Renegotiation, Corruption and Cost Overruns in Procurement

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Abstract

A sponsor –e.g. a government agency– uses a procurement auction to select a supplier who will be in charge of the execution of a contract. That contract is incomplete: it may be renegotiated once the auction's winner has been chosen. We examine a setting where one firm may bribe the agent in charge of monitoring contract execution so that the former is treated preferentially if renegotiation actually occurs. If a bribe is accepted, the corrupt firm will be more aggressive at the initial auction and thus win with a larger probability. We show that the equilibrium probability of corruption is larger when the initial contract is less complete, and when the corrupt firm's cost is more likely to be similar to her rivals'. In addition, we examine how this influences the sponsor's incentives when designing the initial contract.

Keywords: Auctions, Cost overruns, Procurement, Renegotiation, Corruption.

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1 Introduction

Governments and state-owned enterprises around the world spend substantial sums to purchase goods, services and infrastructure projects.[1] How that spending is carried out is a major issue. Governments, supranational entities and international organizations choose and recommend procurement procedures intended to foster competition among suppliers that allow the public sector to receive more value for the money.

In general, though, those procedures could be vulnerable to corruption. A procurement agent or government official could be bribed in exchange for preferential treatment at some stage of the procurement process. In this note, we study the impact that corruption may have on the whole process when it operates at one specific stage: renegotiation. In particular, we model a setting where a sponsor –e.g. a public agency– has to allocate the execution of a contract to one of several potential suppliers. The contract is awarded through an auction. However, the original contract is incomplete: contingencies may arise that make it convenient for both parties to renegotiate. Then, we allow for the possibility that one specific bidder may bribe the agent in charge of monitoring the execution of the project so that the former receives preferential treatment if renegotiation actually occurs.

As we will describe in the next section, the impact corruption may have is not limited to the renegotiation stage. Anticipating better treatment if renegotiation happens, the corrupt firm will bid more aggressively in the auction and thus win more often than it would if corruption were absent. Furthermore, anticipating that corruption may influence the process changes the sponsor's incentives when designing the contract that will be awarded through the auction.

Below, we provide a specific model where the contract is designed, auctioned, possibly renegotiated and finally executed. Between contract design and the auction itself, a firm may bribe the agent to gain a larger share of renegotiation surplus when renegotiation

[1] Public procurement, excluding public corporations, represents about 13% of GDP in OECD countries. See *stats.oecd.org* and Bosio et al. (2022), which reports that procurement accounts for 12 percent of global GDP -i.e. around $11 trillion.

actually happens. We characterize the optimal bribe to be offered by the corrupt firm. Our main result, Proposition 1, provides two interesting conclusions. First, the optimal bribe falls, and thus corruption is less likely, when the contract awarded through the auction is more complete. In other words, a contract that leaves less room for renegotiation reduces the influence of the form of corruption we examine. Second, the equilibrium probability of corruption is larger when the corrupt firm's cost is more likely to be similar to her rival's. Better treatment at the renegotiation stage yields a given advantage for the corrupt firm. That advantage is more valuable when it is more probable that it becomes decisive in making the corrupt firm win. Then, it becomes more valuable, generating higher bribes, when the corrupt firm is more similar, in terms of costs, to her rivals. We discuss in the next section the significance of this conclusion for the corruption literature.

Our model relies heavily on Arozamena, Ganuza and Weinschelbaum (forthcoming). In that paper, though, we focus on *favoritism* –that is, on the case where the sponsor herself would prefer that some potential contractors win, given the price, as happens when advantages are conferred to local or national firms over their foreign competitors. Here, whether one firm is favored or not follows from a bribing game where an agent of the sponsor may not act in her principal's best interests.

2 The Model

A sponsor has to hire a contractor to carry out a single, indivisible project. $N \geq 3$ firms are potential suppliers, and one of which will be selected through an auction. The auction and contract execution will be run by a procurement agent that may be corrupt. We describe in detail the interaction among all parties involved in specifying, auctioning and carrying out the project.

