firm that commits enjoys a bonus for committing whether commitment is actually in force or not (i.e., whether the other firm did commit or not). Compared with the unilateral commitment with bonus scheme, the difference is that if the other firm does not commit, the firm who committed is free to give bribes while keeping the bonus. So the conditional commitment with bonus mechanism (CCB) gives more incentives to commit than either the conditional or the unilateral commitment mechanism.

The timing of the game is as in Section 3.2 while the selection rule includes the bonus as described above. It is immediate that if conditional commitment can eliminate corruption (in situations (i), (ii) and (iii)), so does the CCB mechanism, incentives to commit are only reinforced by the bonus. Hence, we focus on the “difficult” case defined by condition (iv), where the agent’s discretion is strong, the high quality type has high cost, and the probability for the contestant of the low quality type to be of the high quality is large. In this case, we know that corruption allocates the contract to a low quality type even when there is a high quality type around (see Proposition 1). From Proposition 3 we also know that there exists no equilibrium of the beauty contest with CC and full commitment (but sometimes a partial one, see Proposition 4). We now ask when is full commitment possible with CCB. It turns out that adding the bonus to the conditional commitment mechanism induces asymmetries between firms off the equilibrium path, when a firm is conditionally committed and the other is not. For this reason and in order to get some understanding of what happens, we shall first characterize a simple equilibrium with degenerated but appealing beliefs off the equilibrium path, and only thereafter present the general solution for arbitrary beliefs.

When both firm types commit there is no bribery, both firms get their bonus (which does not

affect allocation) and the payoffs for the high and low types are respectively given by

$$\left(\frac{1}{2}\rho + (1 - \rho)\right)(P - \bar{c}) \text{ and } \frac{1}{2}(1 - \rho)(P - \underline{c}).$$

Let us denote by  $\mu$  the belief off the equilibrium path that firm 2 assigns to the event that firm 1 is of the high quality type when firm 2 observes that firm 1 did not commit. We first consider equilibrium conditions with the extreme beliefs  $\mu = 0$  i.e., if the firm fails to commit the other one believes that it is a low quality type for sure.

If firm 1 deviates two things happen. First, the commitment of firm 2 is not binding. Second, it introduces an asymmetry between the firms because firm 2's quality is  $q_2 + h$  while firm 1's is  $q_1$ . Since we have  $h + \bar{q} > m + \underline{q}$ , it means that firm 2 of the high quality type can win without bribing. From firm 1's perspective it also means that it can only win against a firm 2 of the low quality type. Moreover the bribing game becomes asymmetric compared to the one we studied in Section 2.2 since  $\mu$  may be different from  $\rho$ . In the bribing game off the equilibrium path we claim that the following strategies are part of an equilibrium:

$$b_2^*(\bar{q}) = 0, \quad b_1^*(\bar{q}) = 0, \tag{4}$$

$$b_2^*(\underline{q}) = b_1^*(\underline{q}) = P - \underline{c}_1 \tag{5}$$

These strategies are supported by  $\mu = 0$ , i.e., the complying firm believes that if the other firm did not commit it must for sure be of the low quality type. On the other hand the deviating firm's beliefs about the type of the complying firm are as before: it assigns probability  $\rho$  to the event that it is of the high quality type. To see that the bribes in (4) and (5) are part of an equilibrium, we note that the high quality type of firm 2 is sure to win without bribing since  $h + \bar{q} > m + \underline{q}$  so it is optimal to bribe zero. When  $b_1 = b_2$  and  $q_1 = q_2$ , the agent selects firm 1.

The second line (5) reminds us of the strong bribe competition occurring between low quality types under weak discretion. This follows from the fact that firm 2 is sure to meet a low quality type ( $\mu = 0$ ) and since  $h < m$  it can only win with the corruption advantage ( $m$ ). Firm 1 of the low type knows it can never win against a committed high type. So it only cares about the low type and competition dissipates the rents.

