# *Corruption and individual ethics: insights from a public procurement auction*

# CORRUPTION AND INDIVIDUAL ETHICS. INSIGHTS FROM A PUBLIC PROCUREMENT AUCTION

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## ABSTRACT

*This article proposes an auction model where two firms compete for obtaining the license for a public project and an auctioneer acting as a public official representing the political power, decides the winner of the contest. Players as firms face a social dilemma in the sense that the higher is the bribe offered, the higher would be the willingness of a pure monetary maximizer public official to give her the license. However, it implies inducing a cost of reducing all players' payoffs as far as our model includes an endogenous externality, which depends on bribe. All players' payoffs decrease with the bribe (and increase with higher quality). We find that the presence of bribe aversion in either the officials' or the firms' utility function shifts equilibrium towards more pro-social behavior. When the quality and bribe-bid strategy space is discrete, multiple equilibria emerge including more pro-social bids than would be predicted under a continuous strategy space.*

## 1 Introduction

Public procurements auctions are source of potential corrupt exchanges. All over the world many public projects have been uncovered as being executed resulting from the intervention of bribe transfers. Bribery is bilateral, either is offered by the side of the one who expects to receive a preferential treatment in exchange or is requested by the side of the one who has the discretionary power to decide on something. If we focus on the scenario of public procurement auctions, firms are the ones potentially offering bribes and auctioneers are the ones potentially requiring it. Despite the countless scandals discovered, we are still far from knowing the actual volume of bribery in public procurement because corruption is illegal and secret per se, thus difficult to measure with real data. According to Transparency International this particular kind of corruption is harmful as project's cost can increase more than 50% due to bribe expenses but it also has a direct implication on the execution of the projects by reducing their quality. Moreover, according to the World Bank, worldwide bribes are calculated to be around US$1 trillion ([7]).

Despite the huge effort exerted and the big contributions to the literature on this field, any empirical research about corruption and bribery remains a mere approximation from extrapolating some data from, for example, perception surveys[1]. This is not surprising due to the difficulty in getting the real amount of bribe as it is uncovered by definition, therefore, the

[1] [11] Transparency International publishes annually the Corruption Perceptions Index (CPI) which ranks countries "by their perceived levels of corruption, as determined by expert assessments and opinion surveys." Surveys/assessments are either business people opinion surveys or performance assessments from a group of analysts.

implicated parts are not interested in revealing it. However, we cannot omit the big progress that has been made by researchers in recent years and the reliability of the results obtained. Indeed, all the available indexes have been very useful to make progress in the investigation of corruption, concretely in an empirical way. The researches are mainly oriented to understand how corruption affects development, growth, poverty, and gender equality among others. From a total of 70 countries, [9] demonstrates the negative effect that corruption may have on growth. [10] find evidence that corruption gets lower levels when the public employees wages are high compared to those of the manufacturing sector. [6] show that corruption is positively correlated to poverty in terms of income distribution. [5] using a sample of more than 100 countries, give a gender oriented approach and prove that the higher is the representation of women in the parliament the lower the level of corruption. This article is addressed to present a theoretical model combining two elements, bribery and auctions. In particular, our model is oriented to the study of corruption in public procurement auctions in which firms compete between them and interact with a public official. In addition to empirical works, a large literature concerning theoretical models exists. Works as [1], [8], [3], [4] and [2] have inspired our model. Although those models reflect mainly the situation where the bidders take simultaneously decisions on bribes and prices, our model presents rather the tradeoff between bribe and quality. In particular, our work is based on [2] who propose an auction model where two providers of procurement compete bidding prices and bribe. Their game displays the kind of corruption that we personally consider is creating all over the world the highest damages, the one that involves public procurement auctions. Such a bribery can have fatal effects on the quality of public projects or services. In fact, this bribery is hard to denounce and to demonstrate as far as the political class has the power to control their transparency and the separation of powers is not always as true as desirable.

Hence, we propose a design in which we focus on an auction where two firms compete for obtaining the license for a public project and an auctioneer acting as a public official representing the political power, decides the winner of the contest. This model has the peculiarity of inducing players to engage in bribe as a monetary maximization behavior. Players as firms face a social dilemma in the sense that the higher is the bribe offered, the higher would be the willingness of a pure monetary maximizer public official to give her the license. However, it implies inducing a cost of reducing all players' payoffs as far as our model includes an endogenous externality, which depends on bribe. All players' payoffs decrease with the bribe (and increase with higher quality).

