Cost overrun and auction format in small size public works

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A B S T R A C T

We study the effect on cost overruns of two different auction formats, the first price sealed bid and the average bid, conditional on whether entry is open or restricted. The first price format awards the contract to the lowest bid, while the average bid format awards the contract to the bid closest to the average of all the bids. This latter format is supposed to prevent an unreliable low bidder from winning the auction; as a consequence cost overruns should be lower under the average bid than under the first price format. We test this hypothesis with a panel data set of auctions held in the Italian Veneto region between 2004 and 2006, including small size public projects in sectors such as road works and building maintenance. We find that cost overruns are lower under the average bid format, but only when the entry is restricted. We then speculate on possible explanations for this result.

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1. Introduction

The final cost of public works is often considerably higher than the price at which the contract is awarded in the tendering process (see e.g. Flyvbjerg et al., 2002, 2003, for large transport infrastructure projects, and Odeck, 2004, for small size road projects). In fact, the price winning an auction is just *an anticipation* of the final price arising when the work is completed. Cost overruns, i.e., the difference between final and winning costs, may originate in all stages of the project, from planning to completion. In this paper we concentrate on the relation between cost overruns and the mechanism by which the contract is awarded.

The auction literature provides two different explanations for cost overruns. Ganuza (2007) explicitly focuses on large projects. He considers bidders with different productivities under asymmetric information, arguing that systematic cost overruns may result from a procurer's attempt to minimize the information rent left to the contractor. In order to increase competition, procurers find it optimal to underinvest in initial project design and then recontract both the price and the project specification with the winning bidder. This explanation fits the case of large projects, where the number of competitors is naturally small. A second explanation comes from Spulber (1990). The author shows that, when the cost of production is identical for all the bidders but uncertain at the bidding stage, and bidders can renege on their bids, those with lower penalty from reneging will bid more aggressively in standard auctions, and the contract winner will then be the bidder most likely to renege (also see Waehrer, 1995; Zheng, 2001; Board, 2007). This means that, in standard auctions, adverse selection of the winner will occur, likely generating recontracting and large cost overruns. Practical remedies to this situation are third party guarantees or performance bonds (for a theoretical analysis see Calveras et al., 2004). However, when contractors are small firms and projects are of small size, such remedies can be relatively costly, and in fact they are of limited use in many countries. A cheaper alternative to limit cost overruns is to award the project via non-standard auctions.

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In the so-called "average bid auction", first proposed by Iannou and Leu (1993) in the engineering literature, the winning bid is the one closest to the average of all the bids, and the contractor receives its asked price. Variants of the average bid auction have been used in public procurement in many countries like the US, Italy, Belgium, Switzerland, Taiwan, Japan, etc. (for a review see Decarolis, 2009). This auction format has Nash equilibrium where all the bids are identical. Hence each bidder essentially takes part in a lottery where it has the same probability of having the project assigned, which weakens the adverse selection problem (Albano et al., 2006) and, this way, prevents the procurer from bearing large cost overruns. This result, nevertheless, holds under the assumption that bidders do not collude. However, since the winning price depends on the average of the bids, bidders have incentives to coordinate their bids and influence the average bid (Albano et al., 2006). As we will clarify later, collusion may reintroduce the adverse selection problem cited above.

In this paper we focus on small size projects, where cost overruns are more likely to arise from adverse selection than from strategic underinvestment on project design. We use an original dataset of public procurement auctions with reserve price below one million euros held in the Italian Veneto region between 2004 and 2006, mainly regarding road works and building maintenance. Project design in the sample is set according to objective third-party estimates of the work complexity; procurers would like to face small cost overruns for budget reasons. This data set is suitable for our analysis because in such period the regional law, at variance with the national one, allowed procurers the freedom to choose the rules of the auction from a variety of different mechanisms: first price or average bid format (*auction format*), combined with entry open to all qualified firms or restricted entry to only invited firms (*entry mechanism*). In our analysis we control for the fact that the auction rules are not randomly assigned in our dataset.