Firm 1's incentive constraints write

$$\begin{aligned} \frac{1}{2}(1 - \rho)(P - \underline{c}) &\geq 0 \\ \left(\frac{1}{2}\rho + (1 - \rho)\right)(P - \bar{c}) &\geq \rho(P - \bar{c}) \end{aligned}$$

This yields  $\rho \leq \frac{2}{3}$ .

To summarize, under condition (iv) and when  $h < m$  and  $h + \bar{q} > m + \underline{q}$  we have shown that there exists an equilibrium of the beauty contest game with conditional commitment in which firms commit to transparency whatever their types if  $\rho \leq \frac{2}{3}$ . This is an improvement on the

simple conditional commitment equilibrium. For instance, take  $P = \bar{c}$ , with the simple conditional mechanism the no corruption equilibrium requires  $\rho \leq 1/3$  (CCB only requires  $\rho \leq \frac{2}{3}$ ). It is an improvement over the unilateral commitment mechanism because with  $\rho \leq \frac{2}{3}$  we obtained that only firms of the high quality type commits implying that the equilibrium is characterized by corruption whenever one of the firm is of the low quality type. With CCB both types commit so there is an equilibrium with no corruption at all.

We next address the general case with two-sided asymmetry in the bribing game. Let  $\mu \in (0, 1)$  be firm 2's beliefs about firm 1's type after the deviation. We considered above an extreme belief ( $\mu = 0$ ) that generated incentives constraints from which we derived a condition for full commitment to be an equilibrium of the beauty contest with CCB. In the appendix (A4) we show that as we move away from  $\mu = 0$  the incentive constraint of a low quality type becomes less binding. Hence, for appropriate intermediate beliefs a firm may put sufficient weight on *both* types which forces them to bribe consequently and reduces the attractiveness of the deviation. In the next proposition we actually show that there exists an equilibrium of the beauty contest with CCB with full corruption deterrence provided only that  $h + \bar{q} > m + \underline{q}$  (the detailed proof is in the Appendix). This equilibrium is supported by beliefs  $\mu = 1/2$  off the equilibrium path and has the following form. Firm 1 with the high quality plays a mixed strategy according to a continuous distribution with support  $(0, y_1]$ , firm 1 with the low quality plays a mixed strategy according to a continuous distribution with support  $(y_1, y]$ , firm 2 with the high quality plays a mixed strategy according to a discontinuous distribution with support  $[0, y_2]$  and a positive mass at the lower end of the interval, and firm 2 with the low quality plays a mixed strategy according to a continuous distribution with support  $(y_2, y]$ , where  $0 < y_2 < y_1 < y$ .

**Proposition 7** *Assume that  $h + \bar{q} > m + \underline{q}$ . In the beauty contest game with conditional commitment with bonus, there always exists an equilibrium with full corruption deterrence.*

**Proof.** See Appendix A.4. ■

We already knew that conditional commitment achieves corruption deterrence for the case the no corruption regime is preferred by the firms of both types. It gives them an instrument to cooperate in resisting costly competition in bribe. What the CCB mechanism achieves is to preclude corruption even when some firms strictly prefers the corruption regime. This is made possible because of the conjunction of the conditionality of commitment combined with the bonus for (unilaterally) committing. By rewarding a "good" firm that commits with a selection advantage but leaving it "free to bribe" in case full commitment fails, competition in bribes is made unprofitable for the firm who initially preferred the corruption regime. It may at first appear trivial: making corruption more expensive reduces its attractiveness. What is much less trivial is that this obtains as the result of the interaction between firms that make voluntary commitment not to bribe in spite of the fact that some originally gain from corruption.

