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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 for 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) allows complete elimination of 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 to the highest standards of integrity and does not become a party to or facilitator of corrupt transactions.* "H. Labelle, Chair of Transparency International.[1]

> "*Business should work against corruption in all its forms, including extortion and bribery.* "United Nations Global Compact.[2]

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, Bardhan, 1997; Mauro, 1995; Robinson and Torvik, 2005). The consequences are 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 have adopted new procurement legislation (satisfying international standards), started deep-reaching reforms of public administration, introduced conflict of interest 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 and vulnerability to extortion and also makes capital more expensive. Among the instruments developed by the business community, we have seen a proliferation of codes of conduct and ethical standards. The discussion of how the private sector can help to fight corruption has also been taken forward under the umbrella of the G20.[3] The anti-corruption community has since many years developed a variety

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[1] See introduction to the Global Corruption Report, 2009 "Corruption and the Private Sector".
[2] Principle 10 of the UN Global Compact is a commitment to combat corruption.
[3] On April 27–28, 2011 the G20 and the OECD held a conference "Joining forces against corruption, G20, Business and Government".

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of commitment mechanisms aimed at curbing corruption in competitive procedures. Of particular interest are the Integrity Pact[4] (which comes in several variants) and the Extractive Industries Transparency Initiative (EITI).[5] The United Nations Convention Against Corruption also calls for the private sector to adopt standards of transparency that preclude bribery.[6]

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 for the exploitation of natural resources.[7] A central lesson from the 2009 Global Corruption Report: Corruption and Private Sector, which compiles expert research and analysis 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 an automated device and would rely on an 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 preclude bribery.

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 greatly values the firm's contribution to the development of the industry's infrastructure. 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 will reduce the winning firm's capacity to make 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. One of the main criticisms leveled 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). Consequently, it opens the way for favoritism and corruption. We view this vulnerability as a 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 discusses 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 firm against a high-quality one,[8] or when discretion is strong but the high-quality firm has low costs. Otherwise, when the high quality firm has high costs, the low-quality firm 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 opponent is of the low-quality type is not sufficiently large. The low-quality firm then has better prospects of winning with corruption against a high-quality firm.

When conditional commitment by both types of firm 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 elimination of corruption when two high-quality firms meet. Publicly announcing the firms' commitment decisions either has no impact on behavior or is detrimental, i.e., it induces more corruption than if commitment decisions were kept secret.

Finally, we devise a new mechanism of *conditional commitment with bonus*. 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 a win for a committing firm of the high-quality type against a corrupt firm of the low-quality type.

1.1. Related literature

Corruption in competitive procedures has been studied in a few papers, including Burguet and Che (2004), Celentani and Ganunza (2002), and 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 Burguet and Che (2004) and more recently in Kosenok and Lambert-Mogiliansky (2009). While Burget and Che's main result is 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 using simple voluntary commitment mechanisms. For that reason, we depart from the above-mentioned literature and model the competitive procedure awarding the project as a beauty contest (rather than an auction), while the bribing game is modeled as an auction in bribes.

Our approach allows one to focus on the impact of commitment and brings us to recent literature in game theory, including Kalai et al. (2010), Peters and Troncoso-Valverde (2010), and Celik and Peters (2011), 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 in games with complete information. 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.

[4] http://transparency.org.

[5] http://eitransparency.org.

[6] 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."

[7] 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 properties of new tools aimed at reducing corruption in the management of natural resources of central interest for the development community (see, e.g., the report "Impact in Africa — story from the ground", EITI 2010, www.eiti.org).

[8] Corruption only determines allocation in the event of a tie.

1.2. Organization of the paper

In the next section, we present the model and characterize the benchmark equilibria with and without corruption. In Section 3, we introduce commitment. First, we discuss the practical aspects of implementing a commitment mechanism. We then 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. Finally, we investigate a conditional mechanism that rewards commitment with a bonus and characterizes an equilibrium that fully eliminates corruption. The last section concludes and discusses some policy implications of the results.

2. The model

2.1. Benchmark: no corruption

Consider a situation where the state is looking 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 ρ 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 ($q_i = \underline{q}$).[9] 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 ($\underline{q}$). Note 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.[10] In particular, the high-quality firm cannot produce the low-value 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 (its 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 higher quality, and selects either firm with equal probability in the event of a tie. Note that for $\bar{q} - \bar{c} > \underline{q} - \underline{c}$, which we shall assume, the beauty contest selects the socially efficient project.

