

Unobservable Opportunity Costs in Contract Auctions with Interdependent Values

NSF Proposed Research Essay, by Julian Reif

Summary

I propose to model bidding in an environment with unobservable opportunity costs and interdependent values and to apply my model to contract auction data. I intend to quantify the relationships among cost-sharing rates, information rents accruing to winning bidders, and inefficiencies caused by unobservable costs. I would also like to test whether or not independent private values are a reasonable assumption for my data.

Motivation

A contract auction is a type of procurement auction in which there is a relationship between the principal (auctioneer) and the winning bidder after the auction ends. Many government construction contracts are awarded using this type of auction design. The inherent uncertainty in these large projects can result in costly overruns. A well-known example is Boston's multibillion-dollar "Big Dig" highway project that went over budget by \$1.6 billion (Lewis and Murphy 2). America's per-capita spending on infrastructure is at an all-time high and is expected to continue increasing, especially after the fatal collapse of the I-35W highway bridge in Minneapolis this past summer ("America's Creaking Infrastructure" 23). Researching ways to decrease construction costs is therefore of great value to taxpayers.

Opportunity costs are an important component of total costs. However, the majority of the economics literature on contract auctions has either ignored them or unrealistically assumed they are as observable as equipment or labor costs because opportunity costs are generally unobservable and consequently difficult to model in many contexts. As a result, their unique effects on auctions remain understudied.

In Katzman, Reif, and Schwartz (2007), we model an auction where the addition of unobservable opportunity costs increases the variance of bidder values but decreases the economic rent to the winning bidder. This result, which disproves conventional wisdom espoused in the auction literature, is significant because it means measures aimed at reducing the principal's costs by decreasing variance (e.g., raising the principal's cost-sharing rate) may in fact be counterproductive.¹ Our finding was a direct result of investigating the effects of unobservable opportunity costs in an independent private values environment; much remains to be researched in other theoretical contexts. In addition, I am unaware of any empirical literature on this topic.

Proposal

I propose to estimate cost-sharing rates, information rents, and costs due to inefficient bidder selection in contract auctions. One potential source of data for this is a panel dataset of multiple-unit bids on highway contracts analyzed in Bajari, Houghton, and Tadelis (2007).² This dataset records bids as well as information on how cost overruns are split between the winning bidder and the principal, thereby allowing me to derive an implicit cost-sharing rate. I should be able to estimate the amount of information rent captured by the winning bidder as well as the costs due to selecting an inefficient bidder because the data include detailed information on all bidders' observable

¹ See my essay on previous research experience for more details.

² I contacted Professor Bajari and confirmed that this dataset is publicly available.

costs and the final *ex post* quantities and prices of the construction jobs. Examining inefficiency is especially interesting because, as noted in Samuelson (1986), unobservable costs can cause inefficient bidder selection. After controlling for other factors,³ I intend to estimate the amount of inefficiency due to these unobservable costs.

To date, my research has assumed that bidders have independent private values. I would like to relax this assumption and explore the effects of unobservable opportunity costs in the context of interdependent values and affiliated signals, an environment first introduced in Milgrom and Weber (1982), because this is more appropriate for the data.

For example, suppose companies A and B are both bidding for a construction contract. Both face similar uncertain future costs, i.e., they only have partial information. Company A would like to know Company B's cost estimates because this would give it more information; indeed, it is quite likely their estimates are interdependent and positively affiliated (i.e., positively correlated). Their opportunity costs for any particular project, however, are unlikely to be correlated. What happens in a model with interdependent and affiliated observable costs but independent opportunity costs? It is well known that different auction types are not revenue equivalent when values are interdependent and estimates are affiliated (Krishna 99); what effect the addition of unobservable costs would have in this context is unknown.

I am aware that relaxing the independent private values assumption in a multiple-unit auction is difficult. I hope to resolve this problem by averaging costs across units. I believe this is reasonable since a unidimensional scoring system is used to award the contracts. In addition, I plan to assume that the distribution of bidders' opportunity costs is public knowledge.

Overall, I hope to make three contributions to the literature: (1) quantify the dollar amount of inefficiency caused by unobservable opportunity costs; (2) test the reasonableness of an independent private values assumption versus interdependent values for my highway contract data in the context of unobservable opportunity costs; and (3) determine whether unobservable opportunity costs have any unique effects in an interdependent values environment. To my knowledge, nobody has done this before.

References

- "America's Creaking Infrastructure: A Bridge Too Far Gone." (11 August 2007). *The Economist*, p. 23-24.
- Bajari, P., S. Houghton, and S. Tadelis (2007). "Bidding for Incomplete Contracts: An Empirical Analysis of Adaptation Costs," working paper.
- Katzman, B., J. Reif, and J. Schwartz (2007). "The Relation Between Variance and Information Rent in Auctions," manuscript.
- Krishna, V. (2002). *Auction Theory*, San Diego: Academic Press.
- Lewis, M., and Sean Murphy. (9 February 2003). "Artery Errors Cost More Than \$1B." *Boston Globe*. <http://www.boston.com/news/specials/bechtel/part_1>.
- Milgrom, P., and R. Weber (1982): "A Theory of Auctions and Competitive Bidding," *Econometrica*, **50**, 1089-1122.
- Samuelson, W.F. (1986): "Bidding and Contracts," *Management Science*, **32**, 1533-1550.

³ Other causes of inefficiency include, for example, "when contractors expect overruns they will actively skew their bids and their total payments will increase" (Bajari, Houghton, and Tadelis 19).