## 4 Conclusion

In this paper we have investigated mechanisms of corruption deterrence based on firms' voluntary decision to commit to transparency. A first main finding is that a simple conditional commitment mechanism has a powerful potential to deter corruption when no firm benefits from it, i.e., when corruption boils down to pure extortion. In those cases, the firms face a cooperation problem, they prefer not to bribe but do bribe unless they trust the other will not. A conditional commitment mechanism provides them with an instrument to cooperate. When introducing a selection advantage rewarding the decision to commit, the no corruption regime becomes even more attractive. In contrast we find that the wider spread unilateral commitment mechanism has a much less powerful deterrence potential. Basically it has no impact if used without bonus and with a (sufficiently high but not prohibitive) bonus it can at best induce high quality types to refrain from corruption. In the more difficult cases where the low quality type can gain from corruption, we find that a mechanism that rewards the commitment decision but where commitment itself is conditional on the other firm's decision has the potential to fully deter corruption and bribery.

Two policy recommendations emerge from this analysis. First, it may not always be necessary to make commitment compulsory to obtain significant or even full corruption deterrence. Next, it may be worthwhile to consider making commitment conditional and explicitly rewarding with a selection advantage firms that choose to commit. These recommendations are a contribution to the public debate that underlies the on-going powerful drive to promote corporate integrity and corporate social responsibility in particular among multinational corporations operating in LDC. It also contributes to the research and development activity of the anti-corruption community with respect to its concern for engaging the civil society and the private sector in the efforts to curb corruption. Indeed, the development of EITI arose from a disappointment with unilateral commitment (the Corporate Social Responsibility approach). EITI puts emphasis on engaging the host governments to make commitment compulsory for firms. However, truly engaging the government is a pretty heavy task and not all countries are willing to enter EITI. Moreover, it does not apply to all sectors. In those cases our results suggest that a conditional commitment may be a solution that firms can manage autonomously. Similarly, rewarding commitment with bonus only requires a limited engagement from the government but, as we show, it has the potential to significantly reduce corruption. We believe that these two features, i.e., full autonomy or limited demand on government's engagement together with effectiveness make our recommendations realistic and attractive.

The analysis in this paper relies on a number of simplifying assumptions. In particular we assume ex-ante symmetric firms. Some readers may feel that this assumption is not always warranted. Consider the case when on an extraction rights market a foreign firm compete with a local one. It may be more reasonable to assume that the probability that the contestant of the local firm is of good quality is close to one. This means that a local firm of the low quality type can only win with corruption and therefore has no incentive to commit to transparency; so the simple

conditional commitment fails to prevent corruption if the local firm also has lower costs. However, with the conditional bonus scheme the foreign firm of the high type wins without corruption. If the probability that the foreign firm is of the high quality type is high, there will be very little corruption in equilibrium. This suggests that despite the simplifying assumptions our main results can be useful to the more complex situations of real life.

Another interesting extension would be to study how commitment can deter corruption in beauty contests with more than two firms. This raises practical implementation problems when only a strict subset of firms decide to (conditionally) commit. Should those firms being effectively bound to transparency while the others are not subject to any constraints? How should the official selection advantage (the bonus) be shared? More generally, voluntary commitment in incomplete information contests is clearly an important applied and theoretical issue that should deserve more attention in future research.

## A Appendix

### A.1 Equilibrium Characterization without Commitment

#### A.1.1 Stong discretion ( $m > \bar{q} - \underline{q}$ )

**Quality is costly** ( $\bar{c} > \underline{c}$ ). When  $P - \underline{c} > P - \bar{c}$  the value of the contract is larger for a low quality type. There exists a unique equilibrium where a high cost (and quality) type submits  $b_i^*(\bar{q}) = P - \bar{c}$ , earning an expected profit of  $\Pi^C(\bar{q}) = 0$ , and a low quality type plays a mixed strategy according to a distribution  $F(b)$  with support  $[P - \bar{c}, \hat{b}]$ . The boundaries are calculated in the standard way by setting the expected profit equal to a constant:

$$\Pi^C(\underline{q}) = (P - \underline{c} - b) (\rho + (1 - \rho) F(b)),$$

for every  $b \in [P - \bar{c}, \hat{b}]$ . When  $b = P - \bar{c}$  we have  $F(b) = 0$  so

$$\Pi^C(\underline{q}) = (\bar{c} - \underline{c})\rho. \tag{6}$$

At  $\hat{b}$ ,  $F(\hat{b}) = 1$  so  $(P - \underline{c} - \hat{b}) = (\bar{c} - \underline{c})\rho$ , which implies  $\hat{b} = P - \underline{c} - (\bar{c} - \underline{c})\rho$ . Notice that  $\hat{b}$  is decreasing with  $\rho$  down to  $P - \bar{c}$  when  $\rho \rightarrow 1$  and that  $\Pi^C(\underline{q})$  is increasing with  $\rho$ .

In this situation the high quality firm type always strictly prefers the no corruption regime since it earns zero with corruption and some positive expected profit without corruption. For the low quality firm type, we have

$$\Pi^N(\underline{q}) > \Pi^C(\underline{q}) \iff \frac{1}{2}(1 - \rho)(P - \underline{c}) > (\bar{c} - \underline{c})\rho, \tag{7}$$

so the low quality firm type prefers the no-corruption regime whenever

$$\rho < \frac{(P - \underline{c})}{(P - \underline{c}) + 2(\bar{c} - \underline{c})}. \tag{8}$$

Under the no corruption regime the low quality firm wins only if it meets another low quality firm, so the probability that the contestant is of the low quality type should not be too small, i.e.,  $\rho$  should not be too large to secure the dominance of the no-corruption regime. The right hand side of Equation (8) is increasing in the value  $P - \underline{c}$  of the corruption free contest. Under the corruption regime what matters is the difference between the costs of the two firms; the larger the difference, the less intense competition **in bribes** and the more attractive corruption.

**The quality efficient type has lower cost ( $\bar{c} < \underline{c}$ ).** When the high quality firm type is also the cost efficient firm, the low quality type submits  $b_i(\underline{q}) = P - \underline{c}$  and earns zero profit with corruption. With a similar reasoning as above, the high quality firm type plays a mixed strategy and earns an expected profit of  $\Pi^C(\bar{q}) = (\underline{c} - \bar{c})(1 - \rho)$ . In this situation the low quality firm type always strictly prefers the no corruption regime, and the high quality firm type prefers the no corruption regime iff

$$\Pi^N(\bar{q}) > \Pi^C(\bar{q}) \iff \left( \frac{1}{2}\rho + (1 - \rho) \right) (P - \bar{c}) > (\underline{c} - \bar{c})(1 - \rho),$$

i.e.,  $\rho(P - \bar{c}) + 2(1 - \rho)(P - \underline{c}) > 0$ , which is always satisfied.