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

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

It always wins the contest when the other firm's type is low quality, and it wins with probability 1/2 when the other firm is also high quality. 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

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

In this case, it only wins with probability 1/2 when the opponent's type is also low quality.

2.2. Equilibrium with corruption

Now let us assume that the government cannot observe the quality of the firms' projects and must rely on an agent whose incentives are not aligned with the interests of the government. The evaluation process is quite complicated 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 $m > 0$.[11] If $m < \bar{q} - \underline{q}$ he cannot strictly affect the selection; he can only favor a firm in the event of a tie (*weak discretion*). But if $m > \bar{q} - \underline{q}$ he can always choose the winner (*strong discretion*). The corrupt agent will try to cash in on his discretion, accepting bribes in exchange for adding m to the submitted quality.[12]

Firms are willing to offer bribes $(b_1, b_2) \in \mathbb{R}^2_+$ in exchange for the favor. The bribe is only paid if the firm wins the contest, and the agent only derives utility from bribes.[13] 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 $q_i > q_{-i} + m$.[14] Finally, the proposed 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 are 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 proposition:

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

[9] Firms are ex-ante symmetric, which is useful for deriving equilibrium strategies with bribery.

[10] 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 ex-ante symmetric firms, the model would be strategically equivalent.

[11] We assume that he cannot downscale the quality presumably because the firm would then complain.

[12] In our model there exists only two levels of quality, $\bar{q}$ and $\underline{q}$, so the abuse of discretion corresponds to scaling up the low quality to the high quality; in case of a tie, the agent chooses the firm with the upscaled quality instead of randomizing.

[13] Modeling 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). Note 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 are higher, our results would be reinforced, since firms would have even more incentive to commit to transparency.

[14] To ensure the 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, sufficiently fine bribing strategy space.

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 low-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 the equilibrium payoffs in the game with corruption for both firm types in the following situations:*

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

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

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 neither 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 firm's profit-if-win from corruption is equal to its 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-quality type (i.e., that the corruption gain can be realized) must be $\rho \leq 1/3$ 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 firm could mimic the low-quality firm 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 firm when it also has low costs and ρ is large. The low-quality firm 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 the costs of the firm are the only thing that matters for selection. Clearly, if the high-quality firm could choose between $\bar{q}$ and $\underline{q}$ with the associated costs, it would 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 is reached, so profits 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 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 low 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 multinational corporations (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 has ever contributed to the development of LDC. Rather the contrary, the so-called "resource curse" is an example where large corrupt transfers (often from efficient MNC) benefit the ruling elite but are systematically linked with very poor development performances.[15] Hence, we 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 a mechanism whereby firms make conditional commitment not to bribe. Finally, we introduce a reward for commitment and derive a result about full corruption deterrence.

3.1. Commitment in practice

There exists a rich body of domestic legislation (pioneered by the Foreign Corrupt Practices Act in the US) and international agreements and conventions (including the OECD Convention against the Bribery of Foreign Officials and the United Nations Convention Against Corruption (UNCAC), to name but two) outlawing the corruption of foreign officials in LDC in the context of international public procurement. The German MNC Siemens, for example, should not be involved in corruption, by force of the OECD convention alone. Yet it was recently found guilty of corruption.[16] Other MNC like Total and Haliburton are the subject of multiple corruption investigations.[17] This suggests that the actual deterrence power of the legal framework is not sufficient to effectively preclude corruption. Many MNC are aware that corruption is a costly business, but they feel trapped because they expect competing MNC and local firms to practice corruption. This is why MNC have an interest in developing instruments, including commitment mechanisms, that, 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 the rapid development of codes of conduct and standards of ethics as well as commitment mechanisms promoted by the anti-corruption community. To some extent, they are all intended to affect expectations in that sense (see Alan Knight in the Global Corruption Report, 2009, p. 99). In particular, the UN Global Compact includes a voluntary commitment not to engage in corruption.[18]

The mechanisms that we investigate only involve firms, not the government. This is in contrast to the above-mentioned EITI, in which the commitment of the government is a central feature.[19] This "firm-only" feature of the mechanisms that we study brings us closer to codes of conduct and standards of ethics that are voluntary and only commit the firms that adopt them — irrespective of what other players do. As we observe (see Remarks 1 and 2), unilateral

[15] See, e.g., Réseau mondial Caritas, February 2011: "Congo Brazzaville: Le pétrole ne coule pas pour les pauvres", http://www.secours-catholique.org.