1. *Contract specification*

   The optimal specification of the project is uncertain. There is a set of possible contingencies (states of nature) W that may arise during project execution. The contingency that actually occurs determines the optimal design. Let $e \in [0, 1]$ be the sponsor's effort in specifying the contract. Then, $W^C(e) \subset W$ will be the set of contingencies covered in the contract. Contractually specifying designs for each contingency is costly, though, so the contract chosen by the sponsor will be incomplete. Specifically, choosing effort let $k(e)$ be the cost to the sponsor of selecting a specification effort e, where $k'(e), k''(e) > 0$, $k'(0) = 0$ and $\lim_{e \to 1} k(e) = \infty$. A larger value of e means that more contingencies are covered: if $e' < e''$, then $W^C(e') \subset W^C(e'')$. The sponsor values the project at v if it is carried out with the exact design that corresponds to the state of nature that occurs during contract execution –for simplicity, we assume that she values the project at zero if not. Then, as we will see below, if the contingency that occurs is not covered in the initial specification, the contract will have to be renegotiated. To simplify, we assume that if the sponsor selects specification effort e, then the probability that the contingency actually occurring is covered in contract $W^C(e)$ is also e.

2. Bribing stage

The procurement agent that will run the project may be bribed. One of the potential contractors, firm 1, offers a bribe b to her in exchange for preferential treatment if renegotiation is necessary. We describe in detail how firm 1 will be favored when we introduce the renegotiation stage below. If the procurement agent takes the bribe, she incurs a cost τ. This cost includes expected penalties, but possibly idiosyncratic factors related to moral costs as well. Cost τ is distributed according to a c.d.f. $G(.)$ that is continuous, strictly increasing, and has a density $g(.)$. We assume that $x + \frac{G(x)}{g(x)}$ is increasing. Initially, then, the procurement agent learns the value of τ (her private information), and firm 1 makes an offer. The agent can only accept or reject that offer.

3. Auction

A contractor is selected to carry out contract $W^C(e)$ through a second-price, sealed-bid auction. So as to simplify, we assume that, for any $W^C(e)$, firm 1's cost of executing the project is $c_1 = c + \Delta$, where Δ is uniformly distributed on the interval $[-B, B]$, and $B > 0$. Firm 1 learns the actual value of Δ (which is her private information) before the auction. Any firm i, $i = 2, ..., N$ has cost $c_i = c$. Then, all firms face the same expected cost ex ante, and Δ represents firm 1's cost advantage/disadvantage. In addition, we are assuming, for simplicity, that expected costs are independent of contract specification.

4. Contract execution and renegotiation

As we mentioned above, the actual contingency occurring, which we will denote by w^*, is revealed after the auction but before contract execution. If $w^* \in W^C(e)$ (which happens with probability e), the initial contract can be implemented by the auctions's winner without changes. However, if $w^* \notin W^C(e)$, the procurement agent and the winning contractor have to renegotiate the contract so that its execution yields value to the sponsor. The cost of adapting the contract to the new contingency w^* is $c_{w^*} < v$ for any contractor.[2] We model renegotiation as a two-stage variation of that in Bajari and Tadelis (2001). First, renegotiation effort λ is chosen by the procurement agent. The cost of effort is given by $\beta\lambda^2/2$, where $\beta > 0$ captures the agent's bargaining efficiency. At the second stage, with probability $\lambda > 0$ the agent makes a take-it-or-leave-it (TIOLI) offer to the contractor, and with probability $1 - \lambda > 0$ it is the winning firm that makes the TIOLI offer. If the agent has not taken a bribe from firm 1 or firm 1 has not won the auction, she will select a renegotiation effort that maximizes the sponsor's expected utility. However, if she has taken a bribe and firm 1 won, she will treat the bribing firm preferentially. She will act as a representative of firm 1 would, by selecting $\lambda = 0$.[3] Once renegotiation (if necessary) is over, the contract is executed. We assume that $v \geq c + B + c_{w^*}$, so that the project is carried

[2] We simplify greatly by assuming that c_{w^*} is independent of the initial contract and of the exact contingency that occurs.

[3] The agent may face constraints that impose a minimum but positive value of λ. Since our results would not change, we assume such a constraint does not exist.

out even if renegotiation is certain.