### A.1.2 Weak Discretion ( $0 < m < \bar{q} - \underline{q}$ )

This situation is simpler because here firms compete in bribes only when they are of the same quality type. Whether  $\bar{c}$  is lower or higher than  $\underline{c}$  there exists a unique symmetric equilibrium where a low quality type submits  $b_i^*(\underline{q}) = P - \underline{c}$ , earning an expected profit of  $\Pi^C(\underline{q}) = 0$ , and a high quality type plays a mixed strategy according to a distribution  $F(b)$  with support  $[0, \hat{b}_2]$  with  $\hat{b}_2 = \rho(P - \bar{c})$ . We have  $\Pi^C(\bar{q}) = (P - \bar{c} - b)((1 - \rho) + \rho F(b))$  for every  $b \in [\hat{b}_1, \hat{b}_2]$ . When  $b = \hat{b}_1$  we have  $F(b) = 0$  so  $\Pi^C(\bar{q}) = (P - \bar{c} - \hat{b}_1)(1 - \rho)$ . By bribing 0 the firm gets at least  $(P - \bar{c})(1 - \rho)$ , so  $\hat{b}_1 = 0$  and  $\Pi^C(\bar{q}) = (P - \bar{c})(1 - \rho)$ . At  $\hat{b}_2$ ,  $F(\hat{b}_2) = 1$  so  $(P - \bar{c} - \hat{b}_2) = (P - \bar{c})(1 - \rho)$ , which implies  $\hat{b}_2 = \rho(P - \bar{c})$ . We have  $\Pi^C(\bar{q}) = (P - \bar{c} - b)((1 - \rho) + \rho F(b))$  for every  $b \in [\hat{b}_1, \hat{b}_2]$ . When  $b = \hat{b}_1$  we have  $F(b) = 0$  so  $\Pi^C(\bar{q}) = (P - \bar{c} - \hat{b}_1)(1 - \rho)$ . By bribing 0 the firm gets at least  $(P - \bar{c})(1 - \rho)$ , so  $\hat{b}_1 = 0$  and  $\Pi^C(\bar{q}) = (P - \bar{c})(1 - \rho)$ . At  $\hat{b}_2$ ,  $F(\hat{b}_2) = 1$  so  $(P - \bar{c} - \hat{b}_2) = (P - \bar{c})(1 - \rho)$ , which implies  $\hat{b}_2 = \rho(P - \bar{c})$ .<sup>26</sup> Competition in bribes against the own type<sup>27</sup> dissipates the rents:  $\Pi^C(\underline{q}) = 0$  and  $\Pi^C(\bar{q}) = (P - \bar{c})(1 - \rho)$  see the footnote above and compare with (1) and (2). Hence, whatever  $\underline{c}$  and  $\bar{c}$ , the corruption regime is worse for both types of players.

## A.2 Proof of proposition 4

**Publicly observable conditional commitments** When firms' commitment decision are publicly observable, the profit of a firm type  $\underline{q}$  when it does not commit is

<sup>26</sup> We have  $\Pi^C(\bar{q}) = (P - \bar{c} - b)((1 - \rho) + \rho F(b))$  for every  $b \in [\hat{b}_1, \hat{b}_2]$ . When  $b = \hat{b}_1$  we have  $F(b) = 0$  so  $\Pi^C(\bar{q}) = (P - \bar{c} - \hat{b}_1)(1 - \rho)$ . By bribing 0 the firm gets at least  $(P - \bar{c})(1 - \rho)$ , so  $\hat{b}_1 = 0$  and  $\Pi^C(\bar{q}) = (P - \bar{c})(1 - \rho)$ . At  $\hat{b}_2$ ,  $F(\hat{b}_2) = 1$  so  $(P - \bar{c} - \hat{b}_2) = (P - \bar{c})(1 - \rho)$ , which implies  $\hat{b}_2 = \rho(P - \bar{c})$ .

<sup>27</sup>  $\Pi^C(\underline{q}) = 0$  and  $\Pi^C(\bar{q}) = (P - \bar{c})(1 - \rho)$  see the footnote above and compare with (1) and (2).

$$\begin{cases} \bar{c} - \underline{c} & \text{if the other firm's type is } \bar{q}, \\ 0 & \text{if the other firm's type is } \underline{q}. \end{cases}$$

If a firm of type  $\underline{q}$  deviates and commit (recall we are considering a partial commitment equilibrium), its profit is

$$\begin{cases} 0 & \text{if the other firm's type is } \bar{q}, \\ \bar{c} - \underline{c} & \text{if the other firm's type is } \underline{q}, \end{cases}$$

because when the low quality type observes that the firm commits, it believes that it is of the high quality type and therefore bribes  $b^*(\underline{q}) = P - \bar{c}$ . The incentive constraint for type  $\underline{q}$  in the partial commitment equilibrium thus writes

$$\rho(\bar{c} - \underline{c}) \geq (1 - \rho)(\bar{c} - \underline{c}),$$

i.e.,  $\rho \geq 1/2$ . If the probability to meet a high quality firm is lower, it becomes attractive to fool the contestant hoping that he is of low quality and compete him out in bribes. Under condition (iv) when  $\rho \leq 1/2$ , there exists no equilibrium with full or partial commitment, in which case we simply have the corruption regime.