[16] See Tribune de Genève 20/04/10, "Corruption chez Siemens: prison avec sursis pour deux ex-dirigeants" (Corruption at Siemens: suspended sentences for two former managers).

[17] 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).

[18] See www.unglobalcompact.org.

[19] In the EITI, a key to the mechanism is the so-called reconciliation between the data on payments made declared by the firms and the data on payments received declared by the government. A central feature of EITI is that it obliges governments to be more transparent, so the public can learn the magnitude of state revenues from extraction. Even if all that income is legal, EITI has a point. It means that governments must account for how the revenues are used. So in a sense it also targets corruption further down the line.

commitment has limited efficiency in our model.[20] The mechanism that we propose comprises two elements. The first is related to firms' commitment decisions and the second deals with the enforcement of transparency. We can think of several equivalent ways of implementing the first stage. One possibility is to use a simple automated device. The firms send their message (decision): yes/no to commitment. The output of the device is projected on a screen to an audience of stakeholders including, e.g., firms, government officials and representatives of civil society. The output depends on the particular mechanism chosen. For instance, when commitment is conditional and private, if any of the firms does not commit, the device informs that no commitment is in force. If the decisions are public then the output includes the firms' individual decisions. If both firms commit, the output is that commitment is in force, implying that firms are obliged to provide information about their transactions and accounts. This information is audited by internationally-recognized auditors known for their integrity — this is the second element of the mechanism.[21] If the auditors suspect that bribery has occurred they communicate the matter to 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. An alternative to the automated device is that firms communicate their decisions by phone, letter or in person to the (honest) auditors who inform the public as described above, i.e., either they disclose the firms' decisions and their implication for the auditing phase or they only disclose the outcome with respect to auditing. The second phase proceeds as described above.

Whether the firms use an automated device or disclose their decisions to the auditors, it is easy to tailor variants of the mechanism in response to the firms' 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.[22] 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 today whenever price is not the only criterion of 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 firms' projects takes the bonus into account. The procedure is, however, fully transparent. The automated device delivers an unambiguous message; it says 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 in 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.

We know from Proposition 1 that the zero bribe is not part of any equilibrium of the beauty contest game with corruption: if firm 1 commits, then firm 2 strictly prefers not to commit and to pay a very small bribe, since it wins for sure if $m > \bar{q} - \underline{q}$ or $q_2 = \overline{q}$, and it wins with probability $(1-\rho)$ instead of $1/2(1-\rho)$ otherwise. This implies that, in this context, no firm will ever choose to *unilaterally* commit to transparency. This supports the common perception that codes of conduct precluding corruption are "empty words".[23]

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 (on top of legal ones). Whether or not they are informed about the rival's decision (in the case where they do not commit) depends on whether the conditional commitment device is private or public.

The timing of the beauty contest game with interim[24] 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 or not to make a conditional commitment to transparency. The commitment decisions are either publicly announced or kept private (but a firm that committed learns whether or not its commitment is in force). 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

First, we examine 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 the event that one of the firms deviates and does not commit, the other firm keeps its 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., that none of the conditions of Proposition 2 hold, which we shall refer to as condition (iv).

Condition (iv):

$$m > \bar{q} - \underline{q}, \bar{c} > \underline{c}, \text{and } \rho > \frac{P - \underline{c}}{P - \underline{c} + 2(\bar{c} - \underline{c})} \qquad \text{(iv)}$$

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

[20] Moreover, in practice, codes of conduct often lack credibility as they are not associated with a reliable monitoring and auditing mechanism.

[21] One idea is to create an International Office of Auditors from members of the Supreme Audit Institutions of all the countries that have ratified the UNCAC. Upon request, a number of the Supreme Audit Institutions, selected randomly or by rotation, must delegate one of their officials to participate in the mechanism.

[22] It is noteworthy that the new UK Bribery Act from 2010 includes a provision (7(2)) that is very close to a bonus for voluntary commitment. A company may adopt "adequate procedures" (defined in a guidance note) to combat corruption, and this provides an argument in its defense (to reduce penalty) for the case some employee of the company is found guilty of corruption.

