Three Essays on Public Procurement Auctions

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博士論文（要約）
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Chapter 1. Introduction

1 Analysis of Public Procurement

Public sector procurement makes up a substantial part of GDP: 10 – 20%.\(^1\) Officials in public sectors are concerned not only with the procurement costs but also with the quality of work. As a result, *value for money*, which is a program about the effective use of government spending to improve the quality of work, has started to become common worldwide. Moreover, the government cares about the worsening of the quality of work due to the lack of new participants’ experience in the case of relaxing the regulations of new entry. Cost overruns, which are prevalent in public-works procurement, are considered to be necessary to ensure safety for the execution of projects. Therefore, we empirically examine the effects of various types of systems used in public procurement in terms of price and quality. In particular, we focus on auction mechanisms in this dissertation.

In this dissertation, we adopt structural auction models and the program evaluation approach to quantitatively assess the effects of different auction mechanisms. The structural estimation approach is the method of estimating economic agents’ parameters based on a theoretical model and simulating counterfactual scenarios which are absent in real-world. This approach enables us to compare between actual and counterfactual scenarios. In addition, the structural estimation approach averts Lucas critique which refers to the changes in preferences of economic agents due to policy changes and considers reduced-form estimations implausible. However, this approach tends to make strong assumptions on the theoretical model to estimate the parameters. In contrast to the structural estimation approach, the program evaluation approach enables us to assess the impacts of policy changes without imposing strong assumptions. We exploit exogenous sources of variation to identify the causal evidence on the impacts of policy changes. However, the program evaluation methods do not recover economic agent’s structural parameters or simulate scenarios which are absent in real-world. Since the two estimation approaches have both advantages and disadvantages, we properly use the approaches depending on the situations.

This dissertation consists of three analyses. In Chapter 2, we examine the impacts of scoring auctions over (standard) price-only auctions through a structural auction model. In Chapter 3, we study the effects of relaxing entry regulations in public procurement auctions under a scoring design in terms of price and quality. For this empirical analysis, we exploit the methods of the program evaluation. In Chapter 4, we investigate the impacts of cost overruns on the quality of work and

\(^1\) See [http://www.cid.harvard.edu/cidtrade/issues/govpro.html](http://www.cid.harvard.edu/cidtrade/issues/govpro.html)
social welfare based on a structural estimation model. For our empirical analysis, we exploit a data set obtained from the record of the Ministry of Land, Infrastructure and Transportation (the MLIT) in Japan. The data set includes not only bids and the number of bidders but also the final payments determined after the completion of work and information on the quality of work reviewed at the time of completion.

2 Analysis of Scoring Auctions

Scoring auctions have recently started to become common worldwide. In a (standard) price-only auction, bidders submit price bids and the winner is the bidder with the lowest price bid among all the submitted price bids. In a scoring auction, bidders submit not only price bids but also quality bids as their bids. Prior to auction, the government announces a scoring rule which is the way to rank different bids. The quality bid consists of non-monetary attributes such as the time to completion. The government evaluates the bids and awards the contract to the bidder with the best combination (score) of the price bid and the quality bid. Che (1993) and Asker and Cantillon (2008) show that a scoring auction with a quasi-linear scoring rule gives incentive for bidders to improve the quality of work and welfare gain in comparison with price-only auctions. In spite of the prevalence of scoring auctions, the quantitative evaluations of scoring auctions in comparison with price-only auctions are limited with the exception of Lewis and Bajari (2011). Therefore, it is necessary to assess the impacts of scoring auctions over price-only auctions.

Chapter 2, which provides the quantitative evaluations of scoring auctions over price-only auctions, is titled as “The Impact of Scoring Auctions in Public Procurement: Empirical Analysis”. We develop a structural model to quantify the benefits of scoring auctions over price-only auctions and estimate it using a dataset of price-only auctions including information on the quality of work in each contract. Our approach proposed in this analysis enables us to achieve the identification of various types of cost functions and the nonparametric identification of cost functions of quality levels when the sample size is large.