**Private conditional commitments** Here the commitment of the rival is observed only when the firm commits itself. The expected profit of type  $\underline{q}$  when it does not commit (and thus observes nothing) is  $\rho(\bar{c} - \underline{c})$  as in the corruption equilibrium. If type  $\underline{q}$  deviates and commits its profit is

$$\begin{cases} 0 & \text{if the other firm's type is } \bar{q} \\ X & \text{if the other firm's type is } \underline{q}, \end{cases}$$

where

$$X = \max_b (P - \underline{c} - b)F(b).$$

We know from the analysis of the corruption equilibrium that  $(P - \underline{c} - b)(\rho + (1 - \rho)F(b)) = \rho(\bar{c} - \underline{c})$  so

$$X = \max_{P - \bar{c} \leq b \leq \hat{b}} \frac{\rho}{1 - \rho} (b - (P - \underline{c})) = \rho(\bar{c} - \underline{c}).$$

Hence, the partial commitment equilibrium condition is  $\rho(\bar{c} - \underline{c}) \geq (1 - \rho)\rho(\bar{c} - \underline{c})$ , which is always satisfied.

### A.3 Proof of proposition 6

**Weak discretion** ( $m < \bar{q} - \underline{q}$ ) We know that with weak discretion conditional commitment precludes corruption. However, it is easy to show that unilateral commitment does not (for  $h < m$ ). Consider first the high quality type. He always wins against a low quality type (because of weak discretion). If he commits but the contestant does not, he loses for sure against a high quality contestant. And if the contestant commits, it is better not to commit and win for sure by paying

an infinitesimal bribe. The same reasoning applies to the low quality type which loses for sure if he commits and the contestant does not. But if the contestant commits he can win with an infinitesimal bribe if the other firm is of the low quality type. So there exists no equilibrium where any of the type commits.

**Strong discretion** ( $m > \bar{q} - \underline{q}$ ) We know from Proposition 3 that conditional commitment can preclude corruption in this case (when Condition (ii) or (iii) applies). Yet, we also know that in the absence of commitment mechanism, firms are trapped in corruption and that unilateral commitment can never arise in the absence of bonus (Proposition 1). The question is whether the opportunity to gain the bonus can make firms commit unilaterally.

It is easy to show that there can be no equilibrium where both types commit, even with a bonus ( $h < m$ ). The low type can only win against another low type. Assume that the other low type commits; if our low type also commits he wins with probability  $1/2$ , but by deviating and offering an infinitesimal bribe, our low type secures win against a low type contestant.

Next, consider an hypothetical equilibrium where the high quality type commits but not the low quality type, in which case competition in bribes between the low types drives up the bribes to  $P - \underline{c}$  and they get a zero profit. Clearly, firms of the low quality type have no strict incentive to deviate and commit because they would lose for sure. So it is indeed optimal for the low quality firms not to commit. When considering firms of the high quality type, we have to distinguish between different cases.

When  $\bar{c} > \underline{c}$ , the condition for committing to be part of an equilibrium for the high quality type is:

$$\rho \frac{1}{2} (P - \bar{c}) + (1 - \rho) (P - \bar{c}) \geq \rho (P - \bar{c}), \quad (9)$$

where the right hand side is computed knowing that the high quality type can only win in bribe (with an infinitesimal bribe) against a high quality type, and the low quality type bids  $P - \underline{c} > P - \bar{c}$ . Hence, there exists an equilibrium where the high quality type commits and the low quality does not for  $\rho \leq \frac{2}{3}$ .