[23] According to our results, neither type of firm would commit unilaterally. The commitments that we observe would partly reflect the fact that those commitments are not associated with a reliable verification technology.

[24] See Section 3.2.2 for ex-ante conditional commitment, in which case firms decide to commit *before* learning their types.

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.[25]

What determines the power of the CC mechanism to deter corruption is revealed by Eq. (3). The more profitable the market (large P) and/or the fiercer the competition between high and low cost types ($\bar{c}-\underline{c}$ small), the more likely CC is to eliminate corruption. Another important parameter is ρ, the probability that the low-quality type's opponent is a high-quality type. This probability should not be too small. The intuition is simple. Under the no-corruption regime, the low-quality firm only wins against another low-quality firm, so the expected gain decreases in ρ. On the other hand, since the low-quality firm always wins in bribes against a high-quality firm, the corruption payoff increases in ρ. 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 firm believes there is very little chance that the other firm 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 types. The low-quality (and low-cost) firm 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 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 for the UN Global Compact and EITI (while the Integrity Pact applies to specific markets). Clearly, if the no-corruption regime dominates the corruption regime for both types of firm, then they also have an incentive to commit ex-ante, but the reverse is not true. To see this, consider the situation in which there is strong discretion ($m > \bar{q}-\underline{q}$) and the low-quality firm is the cost-efficient one ($\bar{c} > \underline{c}$). 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 Eqs. (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)

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

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 ρ 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 $\bar{c} \to \underline{c}$, meaning that the firms are close bribe competitors, the agent extracts all the rents and the no-corruption regime dominates for any value of ρ.

Comparing with condition (iii) in Proposition 2 for the no corruption payoff to dominate in the interim case, we note 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 commitment and reduce to $\rho < 1/3$, but they are strictly weaker whenever $P > \bar{c}$. Non-surprisingly, it is easier to secure firms' incentives for *full commitment* ex-ante than interim. However, the interim approach allows for *partial* commitment which can achieve valuable improvements when full commitment is not incentive compatible (see Proposition 4 below).

3.2.3. Partial commitment

Beside equilibria where both firm types commit, it is interesting to consider situations where one of the types commits but not the other. [26] 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) on page 11, so full commitment does not obtain in equilibrium), there may exist a partial commitment equilibrium in which only the high-quality firms choose to commit. In such an equilibrium, the observability of the commitment decisions turns out to play an important role, because the decision whether or not to commit may signal information about a firm's quality to another firm that 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 making a commitment always learns the commitment decision of the other. This is because it must know whether its own commitment is in force before making the subsequent decisions. On the contrary, when a firm does not commit, it never learns the commitment decision of the other. We denote that case as private conditional commitment.

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

Proof. See Appendix A.2. □

Proposition 4 establishes that the observability of conditional commitment decisions induces more corruption than when commitment decisions are not observable. This is because under observability, deviating from separation and committing allows one to fool the other firm, which may be profitable. It allows one to reduce the cost of competition in bribes with a low-quality opponent because the latter is fooled into believing it faces a high-quality firm. When that is profitable (i.e., for $\rho < 1/2$), no partial commitment equilibrium

[25] Note that the proposed mechanisms cannot be used to facilitate collusion along other dimensions of competition. This is because communication between firms is strictly limited to an exchange of well-defined messages through an electronic device.

[26] 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.

exists.[27] When commitment decisions are not observable, 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 ensuring that when two high-quality firms 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 to a unanimity rule. But it is important to note 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-quality type, in which case both firms (secretly) commit, commitment is binding and it precludes corruption.

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 $a_i = h$ 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 actually comes in force or not. 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 $q_i + a_i > q_{-i} + m + a_{-i}$.

