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Procurement auctions with ex-ante endogenous bribery

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ABSTRACT

Corruption is a prevalent phenomenon in various procurement auctions. This paper explores a pattern of bribery between an auctioneer and a favored bidder, and also investigates the regulation scheme of buyer. In the model, the favored bidder is allowed to submit two bids simultaneously with the advantageous one to be announced; auctioneer decides the share of the difference between two bids which is the bribe transfer. The analysis shows that, the favored bidder does not participate in the corruption if his cost exceeds a threshold; otherwise he submits two bids whose difference is decreasing in the share. The corruption benefits both the auctioneer and the favored bidder but harms other bidders. The bribery endogenously leads to allocation inefficiency with a probability decreasing in the bribe share. Specifically, with two uniformly distributed bidders, we examine how the auctioneer optimizes the bribe share and how the buyer regulates the corruption. We find that, by driving the auctioneer to charge a higher bribe share that is less attractive for the favored bidder, severer regulation tends to reduce the probability of corruption. A buyer who adopts extremely severe regulation can exclude the corruption and achieve maximum social welfare, while a buyer who aims to maximize his own profit should tolerate some degree of the corruption.

1. Introduction

Corruption is a worldwide phenomenon and causes serious impacts on economy, such as impeding economic growth (Denizer et al., 2010; Farooq et al., 2013), distorting production (Coppier and Michetti, 2006) and allocation inefficiency. As an important part of the production and service economy accounting for more than 12% of GDP (OECD, 2011; Tran, 2008), procurement is usually inevitable to corruption, since the buyer who spends the money (e.g., a government or a company) and the agent who executes the procurement process (e.g., a procurement official or an auction house) are usually different parties (Lengwiler and Wolfstetter, 2006). Procurement auctions are prevalently employed as a powerful appliance that greatly reduces the risk of corruption. However, auctions are still not corruption-proof, since auctioneers "whose salaries are small relative to the prices of the items they auction off" are likely to "enter a bid-rigging scheme in exchange for a sufficient kickback from a dishonest bidder" (Ingraham, 2005). For example, in order to win a turbine contract worth €205.6 million, Siemens paid €2.987 million in bribes to an Italian utility company; a Scottish engineering company paid £3.1 in kickbacks to foreign officials to secure 16 contracts for water treatment equipment worth £34.3 million (OECD/World Bank, 2012). These cases represent only the tip of the iceberg, and the global volume of bribes per year in public procurement auctions is estimated to be about $200 billion (World Bank, 2005). Motivated by the prevalence of corruption in procurement auctions, we investigate bribery between a corrupt auctioneer and a favored bidder and study the buyer's regulation of it.

In procurement operations, it is frequently observed that the auctioneer and the favored bidder negotiate bribes confidentially (e.g., the Green Case and the TSKJ Case in OECD, 2009). Conventionally, a bribe may be expressed as a share of the contract price/value (multiple cases can be found in: OECD, 2009; OECD/World Bank, 2012; Tran, 2008) or in proportion to the value of the favor offered by the auctioneer (e.g., Burguet and Perry, 2007; Lengwiler and Wolfstetter, 2004, 2010; Menezes and Monteiro, 2006). In this paper, the favored bidder is tacitly permitted to submit two bids simultaneously, and only the advantageous one will be announced together with other rival bids simultaneously. Such corruption is claimed to be widespread in China (Tian and Liu, 2008). The difference between the two bids of the favored bidder can be considered as the value of the favor, since it partially reflects by how much the favored bidder may improve his possible profit. So it is reasonable for the auctioneer to charge a share of the difference as a bribe, which is consistent with the proportional bribery convention stated above. Since the auctioneer's decision on the bribe share will affect the favored bidder's subsequent bidding strategy, the realized bribe is determined by both the auctioneer and the favored bidder, which resembles a negotiation process where both parties exert bargaining power. Analyzing the interaction between the auctioneer and the favored bidder is of much interest.

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We identify two types of corruption in procurement auctions. If the auctioneer has decided whom to favor before learning bidder types (e.g., cost structures), we say the corruption is ex-ante. For example, the auctioneer may reveal insider information to a bidder who has paid bribes early (e.g., Boehm and Olaya, 2006). If the auctioneer chooses whom to favor after he learns the bidder types (e.g., after observing all bids), the corruption is called ex-post. For example, the auctioneer may offer the winner a possibility of bid revision so that the winner can reap more profit (e.g., Menezes and Monteiro, 2006); or, the auctioneer may allow a loser to revise his bid to just beat the original best bidder (e.g., Lengwiler and Wolfstetter, 2010). Both ex-ante corruption and ex-post corruption are well documented (see Boehm and Olaya, 2006 for a brief review), but they differ from each other with regard to allocation efficiency and to the bargaining power of corrupt players. In many auctions with ex-post corruption (like the examples above), the allocation is either efficient with probability one or inefficient with probability one, because it is clear whether the favor is offered to the most efficient bidder. The favored bidder, having submitted his bid, possesses no ability to affect the bribe condition required by the auctioneer. Consequently, the auctioneer may charge a bribe that leaves no extra expected profit for the favored bidder. By contrast, in auctions with ex-ante corruption (like our model), it is unclear whether the corruption will distort the allocation or not, since the favored bidder may or may not be the most efficient one. Facing the bribe condition required by the auctioneer, the favored bidder can respond by adjusting his bidding strategy, which may eventually affect the auctioneer's profit. As a result, the favored bidder retains some bargaining power and may earn some rents from the corruption. Our focus is on ex-ante corruption and will contrast the results with that of ex-post corruption.