When  $\bar{c} < \underline{c}$  and firms do not observe the other firm's commitment decision, a high type who deviates from commitment either bribes just above zero to win only against a high type, or bribes just above  $P - \underline{c}$  to win against both contestant's types. Hence, the equilibrium condition is given by:

$$\rho \frac{1}{2} (P - \bar{c}) + (1 - \rho) (P - \bar{c}) \geq \max\{\rho (P - \bar{c}), \underline{c} - \bar{c}\}. \quad (10)$$

Instead, when commitment decisions are publicly observed, the deviant type can bribe depending on the commitment choice, and the equilibrium condition becomes

$$\rho \frac{1}{2} (P - \bar{c}) + (1 - \rho) (P - \bar{c}) \geq \rho (P - \bar{c}) + (1 - \rho)(\underline{c} - \bar{c}). \quad (11)$$

Notice that (10) is stronger than (11), so as in the conditional commitment case commitment is easier to sustain when commitment decisions are not observable.

#### A.4 Proof of proposition 7

We show that when conditions (i), (ii) and (iii) of Proposition 2 are not satisfied, i.e.,  $m > \bar{q} - \underline{q}$ ,  $\bar{c} > \underline{c}$  and  $\rho > \frac{P-\underline{c}}{P-\underline{c}+2(\bar{c}-\underline{c})}$ , there is an equilibrium in which both firms, whatever their types, conditionally commit to transparency for a bonus  $h$  such that  $h + \bar{q} > m + \underline{q}$ . The case  $h > m$  has been solved in Proposition 5 so we focus on the case where  $h < m$ . Consider such an hypothetical equilibrium and consider without loss of generality (firms are ex-ante symmetric) a deviation by firm 1. We have to construct equilibrium bribing strategies as a function of firm 2's belief about firm 1's type after the deviation from commitment. Notice that in this situation, since firm 1 is conditionally committed, it gets the bonus, so  $\underline{q}_1$  cannot win against  $\bar{q}_2$  but  $\underline{q}_2$  can win against  $\bar{q}_1$  by bribing more. Let  $\mu \in (0, 1)$  be firm 2's belief about firm 1's type after the deviation. There are two asymmetries now compared to the bribing game analyzed in Subsection 2.2 because the selection rule and the priors ( $\rho$  and  $\mu$ ) are asymmetric.

We show that this asymmetric bribing game induced by firm 1's deviation from conditional commitment has an equilibrium of the following form. Firm 1 with the high quality plays a mixed strategy according to a continuous distribution  $\bar{F}_1(b)$  with support  $(0, y_1]$ , firm 1 with the low quality plays a mixed strategy according to a continuous distribution  $\underline{F}_1(b)$  with support  $(y_1, y]$ , firm 2 with the high quality plays a mixed strategy according to a discontinuous distribution  $\bar{F}_2(b)$  with support  $[0, y_2]$  and a positive mass  $\bar{F}_2(0) > 0$  at the lower end of the interval, and firm 2 with the low quality plays a mixed strategy according to a continuous distribution  $\underline{F}_2(b)$  with support  $(y_2, y]$ , where  $0 < y_2 < y_1 < y$ .

The boundaries  $y_1$ ,  $y_2$  and  $y$ , the mass  $\bar{F}_2(0) > 0$  and the values of  $\underline{F}_2(y_1)$  and  $\bar{F}_1(y_2)$  are calculated by setting the interim expected profits equal to constants, which lead to the following system of 6 equations with 6 unknowns:

$$(P - \bar{c})\bar{F}_2(0) = P - \bar{c} - y_2 \quad (12)$$

$$(P - \bar{c} - y_2)\rho = (P - \bar{c} - y_1)(\rho + (1 - \rho)\underline{F}_2(y_1)) \quad (13)$$

$$(P - \underline{c} - y_1)\underline{F}_2(y_1) = P - \underline{c} - y \quad (14)$$