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) in Section 3.2.1 above, where the agent's discretion is strong, the high-quality type has high costs, and the probability for the contestant to be a high-quality firm is large. In this case, we know that corruption allocates the contract to a low-quality firm even when there is a high-quality firm present (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 seek to determine when full commitment is possible with CCB. It turns out that adding the bonus to the conditional commitment mechanism induces asymmetries between firms off the equilibrium path, when one 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-quality types are respectively given by:

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

Let us denote by μ 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 one firm fails to commit, the other 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 with the one we studied in Section 2.2, since μ may be different from ρ. In the bribing game off the equilibrium path, we claim that the following strategies are part of an equilibrium:

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

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

These strategies are supported by $\mu = 0$, i.e., the committing 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 committing firm's type are as before: it assigns probability ρ to the event that it is of the high-quality type. To see that the bribes in Eqs. (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 propose no bribe. When $b_1 = b_2$ and $q_1 = q_2$, the agent selects firm 1.

The second line (Eq. (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-quality type knows it can never win against a committed high-quality firm. So it only cares about the low-quality type, and competition dissipates the rents.

Firm 1's incentive constraints can be written:

$$\frac{1}{2}(1-\rho)(P-\underline{c}) \geq 0,$$

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

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

To summarize, we have shown that under condition (iv) (see Section 3.2.1) and when $h < m$ and $h + \bar{q} > m + \underline{q}$ 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, when $P = \bar{c}$, with the simple conditional mechanism, the no-corruption equilibrium requires $\rho \leq 1/3$ (CCB only requires $\rho \leq \frac{2}{3}$). 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 belief about firm 1's type after the deviation. Above, we considered an extreme belief ($\mu = 0$) that generated incentive constraints from which we derived a condition for full commitment to be an equilibrium of the beauty contest with CCB. In Appendix A.3 we show that as we move away from $\mu = 0$ ($\mu = 1$, respectively), the incentive constraint of a low-quality (high-quality, respectively) type becomes less binding. Hence, for appropriate intermediate beliefs, a firm may put sufficient weight on *both* types, which forces them to bribe substantially 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 Appendix A.3). This equilibrium is supported by beliefs $\mu = 1/2$ off the equilibrium path and has the following form. Firm 1 of high quality type plays a mixed strategy according to a continuous distribution with support $(0,y_1]$, firm 1 of low quality plays a mixed strategy according to a continuous distribution with support $(y_1,y]$, firm 2 of 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 of low quality plays a mixed strategy according to a continuous distribution with support $(y_2,y]$, where $0 < y_2 < y_1 < y$.

[27] It can also be verified that there is no equilibrium in which only the low-quality firm commits. The high-quality firm gets zero if it does not commit, while it earns a strictly positive profit if it does commit.

Proposition 5. *Assume that $h+\bar{q} > m+\underline{q}$. In the beauty contest with conditional commitment with bonus, there always exists an equilibrium with full corruption deterrence.*

Proof. See Appendix A.3. □

We already know that conditional commitment achieves corruption deterrence for the case where the no-corruption regime is preferred by firms of both types. It gives them an instrument to cooperate in resisting costly competition in bribes. What the CCB mechanism achieves is to preclude corruption even when some firms strictly prefer the corruption regime. This is made possible because of the combination of the conditionality of commitment and the bonus for (unilaterally) committing. By rewarding a "good" firm that commits with a selection advantage but allowing it to bribe in the event that full commitment fails, competition in bribes is made unprofitable for the firm who initially preferred the corruption regime. This 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 a voluntary commitment not to bribe in spite of the fact that some of them originally gain from corruption.

Remark 2. In an earlier version of the paper, we investigated unilateral commitment with bonus (UCB). We show that unless the bonus is larger than the selection advantage available in corruption, the beauty contest with UCB is characterized by more corruption than the beauty contest with CC alone. In particular, it fails to get firms to cooperate even to avoid pure extortion, i.e., under weak discretion. The UCB never provides incentives for low-quality firms to commit, and does not always allow the high-quality firm to avoid extortion under strong discretion, even when commitment decisions are not observable and the high-quality firm is cost-efficient.