3 Equilibrium

We solve the model backwards, starting at the final stage in renegotiation. Recall that, under our assumptions, the surplus from renegotiation, $v - c_{w^*}$, will always be generated. Given that the procurement agent has chosen a renegotiation effort λ, if that agent makes a TIOLI offer (which happens with probability λ) she will just compensate the winning contractor for the adaptation cost c_{w^*}. If the contractor makes the offer (which happens with probability $1 - \lambda$), she will be paid v and seize the entire renegotiation surplus. At the first stage of renegotiation, λ is chosen by the agent. If the auction's winner is firm 1 and a bribe has been accepted, as we mentioned above, the agent will choose $\lambda = 0$, ensuring that the corrupt firm captures all the surplus. In any other circumstance, the agent will solve

$$\max_{\lambda \in [0,1]} \quad \lambda(v - c_{w^*}) - \beta \frac{\lambda^2}{2}.$$

so that

$$\lambda^* = \frac{(v - c_{w^*})}{\beta}$$

We move back now to the second-price auction. For any participating firm, it is weakly dominant to submit a bid such that, if it won and was compensated according to that bid, its expected profits would be zero. Then, all contractors will discount in their bids any expected profits from future renegotiation. That is, any firm $i > 1$ will bid

$$P_i^* = c - (1 - e)[1 - \frac{(v - c_{w^*})}{\beta}](v - c_{w^*}),$$

where the second term on the right-hand side is the expected renegotiation profit. Analogously, if the agent has not taken a bribe, firm 1 will bid

$$P_1^* = c + \Delta - (1-e)[1 - \frac{(v - c_{w^*})}{\beta}](v - c_{w^*}).$$

However if firm 1 has bribed the agent, it will bid

$$P_1^* = c + \Delta - (1-e)(v - c_{w^*}).$$

Then, without bribing, firm 1 wins if $\Delta < 0$. If it has bribed the agent, though, it wins if

$$\Delta < (1-e)\frac{(v - c_{w^*})^2}{\beta} = \Delta^*$$

The corrupt firm seizes an advantage Δ^* at the auction stage from preferential treatment if renegotiation occurs. That advantage is decreasing in specification effort e. Ex ante, then firm 1's expected profit if it has not bribed is

$$\Pi_1 = Prob(\Delta < 0).E[-\Delta|\Delta \leq 0] = \frac{B}{4}$$

There is no profit from renegotiation, since expected renegotiation surplus is competed away when bidding. If it has bribed the agent, firm 1's expected profit is

$$\Pi_1^c = Prob(\Delta < \Delta^*).[E[-\Delta|\Delta \leq \Delta^*] + \Delta^*] = \frac{B + \Delta^*}{2B}(\frac{B - \Delta^*}{2} + \Delta^*) = \frac{(B + \Delta^*)^2}{4B}$$

In this case firm 1 seizes a positive expected profit from renegotiation: given that it will be treated preferentially at the renegotiation stage, not all its surplus will be competed away when bidding. Moving back to the bribing stage, firm 1 has to decide which bribe b it will offer. The procurement agent will take the bribe if it outweighs its cost -i.e. if $b > \tau$. So the probability that a bribe b will be accepted (the probability of corruption) is $G(b)$. Then, firm 1 chooses the bribe b that solve the following problem.

$$\max_{b} \quad \Pi_1^c G(b) + \Pi_1(1 - G(b)) \tag{1}$$

Let b^* be the optimal bribe, the solution of firm 1's bribing problem. It satisfies

$$\begin{aligned} b^* + \frac{G(b^*)}{g(b^*)} &= \Pi_1^c - \Pi_1 \\ &= \frac{\Delta^*}{2} + \frac{\Delta^{*2}}{4B}. \end{aligned}$$

We can state an interesting comparative statics result

Proposition 1 *The equilibrium bribe and the probability of corruption is decreasing in the level of specification e and the cost parameter B.*

The left hand side of the first order condition is increasing on b^*, and the right hand side is decreasing in e (since Δ^* is decreasing in e) and B.

We discuss here the two parts in Proposition 1 in order. The first part –i.e. that the equilibrium probability of corruption falls with the specification effort e– suggests that an effective way of coping with the form of corruption that we are analyzing should be increasing contract specification. Indeed, we can now complete our description of the equilibrium by moving back to the contract specification stage, and verify that this is the case.

We have assumed that the sponsor selects e. Anticipating its effects on the equilibrium bribe and future possible renegotiation, and without considering specification costs the sponsor's expected utility if a bribe is accepted will be given by

$$\Pi_S^c = v - c + (1-e)(1 - \frac{v - c_{w^*}}{\beta})(v - c_{w^*})$$
$$- (1-e)(\frac{B + \Delta^*}{2B}(v - c_{w^*}) + \frac{B - \Delta^*}{2B}(1 - \frac{v - c_{w^*}}{\beta})(v - c_{w^*}) + \frac{(v - c_{w^*})^2}{2\beta})$$

