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Bidding under auctioneer default risk☆

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ABSTRACT

In a financially turbulent economy, participants of a procurement auction should consider in their bids the event of default of the auctioneer, which may result to substantial damages for the winning bidder. We examine a sealed bid auction, with private cost values and interdependence among the beliefs of the bidders about the auctioneer's default risk. The probability of payment of the bid price by the auctioneer is estimated by each bidder. For a first and a second price auction, we derive equilibrium bidding strategies, which address the risk of default and optimally adjust the bid price, introducing a risk premium in the form of an additional mark-up. A numerical illustration of the proposed strategies is provided. The effect of auctioneer's risk of default on the procurement project cost is examined. Financial arrangements that may be used to relax or eliminate the effect of the risk of default, such as early payment methods, third party guarantees or insurance programs are discussed and evaluated in comparison with the approach of risk premium on bid price.

1. Introduction

The financial crisis in the economy has forced agents to reconsider the risk of default of both private companies and public entities. In 2012, a survey in 2.5 million firms in the U.K. revealed that 69% of them were likely to default or get into financial difficulty [1], whereas three years ago the same figure was at 60%. Moreover, in 2011, 1.1% of all companies in the U.K. became insolvent compared to 1.03% in 2010 [2]. For this reason, payment terms should be carefully examined and agreed upon from the outset in every supply contract [3].

When companies bid in auctions for the procurement of goods or services, as, for example, when they participate in a public tender or they respond to a Request for Quotation (RFQ), there is a considerable risk that the awarding agent – the auctioneer – may default and become unable to pay to the winner of the auction the agreed contractual amount, even though the winning bidder may have successfully fulfilled all the contract terms. In 2011, many pharmaceutical companies, such as Roche Holding AG, stopped delivering medicines to public hospitals in Greece fearing that, due to its rising debt, the Greek government would be unable to pay its bills [4]. In the presence of financial turmoil, due to which corporations and, even, nations, receive extremely low credit ratings, reflecting a high probability of default, it is important to include among contingencies the event of default of the auctioneer.

In the event of default of the auctioneer, the auction winner will still bear the entire cost of the procurement, whereas the revenue received will be slashed. In such a risky environment, auction participants must carefully assess the auctioneer default risk and incorporate in their bids a premium to compensate for any possible damages. In fact, many bidders often choose to increase the mark-up of their bid by an appropriate premium to address the default risk of the auctioneer. For instance, a study of Brazilian public purchases of pharmaceuticals and medical supplies showed that when individual acquisitions were pooled in one large procurement, bid prices for federal agencies, which had a better financial record compared to state agencies, increased instead of dropping [5].

The auction setting that we consider is an independent private value (IPV) model, in which each bidder knows precisely his/her own cost. At the same time, an estimate of the probability of non-default of the auctioneer is available to each bidder. These estimates are essentially noisy signals of the probability that the auctioneer will be able to pay the agreed bid price to the auction winner. This information structure generates interdependence because all the estimates are driven by the same factor, namely, the event of default. We will assume, however, that once we condition on the actual but unobserved probability of payment, the cost values and the estimates of the payment probability can be treated as stochastically independent.

The classical approach of Milgrom and Weber [6] for common value auctions, with interdependence of the cost values, is inapplicable in our setting for two profound reasons. First, in our model, the bidder types are two-dimensional so that the bid price is a bivariate function of both the cost of the auctioned object and

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the estimate of the probability of payment. In contrast, in the setting of Milgrom and Weber [6], the bid price depends only on the cost value, and, therefore, in equilibrium, the cost of the winner of the auction is lower than the minimum cost of the competition. The second reason that sharply differentiates our auction environment from a common value auction is that the probability of payment enters the expression of the expected profit by multiplying the bid price and, thus, it exclusively affects only the revenue side. In our auction framework, the probability of payment does not affect the cost value of the auctioned item, which remains a private value for each bidder. Therefore, since there is no uncertainty related to the cost value, the setting of our model is not a common value auction.

In our symmetric environment, all players consider the same probability distribution, according to which the cost and the estimate of the probability of payment are drawn. In addition, all bidders agree on a common and known prior distribution for the probability of payment. Similar to the competitive bidding models of Wilson [7] and Reece [8], each player determines the bid price by maximizing the expected profit, which is computed with respect to all possible realizations of the actual but unobserved probability of payment. The purpose of our paper is to analytically derive and discuss the symmetric Nash equilibrium bidding strategies that optimally provide an adjustment of the bid price against the risk of default in a first-price and in a second-price sealed bid auction. The risk premium, which compensates for the risk of default, is provided for each strategy.