4. Conclusion

In this paper we have investigated mechanisms of corruption deterrence based on firms' voluntary decision to commit to transparency in a beauty contest game in which the price is fixed or plays a minor role in competition. Our first main finding is that a simple conditional commitment mechanism has a powerful potential to deter corruption when corruption boils down to pure extortion. In those cases, the firms face a cooperation problem: they prefer not to bribe but they do bribe unless they trust their rival not to. A conditional commitment mechanism provides them with an instrument to cooperate. A low quality firm may prefer not to commit to transparency 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. When we introduce a selection advantage rewarding the decision to commit, the no-corruption regime becomes even more attractive. We find that the mechanism combining both conditionality and a reward (a transparent selection advantage that need not be large) allows complete elimination of 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 firms that choose to commit with a selection advantage. These recommendations are a contribution to the public debate underlying the present 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 in its concern to engage the civil society and the private sector in the effort to curb corruption. Indeed, the development of EITI arose from disappointment with unilateral commitment (the Corporate Social Responsibility approach). EITI puts emphasis on urging host governments to commit which makes commitment compulsory for firms. However, persuading governments is an onerous task, and not all countries are willing to sign up to the 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 a bonus only requires a limited engagement from the government and yet, as we show, it has the potential to significantly reduce corruption. We believe that these two features, namely full autonomy and making limited demands on the government, together with their 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 a foreign firm competes with a local firm for extraction rights. It may be more reasonable to assume that the probability that the local firm's rival 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-quality 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 in 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 be 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.

Appendix A

A.1. Equilibrium characterization without commitment

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

A.1.1.1. 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 firm. There exists a unique equilibrium where a high-cost (and high-quality) firm proposes $b_i^*(\bar{q}) = P-\bar{c}$, earning an expected profit of $\Pi^C(\bar{q}) = 0$, and a low-quality firm plays a mixed strategy according to a distribution $F(b)$ with support $\left[P-\bar{c}, \hat{b}\right]$. 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 $b \in \left[P-\bar{c}, \hat{b}\right]$. When $b = P-\bar{c}$ we have $F(b) = 0$ so

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

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

In this situation, the high-quality firm always strictly prefers the no-corruption regime, since it earns nothing with corruption and some positive expected profit without corruption. For the low-quality firm, we have

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

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

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

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., ρ should not be too large to secure the dominance of the no-corruption regime.

A.1.1.2. The high-quality type has lower cost $(\bar{c} < \underline{c})$. When the high-quality firm is also the cost-efficient firm, the low-quality firm proposes $b_i(\underline{q}) = P-\underline{c}$ and earns zero profit with corruption. With the same reasoning as above, the high-quality firm 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 always strictly prefers the no-corruption regime, and the high-quality firm prefers the no-corruption regime iff

$$\Pi^N(\bar{q}) > \Pi^C(\bar{q}) \Leftrightarrow \left(\frac{1}{2}\rho+(1-\rho)\right)(P-\bar{c}) > \left(\underline{c}-\bar{c}\right)(1-\rho),$$
$$i.e.,\ \rho(P-c)+2(1-\rho)\left(P-\underline{c}\right) > 0,\ \text{which is always satisfied.}$$

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. Whether $\bar{c}$ is lower or higher than $\underline{c}$, there exists a unique symmetric equilibrium where a low-quality firm submits $b_i^*(\underline{q}) = P-\underline{c}$, earning an expected profit of $\Pi^C(\underline{q}) = 0$, and a high-quality firm plays a mixed strategy according to 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 $\hat{b}_2 = \rho(P-\bar{c})$.[28] Competition in bribes against the same quality type 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.

[28] 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 $\Pi^C(\bar{q}) = \left(P-\bar{c}-\hat{b}_1\right)(1-\rho)$. 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 $\hat{b}_2$, $F\left(\hat{b}_2\right) = 1$ so $\left(P-\bar{c}-\hat{b}_2\right) = (P-\bar{c})(1-\rho)$, which implies $\hat{b}_2 = \rho(P-\bar{c})$.

A.2. Proof of proposition 4

A.2.1. Publicly observable conditional commitments

When firms' commitment decisions are publicly observable, the profit of a firm type $\underline{q}$ when it does not commit is:

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

If a firm of type $\underline{q}$ deviates and commits (remember 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 other 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 $\bar{q}$ in the partial commitment equilibrium can thus be written:

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

i.e., $\rho \geq 1/2$. If the probability of meeting a high-quality firm is lower, it becomes attractive to fool the contestant hoping that he is of low quality and out-compete him 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.