The first line in this expression reflects the fact that the project will always be completed (so the sponsor receives v with certainty), and that, given our assumptions, the auction's price will always be given by the cost c plus the expected renegotiation profits for any firm $i > 1$. All expected costs for the sponsor that follow from renegotiation are included in the second line, as well as specification costs. Notice that if firm 1 wins (which happens with probability $(B + \Delta^*)/(2B)$, it grabs the entire renegotiation surplus, but there is no costly renegotiation effort. If no bribe has been accepted, the sponsor's expected utility is given by

$$\Pi_S = v - c + (1-e)\frac{(v - c_{w^*})^2}{2\beta}$$

Since all contractors are treated equally if they win, all expected renegotiation profits are competed away at the bidding stage. The only cost the sponsor bears from renegotiation follows from the choice of renegotiation effort λ.

Combining both possibilities and considering specification costs, the sponsor solves

$$\max_e \quad \Pi_S^c G(b^*) + \Pi_S(1 - G(b^*)) - k(e)$$

with first-order condition

$$\frac{v-c_{w^*}}{2\beta}(1+G(b^*)\frac{B+\Delta^*}{2B}-(1-e)(\frac{G(b^*)}{2B}\frac{\partial\Delta^*}{\partial e}+\frac{B+\Delta^*}{2B}g(b^*)\frac{\partial b^*}{\partial e})=k(e) \qquad (2)$$

Without corruption, the sponsor's problem would be

$$\max_{e} \quad \Pi_S - k(e)$$

with first-order condition

$$\frac{(v-c_{w^*})^2}{2\beta}=k'(e) \qquad (3)$$

It is easy to verify that the left-hand side of (2) is larger than that in (3). Therefore, given that $k(e)$ is strictly convex, it has to be the case that the sponsor chooses a a higher specification effort when corruption is possible. The contract that results from the possibility of corruption is thus more complete.

The second part of Proposition 1 states that the probability of corruption falls with B. The intuition is as follows. The corrupt firm's comparative advantage in the bidding process is bounded by renegotiation rules and limits. When B increases, the dispersion of firm 1's cost increases, and it becomes more likely that the difference in costs between firm 1 and its rivals are larger than the corruption advantage. However, if B is small, and the cost differences across firms are smaller, the corruption advantage may be key in the procurement process and then, the incentives of firm 1 to bribe the agent are larger.

This result is interesting for the corruption literature. Cost dispersion is, in general, directly related to firms' rents and, then, inversely related to the level of competition in a particular industry. Therefore, we can read our result as stating that more competitive markets (in which firm's costs differences are small) with low firm profits are more vulnerable to corruption when it takes place through this procurement renegotiation channel. This goes against the traditional view that relates corruption to lack of market competition, which generates rents that can be illegally appropriated.[4]

This form of "competitive corruption" fits well with the Odebrecht corruption case described in Campos et al.(2021). In that case, corruption emerged in a construction sector characterized by its competitiveness and low firm profits. During the period 2001-2016, Odebrecht –the largest engineering and construction company in Latin America– bribed about 600 politicians and public servants in 10 Latin American countries. According to the US Department of Justice (2016), this corruption case was the largest foreign bribery case in history, accounting for 788 millions of dollars in bribes.

Although, in exchange for the bribes, Odebrecht asked for several ways to be favored, the most prominent one was obtaining higher prices during the renegotiation process. Campos et al.(2021) shows that renegotiation revenues in Odebrecht's projects for which there is evidence of corruption were higher than in the regular projects. As the theoretical discussion of the case in Campos et al.(2020) and our model predict, this renegotiation advantage translated into an advantage at the bidding stage. Odebrecht multiplied its contracts by a factor higher than 8 times between 2003 and 2016 due to its corrupt practices.

Beyond these results, this note leaves a number of open questions that could be interesting avenues for future research. In particular, in our model it is the sponsor that chooses contract specification at the initial stage. Alternatively, the procurement agent could be in charge of contract design and execution, or there could be two agents with one task assigned for each one of them. The impact of corruption on the whole procurement process in these alternative settings is indeed an interesting subject,

[4]Rose-Ackerman was one of the first scholars promoting the idea that as competition reduces rents, it also leads to lower corruption. In her book, Rose-Ackerman (1996), she states: "In general any reform that increases the competitiveness of the economy helps reduce corrupt incentives." We provide an additional argument to the literature on competition and corruption that challenges the Rose-Ackerman' principle –see for example Bliss and Di Tella(1997), Celentani and Ganuza (2002) and Laffont and N'Guessan (1999).

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