Moreover, we examine the increase of the expected project cost, which the auctioneer is forced to pay due to the risk of default. Contrary to the Revenue Equivalence Principle [9], according to which, in a private-value environment, the expected project cost is the same for a first-price and a second-price auction, we show that in equilibrium, when the risk of default of the auctioneer is present and under certain conditions, the expected project cost in a first-price auction is lower compared to a second-price auction setting.

To the best of our knowledge, the risk of default of the auctioneer has not been previously studied in the literature. Other forms of risk, which are not related to the event of default of the auctioneer but affect in different ways the bid price, have been extensively examined in auction theory. The most prominent is the risk due to the uncertainty of the cost value of the auctioned item [10,11]. In a common-value framework, bidders address the risk of the uncertainty of the cost by bidding more aggressively and, thus, by incorporating a risk premium in their bid prices, which varies according to their risk aversion [12]. Takano et al. [13] developed a stochastic dynamic programming model and determined the optimal markup when costs are inaccurately estimated in a sequence of auctions. Their scenario-based approach imposes a value-at-risk constraint which limits the risk of suffering a large loss due to the uncertainty of the true cost. In international procurement, the risk due to the variability of the exchange rate generates an additional markup [14].

Another form of risk, which has been considered in the literature, is the risk that an auctioneer faces in the event of default of the winning bidder. Wan and Beil [15] proposed a bidder qualification screening method, which should be optimally integrated in an auction setting. Prequalification by restricting the number of auction participants may be used to reduce the risk of contract non-completion due to default [16]. Calveras et al. [17] showed that, in a procurement auction, abnormally low bids occur due to the limited liability of the bidders. Klemperer [18] noted that if the default costs are small, then bidders actually bid for an option to supply the auctioned item rather than for the supply itself. The option to withdraw bids is examined by Rothkopf [19].

Contractual arrangements, such as insurance against the event of contractor default or performance bonds, are commonly used in auctions to reduce or eliminate the damages of the auctioneer in case the winning bidder defaults. To address abnormally low bids, Calveras et al. [17] proposed the introduction of surety bonds to insure against default. Waehrer [20] determined the equilibrium bidding strategy in a first-price and a second-price auction, where the winner of the auction, in the event of default, pays liquidated damages to the auctioneer or loses a deposited amount. Chillemi and Mezzetti [21] examined the design of optimal procurement mechanisms, introducing damage payments in case of contact breach. When the minimum bidder cost is above a threshold, the optimal mechanism takes the form of a lottery assignment. Upfront payments, however, may be impractical as they may ultimately increase the risk of default for financially distressed firms. Burguet et al. [22] considered the design of optimal mechanisms for which the allocation depends on the financial assets of each bidder. Their findings suggest that to reduce the risk of default, financially weak firms should be discouraged from bidding low by setting a minimum floor in the price level.

Apparently, the effect of bidder default is opposite to auctioneer default and results to lower bids, while, in our model, bids increase by a risk premium. Experimental evidence provided by Roelofs [23] confirms more aggressive bidding when bidder default is allowed. Similarly, in Rhodes-Kropf and Viswanathan [24] bidding behavior in an auction is affected by the financing and payment method of the project. For the Los Angeles City Hall construction projects in the period between 1994 and 2003, Campo [25] estimated that construction firms received financing at 19.9% interest rate, affecting financially constrained bidders, so that if the terms of the auction were changed to payment in advance prior to the completion of the project, bids would decrease substantially.

In our auction environment, an auctioneer may choose to eliminate the default risk premium on the bid price by making use of different financial instruments, such as early payment methods, insurance programs or third-party guarantees. These financial arrangements, however, generate an additional cost, which should be compared against the increase of the project cost when the bids are adjusted by a risk premium. On the other hand, a bidder may propose to subtract from the bid price the risk premium, in the form of a discount, provided that payment will be made early or in-advance. In this way, bidders can practically eliminate or, at least, drastically reduce the impact of the auctioneer risk of default. Due to the default risk, the premium of the mark-up, which we derive, provides the appropriate discount that bidders should consider.

The structure of the remaining of the paper is as follows. The auction environment that we consider and the details of the model are presented in Section 2. The derivation of the equilibrium strategies in a first-price and a second-price auction setting is made in Sections 3 and 4, respectively. A numerical illustration of the bidding strategies is presented in Section 5. The expected project cost that the auctioneer will eventually pay under the presence of default risk is examined in Section 6. A discussion of financial arrangements that address auctioneer's default risk in comparison to the approach of a risk premium on the bid is provided in Section 7. Conclusions can be found in Section 8.

2. Model

We consider an independent private value auction for the purchase of an indivisible item. For simplicity, bidders are assumed to be risk-neutral (in terms of monetary payoffs) sellers of one indivisible item (object or service). There are $n+1$ auction participants. Bidders' valuations are private information and their distributions are common knowledge. Therefore, in our auction