A.2.2. 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 $\rho\left(\bar{c}-\underline{c}\right)$ 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

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

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

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

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

A.3. Proof of proposition 5

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 $\rho > \frac{P-\underline{c}}{P-\underline{c}+2\left(\bar{c}-\underline{c}\right)}$, there is an equilibrium in which both firms, whatever their types, conditionally commit to transparency for a bonus h such that $h+\bar{q} > m+\underline{q}$. Consider such a 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. Note 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 (ρ and μ) 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 of high quality type plays a mixed strategy according to a continuous distribution $\bar{F}_1(b)$ with support $(0,y_1]$, firm 1 of low quality plays a mixed strategy according to a continuous distribution $\underline{F}_1(b)$ with support $(y_1,y]$, firm 2 of 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 of 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:

$$(P-\bar{c})\bar{F}_2(0)=P-\bar{c}-y_2 \tag{9}$$

$$(P-\bar{c}-y_2)\rho=(P-\bar{c}-y_1)\left(\rho+(1-\rho)\ \underline{F}_2(y_1)\right) \tag{10}$$

$$\left(P-\ \underline{c}-y_1\right)\ \underline{F}_2(y_1)=P-\ \underline{c}-y \tag{11}$$

$$(P-\bar{c})(1-\mu)=(P-\bar{c}-y_2)\left(1-\mu+\mu\bar{F}_1(y_2)\right) \tag{12}$$

$$\left(P-\ \underline{c}-y_2\right)\bar{F}_1(y_2)=P-\ \underline{c}-y_1 \tag{13}$$

$$\left(P-\ \underline{c}-y\right)=\left(P-\ \underline{c}-y_1\right)\mu. \tag{14}$$

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

We now show that there exists a belief off the equilibrium path, namely $\mu=1/2$, such that both types of firm 1 have no incentive to deviate from the conditional commitment. Incentive compatible conditions for firm 1 in the commitment stage for the high type and the low type are respectively given by:

$$(P-\bar{c})\rho\bar{F}_2(0)\le(P-\bar{c})\left(\frac{1}{2}\rho+(1-\rho)\right), \tag{15}$$

$$\left(P-\ \underline{c}-y_1\right)(1-\rho)\mu\le\left(P-\ \underline{c}\right)\frac{1}{2}(1-\rho). \tag{16}$$

The equilibrium condition (16) for the low-quality type is clearly always satisfied for $\mu=1/2$. The equilibrium condition (15) for the high type can be rewritten as $\bar{F}_2(0)\le\frac{1}{\rho}-\frac{1}{2}$. From (9) this condition becomes:

$$y_2\ge\left(\frac{3}{2}-\frac{1}{\rho}\right)(P-\bar{c}). \tag{17}$$

Using the system of three equations and three unknowns (10), (12) and (13) we get:

$$\left(P-\ \underline{c}-y_2\right)\frac{y_2}{P-\bar{c}-y_2}=\bar{c}-\ \underline{c}+2\frac{P-\bar{c}-y_2}{1+\rho}. \tag{18}$$

The solution of this last equation is:

$$y_2=\frac{1}{2+6\rho}\left(2(P-\ \underline{c})(1+\rho)+(P-\bar{c})(3\rho-1)+\sqrt{-(1+\rho)\left(8(P-\bar{c})(P-\ \underline{c})-4\left(P-\ \underline{c}\right)^2(1+\rho)+(P-\bar{c})^2(3\rho-5)\right)}\right). \tag{19}$$

Note that $-\left(8(P-\bar{c})(P-\ \underline{c})-4(P-\ \underline{c})2(1+\rho)+(P-\bar{c})^2(3\rho-5)\right)$ is positive because it is linear in ρ and positive for $\rho=0$ and $\rho=1$. The incentive constraint (17) of the high-quality type is therefore given by:

$$2(P-\bar{c})(1+\rho-3\rho^2)+2(P-\ \underline{c})\rho(1+\rho)+\sqrt{-(1+\rho)\left(8(P-\bar{c})(P-\ \underline{c})-4(P-\ \underline{c})^2(1+\rho)+(P-\bar{c})^2(3\rho-5)\right)}\ge0. \tag{20}$$

To verify this inequality it suffices to show that: $(P-\bar{c})(1+\rho-3\rho^2)+(P-\ \underline{c})\rho(1+\rho)\ge0$. This inequality is satisfied for $\rho=0$ and $\rho=1$, and the left-hand side is either increasing (when $(P-\bar{c})-6(P-\ \underline{c})\ge0$) or concave (when $(P-\bar{c})-6(P-\ \underline{c})\le0$), so it is positive for all $\rho\in(0,1)$. □

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