As we will see in the next section, our model presents multiple equilibria for firms. The interesting point is that, according to the monetary maximization theory, public officials should always prefer the firm that offers the highest transfer of bribe. Therefore firms and officials have divergent preferences.

The paper is organized as follows: in section 2 we present the model. Third section concludes.

## 2 The model

Our model is inspired on the theoretical framework of [2] in which pairs of sellers bid to obtain a public contract and the bid of each seller could include a bribe to be paid by the public official as buyer. Consider the variation of the previous model. A game is played between two firms $(i, j)$ bidding for a procurement contract which will be granted to one of the two firms by a public auctioneer (official). Like in the original framework, bidding takes place in two dimensions. However, in our version, the social externality of the winning project, net of social or private costs affects uniformly to all agents. Thus, rather than the price paid by the state to the winning firm, the first bidding dimension is a bidder quality net of costs ($Q_i \leq A$, where $A$

represents an exogenously given upper bound to quality). This allows us to model the first dimension of bidding as a simple linear, monotonically increasing function of the winning project social quality benefiting unambiguously all agents, the auctioneer, the two firms and, potentially (as we do in a follow-up of this paper), the society surrounding them. The second dimension is a bribe ($B_i$) promised and finally paid by the winner of the auction to the auctioneer. Furthermore, in order to guarantee that a social dilemma emerges in this bribery game, we impose a restriction on bribes and qualities[2]: $Q_i + B_i \leq A$. We use a linear specification of the three agents monetary (induced) utilities, adding a psychological cost parameter, $\gamma$, capturing an agent′s aversion to bribe due to ethical reasons, expressed in monetary loss per monetary unit of bribe received by the official. Thus, the three agents' utility levels are given by:

$$\pi_{official} = F + a.Q_{winner} + \left(1 - \gamma_{official}\right).B_{winner} \quad (1)$$

$$\pi_{winner} = F + a.Q_{winner} - (c + \gamma_{winner}).B_{winner} + R \quad (2)$$

$$\pi_{loser} = F + a.Q_{winner} \quad (3)$$

Where $F$ is a fixed amount earned by each subject in each period, $R$ is a fixed private profit obtained by the firm winning the procurement and $c$ a per monetary unit of bribe cost, borne by a bribing winner, denoting that the bribe may yield further monetary costs on its way from the firm to the official. Assuming perfect information on the agents preferences, the resolution of the game depends on the hypothesis of continuous versus discrete strategies.

### *2.1 Continuous strategies*

In this section we study the theoretical prediction of the game assuming a continuous space of strategies. We first solve the case in which agents have non-monetary (psychological) concerning, then the case in which agents purely maximize their payoffs.

#### *2.1.1 Non-monetary (psychological) payoffs*

1. If $a_{of} > 1 - \gamma_{of}$, the highest quality project will be chosen and firms will bid only in qualities, leading to the equilibrium: $(Q_i, B_i) = \left(Q_j, B_j\right) = (A, 0)$ independently of the firms' preferences. □
2. If $a_{of} < 1 - \gamma_{of}$, the highest bribe will be preferred by the auc- tioneer. In that case, firms will bid with the maximum bribe they can, as long as the bribing (monetary and psychological) cost does not exceed the fixed amount $R$earned by the winner. Thus, in □equilibrium, firm i will bid $(Q_i, B_i) = (A - \frac{R}{c+\gamma_i}, \frac{R}{c+\gamma_i})$

Thus, we would expect officials to choose the highest quality proposals if they are sufficiently bribery-averse, while they will choose the bidder with the highest bribe otherwise. Firms (believing that they are) faced with a quality-maximizing auctioneer will not bid with bribes, independently of their own preferences, whereas firms anticipating a bribery-maximizing behavior by the auctioneer will promise higher bribes, the more bribery averse they are.

#### *2.1.2 Monetary payoffs*

Finally, in absence of psychological, bribe-regarding considerations, a monetary-reward maximizing behavior would predict maximal quality bids $(Q_i, B_i) = \left(Q_j, B_j\right) = (A, 0)$, if

[2] Corresponding, for example, to a resource-driven budget constraint in a more general version of the model

$a_{of} > 1$ and $(Q_i, B_i) = (A - \frac{R}{c+\gamma_i}, \frac{R}{c+\gamma_i})$ if $a_{of} > 1$, in which case, the social dilemma leads to a socially suboptimal equilibrium. In the linear version, the following parameters are adopted, $(F, a, A, R, c) = (10, \frac{1}{2}, 10, 10, 2)$, which guarantee the emergence of the social dilemma equilibrium bids: $(Q_i, B_i) = (Q_j, B_j) = (5,5)$ in the case of bribery-neutral agents with universal preference for the bribe- maximizing bids by the official, or top quality $(Q_i, B_i) = (Q_j, B_j) = (A, 0)$, and quality maximizing auctioneer behavior if $\gamma_{of} > \frac{1}{2}$.