$$(P - \bar{c})(1 - \mu) = (P - \bar{c} - y_2)(1 - \mu + \mu\bar{F}_1(y_2)) \quad (15)$$

$$(P - \underline{c} - y_2)\bar{F}_1(y_2) = P - \underline{c} - y_1 \quad (16)$$

$$(P - \underline{c} - y) = (P - \underline{c} - y_1)\mu. \quad (17)$$

The third and sixth equations immediately give  $\underline{F}_2(y_1) = \mu$ . It can also be checked that under the constraints above, the functions  $\underline{F}_i$  and  $\bar{F}_i$ ,  $i = 1, 2$ , are proper distributions since there are increasing from 0 to 1.

We now show that there exists a belief off the equilibrium both, namely  $\mu = 1/2$ , that guarantee that both types of firm 1 have no incentive to deviate from the conditional commitment. As remarked in the main text, the incentive constraints may be binding for degenerate beliefs  $\mu = 0$  and  $\mu = 1$ . Incentive compatible conditions for firm 1 in the commitment stage for the high type

and the low type are respectively given by:

$$(P - \bar{c})\rho\bar{F}_2(0) \leq (P - \bar{c})\left(\frac{1}{2}\rho + (1 - \rho)\right), \quad (18)$$

$$(P - \underline{c} - y_1)(1 - \rho)\mu \leq (P - \underline{c})\frac{1}{2}(1 - \rho). \quad (19)$$

The equilibrium condition (19) for the low type is clearly always satisfied for  $\mu = 1/2$ . The equilibrium condition (18) for the high type can be rewritten as  $\bar{F}_2(0) \leq \frac{1}{\rho} - \frac{1}{2}$ . From (12) this condition becomes:

$$y_2 \geq \left(\frac{3}{2} - \frac{1}{\rho}\right)(P - \bar{c}). \quad (20)$$

Using the system of three equations and three unknowns (13), (15) and (16) we get

$$(P - \underline{c} - y_2)\frac{y_2}{P - \bar{c} - y_2} = \bar{c} - \underline{c} + 2\frac{P - \bar{c} - y_2}{1 + \rho}. \quad (21)$$

The solution of this last equation is:

$$y_2 = \frac{1}{2 + 6\rho} \left( 2(P - \underline{c})(1 + \rho) + (P - \bar{c})(3\rho - 1) + \sqrt{-(1 + \rho)(8(P - \bar{c})(P - \underline{c}) - 4(P - \underline{c})^2(1 + \rho) + (P - \bar{c})^2(3\rho - 5))} \right). \quad (22)$$

Notice that  $-(8(P - \bar{c})(P - \underline{c}) - 4(P - \underline{c})^2(1 + \rho) + (P - \bar{c})^2(3\rho - 5))$  is positive because it is linear in  $\rho$  and positive for  $\rho = 0$  and  $\rho = 1$ . The incentive constraint (20) of the high type is therefore given by:

$$2(P - \bar{c})(1 + \rho - 3\rho^2) + 2(P - \underline{c})\rho(1 + \rho) + \sqrt{-(1 + \rho)(8(P - \bar{c})(P - \underline{c}) - 4(P - \underline{c})^2(1 + \rho) + (P - \bar{c})^2(3\rho - 5))} \geq 0. \quad (23)$$

To check this inequality it suffices to check that

$$(P - \bar{c})(1 + \rho - 3\rho^2) + (P - \underline{c})\rho(1 + \rho) \geq 0. \quad (24)$$

This inequality is satisfied for  $\rho = 0$  and  $\rho = 1$ , and the left hand side is either increasing (when  $(P - \bar{c}) - 6(P - \underline{c}) \geq 0$ ) or concave (when  $(P - \bar{c}) - 6(P - \underline{c}) \leq 0$ ), so it is positive for all  $\rho \in (0, 1)$ . ■

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