The empirical literature on procurement has paid attention to the advantages and disadvantages of auctions with respect to negotiation as a selection mechanism (the main contribution is Bajari et al., 2008) and the price winning an auction; in particular, the winning asked price is found to be higher under the average bid format (Decarolis, 2009). Nevertheless, the effect of different auction formats on cost overruns has received little attention. The paper more related to ours is Decarolis (2009) on Italian public procurement sector. Although having a different goal, among other things the author finds that cost overruns are lower in average bid auctions rather than in first price auctions. Our data permit a closer examination of the question, as they enable to control also for the effect of different entry mechanisms.

Our analysis finds that cost overruns do not vary systematically with either the auction format or the entry mechanism. In contrast, they are lower when the average bid format is implemented together with a restricted entry mechanism. This evidence only partly supports the theoretical and empirical literature, as it shows that *not necessarily* cost overruns are lower under the average bid format.

The paper is organized as follows. Section 2 describes our dataset and its main variables. Section 3 discusses the results from our analysis, and Section 4 concludes. In the Appendix A we formalize a situation in which adverse winner's selection emerges at equilibrium in the average bid auction with open entry and collusion.

2. Data

Our dataset consists of fixed reserve price contracts included in the database managed by the Italian Observatory for Public Contracts. The observatory records publicly procured contracts in Italy with reserve price above 150 thousand euros. In this analysis we concentrate on small projects with reserve price up to one million euros, held in the Veneto region between the years 2004 and 2006 and completed by the end of March 2009. Procurers included in our dataset were free to choose the auction format (average bid or first price). The Italian average bid format is essentially a first-price sealed bid format augmented with an exclusion rule according to which bidding discounts larger than a given threshold are automatically eliminated from the set of valid bids (see Decarolis et al., 2010, for details). In Italy, national Law 109/1994 (Art.32) allowed only the average bid format for awarding public works worth up to 1 million euros. In contrast, since 2003 regional Law 27/2003 in Veneto also allowed the use of the first price format. Focusing on this sample then allows us to analyze a set of small-size public procurement auctions showing wide heterogeneity of formats. In addition, we double-checked the dataset with hard-copy data stored in its regional offices. This guarantees that the quality of the data is generally good, which is important because national data on public procurement auctions frequently contain errors.

The sample is a panel dataset, where the observation unit is the public procurer, and for each procurer we observe some characteristics of the auctions it held between 2004 and 2006 (on average 4.1). For each auction we know the project classification, the expected delivery time, the reserve price, the number of bidders, the auction rules, the winning price, and post-auction information on the final delivery time and the final price. Our final dataset is made of 1093 auctions held by 265 procurers. Procurers are mainly municipalities (58% of the sample), and auctions primarily concern road works (40%) and building maintenance (29%). In the sample there are four groups of auctions, differing along two dimensions: the auction format (first price selection as opposed to average bid selection, hereafter FP and AB respectively) and the entry mechanism (open entry to the auction as opposed to restricted entry, namely entry by invitation only). Therefore we observe auctions with FP selection and open entry (72 observations, 6.59% of the sample), auctions with FP selection and restricted entry (518, 47.39%), auctions with AB selection and open entry (371, 33.94%), and auctions with AB selection and restricted entry (132, 12.08%). This heterogeneity is found also within a procurer: in our sample, on average a procurer holds 53.98% of its auctions with FP selection and 59.47% with restricted entry.

Table 1 shows the mean value of the main variables in our dataset, jointly as well as separately for the four groups of auctions. The table suggests that auctions with AB format and (of course) open entry receive more bids on average, and auctions with open entry deal with larger works (there are higher reserve prices and more work days are expected)[1]; it is possible that procurers may want to

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[1] All these differences are significant at the 1% level to Wilcoxon ranksum comparison tests.