### *2.2 Discrete strategies*

Our game's theoretical prediction differs when considering discrete strategies. The matrix in table 1 shows the payoffs of both firms for different combinations of bribe (and quality). In the discrete game there are two strong Nash equilibria $(Q_i, B_i, Q_j, B_j) = (7,3,7,3)$ and $(Q_i, B_i, Q_j, B_j) = (6,4,6,4)$ where the former is Pareto superior to the latter.

The $(Q_i, B_i, Q_j, B_j) = (5,5,5,5)$ is still a weak equilibrium and also Pareto dominated by both the other two. It is weak, because each firm is indifferent between this and biding lower bribes just to become a loser (it earns 12.5 in both cases).

**Table 1** Matrix for discrete strategies

| | | Player 2 | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bribes | 10 | | 9 | | 8 | | 7 | | 6 | | 5 | | 4 | | 3 | | 2 | | 1 | | 0 | |
| player 1 | 10 | 5 | 5 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 |
| | 9 | 10 | 0 | 6,5 | 6,5 | 2,5 | 10,5 | 2,5 | 10,5 | 2,5 | 10,5 | 2,5 | 10,5 | 2,5 | 10,5 | 2,5 | 10,5 | 2,5 | 10,5 | 2,5 | 10,5 | 2,5 | 10,5 |
| | 8 | 10 | 0 | 10,5 | 2,5 | 8 | 8 | 5 | 11 | 5 | 11 | 5 | 11 | 5 | 11 | 5 | 11 | 5 | 11 | 5 | 11 | 5 | 11 |
| | 7 | 10 | 0 | 10,5 | 2,5 | 11 | 5 | 9,5 | 9,5 | 7,5 | 11,5 | 7,5 | 11,5 | 7,5 | 11,5 | 7,5 | 11,5 | 7,5 | 11,5 | 7,5 | 11,5 | 7,5 | 11,5 |
| | 6 | 10 | 0 | 10,5 | 2,5 | 11 | 5 | 11,5 | 7,5 | 11 | 11 | 10 | 12 | 10 | 12 | 10 | 12 | 10 | 12 | 10 | 12 | 10 | 12 |
| | 5 | 10 | 0 | 10,5 | 2,5 | 11 | 5 | 11,5 | 7,5 | 12 | 10 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 |
| | 4 | 10 | 0 | 10,5 | 2,5 | 11 | 5 | 11,5 | 7,5 | 12 | 10 | 12,5 | 12,5 | 14 | 14 | 15 | 13 | 15 | 13 | 15 | 13 | 15 | 13 |
| | 3 | 10 | 0 | 10,5 | 2,5 | 11 | 5 | 11,5 | 7,5 | 12 | 10 | 12,5 | 12,5 | 13 | 15 | 15,5 | 15,5 | 17,5 | 13,5 | 17,5 | 13,5 | 17,5 | 13,5 |
| | 2 | 10 | 0 | 10,5 | 2,5 | 11 | 5 | 11,5 | 7,5 | 12 | 10 | 12,5 | 12,5 | 13 | 15 | 13,5 | 17,5 | 17 | 17 | 20 | 14 | 20 | 14 |
| | 1 | 10 | 0 | 10,5 | 2,5 | 11 | 5 | 11,5 | 7,5 | 12 | 10 | 12,5 | 12,5 | 13 | 15 | 13,5 | 17,5 | 14 | 20 | 18,5 | 18,5 | 22,5 | 14,5 |
| | 0 | 10 | 0 | 10,5 | 2,5 | 11 | 5 | 11,5 | 7,5 | 12 | 10 | 12,5 | 12,5 | 13 | 15 | 13,5 | 17,5 | 14 | 20 | 14,5 | 22,5 | 20 | 20 |

## 3 Summary

A model of public procurement auction is developed where two firms compete and have the possibility to bribe for winning the contest. We imposed a social dilemma to the firms and we added a psychological cost parameter coming from bribing as it consists of an "unethical" behavior. We also consider the situation where no psychological parameters are included. Specific parameters are included in the model and we obtain the theoretical prediction either with continuous strategies or with discrete strategies. We believe that this model is interesting to be implemented in the laboratory to investigate people's preferences in this specific social dilemma.

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