We address three issues: (1) the effects of the ex-ante corruption on the auction outcomes, (2) the determination of the endogenous bribe, and (3) the buyer's regulation of the corruption. To explore issue (1) in a general situation (n bidders with a general cost distribution), we investigate the bidding strategy of the bidders given the bribe share, and find that the favored bidder will participate in the corruption only if his cost is lower than a threshold. Particularly, the favored bidder sets two bids such that the difference between them is decreasing in the bribe share. With the corruption, both the auctioneer and the favored bidder are better off, and ordinary bidders who are unaware of the corruption are worse off. The expected auction price is increased by the bribery event intuitively, and allocation inefficiency happens with a positive probability which decreases in the bribe share. Issues (2) and (3) are analyzed in a specific scenario where the cost parameters of two bidders are uniformly distributed and the buyer regulates the auctioneer's behavior with a performance-based payment. We observe that severer regulation leads to higher bribe share and sufficiently severe regulation can exclude the corruption; however cost minimization of the buyer tolerates some degree of the corruption.

In the rest of this paper, Section 2 discusses the related literature; Section 3 provides the model setup; Section 4 examines the effects of bribery on the auction outcomes; Section 5 discusses the decisions of the auctioneer and the buyer in a scenario with two uniformly distributed bidders; and Section 6 concludes.

2. Related literature

Research on corruption is abundant. Arnold et al. (2012) provides a brief review of studies on corruption from the perspective of various disciplines. OECD (2007) examines the methods, actors and countermeasures of bribery in procurement, mainly from a practical point of view. As for theoretical research on corruption in auctions, many studies (especially those on ex-ante corruption) focus on the effects of the favor obtained by the favored bidder but ignore the explicit modeling of bribes (e.g., Arozamena and Weinschelbaum, 2009; Burguet and Perry, 2009; Laffont and Tirole, 1991; Lee, 2008; Tian and Liu, 2008); some others explicitly model bribes but simply regard them as exogenously given (e.g., Burguet and Perry, 2007; Lengwiler and Wolfstetter, 2004, 2010). Unlike these studies, we investigate endogenous bribery and examine its effects on the auction outcomes.

Regarding endogenous bribery, the player who determines a bribe varies. Burguet and Che (2004), Compte et al. (2005), Lambert-Mogiliansky and Sonin (2006), Büchner et al. (2008) and Wihardja (2010) study models where bribes are determined by bidders. They consider bidders' competition of bribes, while our paper assumes that only the favored bidder is likely to bribe and other bidders are not aware of the corruption. Menezes and Monteiro (2006) and Koc and Neilson (2008) study ex-post corruption where the bribe is determined by the auctioneer. In their models, the favored bidder has no ability to influence the bribe, which makes him no bargaining power and no profit from the corruption. Celentani and Ganuza (2002) study ex-ante corruption where the bribe is also determined by the auctioneer. In their model, the favored bidder would report his type to the auctioneer, which implies no information rent and thus no extra profits from the corruption. In contrast to these studies, we consider ex-ante corruption where the bribe is determined by both the auctioneer (who selects the bribe share) and the favored bidder (who decides two different bids). This is similar to a negotiation in essence, and the favored bidder's bargaining power comes from his ability to influence the bribe, as well as his possession of private information about his type. As a result, he earns an extra profit from the corruption.

As for the corruption scheme, our study is related to models where the favored bidder is allowed to revise his bid after the original submission (e.g., Compte et al., 2005; Ingraham, 2005; Koc and Neilson, 2008; Lengwiler and Wolfstetter, 2004, 2010; Menezes and Monteiro, 2006; and studies related to the *right of first refusal*). In these models, the favored bidder, if he wishes, will revise his bid such that he can just beat his effective rival and win the auction. Such right of bid revision is analogous to a chance of submitting two bids—one is the original bid determined by the favored bidder himself, and the other is the revised bid determined by the effective rival. Our model is different because both bids are determined by the favored bidder. Tian and Liu (2008) study a special case of our scheme where the bribe share is zero.

There are a few studies investigating the interactions between the auctioneer and the buyer (e.g., Auriol, 2006; Burguet and Che, 2004; Celentani and Ganuza, 2002; Compte et al., 2005; Lengwiler and Wolfstetter, 2004). Especially, Lengwiler and Wolfstetter (2004) study a performance-based payment similar to ours in an ex-post exogenous bribery scenario, but we observe that in our ex-ante corruption context, severer regulation is needed to rule out the corruption.

3. The model

A buyer entrusts an auctioneer to allocate a procurement contract. The auctioneer uses a first-price sealed-bid auction to solicit bids from $n(\geq 2)$ bidders. Each bidder i possesses private information about his cost c_i of implementing the contract, and it is common knowledge that $\{c_i\}_{i=1}^{n}$ are independent and identically drawn from a distribution $F(\cdot)$ with positive and continuous density $f(\cdot)$ over the interval $[\underline{c}, \overline{c}]$. We adopt the common assumption that the inverse hazard rate $[1 - F(c)]/f(c)$ is decreasing in c for $c \in [\underline{c}, \overline{c}]$ (e.g., Burguet and Perry, 2007, 2009; Zheng, 2002). The probability that c_i is the lowest cost among all bidders is denoted by $G(c_i) = [1 - F(c_i)]^{n-1}$; that is, $G(c_i)$ would be the winning probability of bidder i in a standard auction. For notation convenience, denote $g(c) = G'(c)$ and $K(c) = \int_c^{\overline{c}} G(t)dt$, $\forall c \in [\underline{c}, \overline{c}]$. As we will see, $K(c_i)$ can be expressed as the expected information rent of bidder i in a standard auction.

Although all bidders are a priori identical, we refer to one of them as the favored bidder and call others ordinary bidders. Without knowing any bidder's cost, the auctioneer approaches the favored bidder before the auction and offers a corruption proposal (ex-ante corruption). If