In this analysis, we provide two sources of the potential benefits of implementing scoring auctions and quantify their effects. The first is the cost structures of improving the quality of work. The second is the government’s uncertainty of the winning bidders’ private information which is included in the cost functions. We compare large-scale and complex projects with small-scale and simple projects, for example, constructing a bridge and painting work on the road. Theoretical and empirical studies show that for the procurement of complex projects, price-only auctions may not work well due to the
lack of contractors’ expertise about construction practices. We assess the effects of scoring auctions for the two work projects which differ in the complexity and the size of a project.

We show that under scoring auctions, the quality of work improves by more than 10% and social welfare increases by about 2 – 7%. The impacts of scoring auctions are larger for bridge work compared with painting work. The government is faced with more uncertainty for bridge work.

3 Analysis of Effects of Relaxing Entry Regulations in Public Procurement under a Scoring Design

Entry regulations are common in many markets including public procurement. The government is concerned not only with the prices but also with the quality levels. In particular, in public-works procurement, officials in the government seem to believe that restricting participants in auctions can ensure ex post performance including the quality of work which is affected by both the uncertainty at the time of bidding and the moral hazard problem during construction. When the government relaxes entry regulations, many new firms enter a market. Large participation in the market can promote competition and reduce prices, but the new firms possibly supply poor-quality goods due to the lack of their experience. However, with the exception of Coviello, Guglielmo and Spagnolo (2014) and Decarolis (2014), there is still a scarcity of empirical research that considers ex post performance to quantify the impacts of the promotion of competition in public procurement. Therefore, it is important to quantify the impacts of relaxing entry regulations in terms of both price and quality in public-works procurement.

We show the quantitative evaluations of relaxing entry regulations under scoring auctions. Scoring auctions can give incentives for contractors to utilize their expertise and induce competition for not only the prices but also the designs. However, the government possibly manipulates the outcomes of scoring auctions through the manipulations of evaluating the quality bids submitted by bidders. In this case, relaxing entry regulations under scoring auctions comes to naught. However, in real-world, we do not know which effects strongly arise because of the scarcity of the empirical analysis of scoring auctions. Therefore, we provide empirical evidence on the effects of relaxing entry regulations under a scoring design.

Chapter 3 titled as “The Effects of Relaxing Entry Regulations on Price and Quality: Evidence from Public Procurement Auctions” provides quantitative evaluations for the benefits of open auctions over invited auctions under a scoring design to investigate the effects of relaxing entry regulations in terms of price and quality. In public-works procurement, invited auctions lead to repeated partici-
pation of particular firms to ensure the quality of work, while open auctions relax entry regulations to enhance competition and reduce price. We exploit a nationwide policy change and data including information on ex post performance in Japan. We show that under a scoring design, open auctions reduce cost overruns and delay in completion by more than 10% without worsening the quality of work.

4 Analysis of Impacts of Cost Overruns

In public-works procurement, cost overruns frequently arise because the winning bids are different from the final payments due to the presence of unanticipated productivity shocks during construction. However, with the exception of Bajari, Houghton and Tadelis (2014) and Miller (2014), there is still a scarcity of the structural model of bidding which incorporates the presence of the cost overrun and the execution of the project during construction into the model. Moreover, the empirical analysis of the moral hazard problem in public procurement is limited except for Lewis and Bajari (2014).

Chapter 4 titled as “Contractual Incompleteness and the Quality of Construction Works in Public-works Procurement: Empirical Analysis” provides a structural auction model which incorporates the cost overrun and the choice of the quality level by the contractor during construction. In the model, similar to McAfee and McMillan (1986), the government provides a linear payment schedule which consists of its bid and the cost overrun. In an auction, bidders submit bids and the bidder with the lowest bid receives the contract. The cost overrun arises during construction and is an incentive scheme to ensure the quality of work. This situation is close to the moral hazard because the cost overrun improves the contractor’s effort level for the quality of work. We quantify the impacts of cost overruns on the quality of construction works and social welfare by using a data set including information on the final payment and the quality of work reviewed after the completion. In counterfactual experiments, we find that the welfare loss is 40% when cost overruns are reduced by 50%.
References


