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Endogenous budget constraints in auctions

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Abstract

In prior literature, bidders' budget constraints have been shown to change revenue and efficiency rankings among auction formats. These results, however, are based on the implicit assumption that the nature of the budget constraint is unaffected by auction rules. I extend the standard symmetric model of auctions for a single good to include principals that optimally constrain their bidder to mitigate an agency problem between the two. I show that the outcomes of the first- and second-price auctions generally agree with those from auction models without budget constraints with the exception that the first-price auction is shown to be more efficient when signals are affiliated.

JEL classification: D44; D82

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1. Introduction

Bidders likely face budget constraints in many real-world auctions, especially in the sale of valuable assets such as wireless spectrum (Bulow et al., 2009; Cramton, 1995; Salant, 1997), and

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these constraints potentially have important strategic effects on the outcomes of auction models that cannot be captured in standard frameworks.

Current literature on the subject argues that incorporating budget constraints into the standard independent private values model invalidates some well-known results like the revenue equivalence theorem (Myerson, 1981; Riley and Samuelson, 1981). For example, in a model where bidders valuations are private and i.i.d. Che and Gale (1998) show that the first-price auction both raises more revenue and is more efficient than the second-price auction with budget constraints. Further work extends these results to show that the all-pay auction dominates the first-price auction in terms of revenue and efficiency (e.g., Che and Gale, 1996; Maskin, 2000; Pai and Vohra, 2014).

The earlier literature offers various explanations for the underlying cause of the budget constraints, including imperfect capital markets and agency problems (Che and Gale, 1998).[2] However, these papers derive their results from models where the budget constraint is treated as an exogenous random variable.[3] A potential advantage of this approach is that it allows one to be agnostic about the source of the budget constraints and focus on the strategic effects introduced by the constraints, but it ignores the possibility that the process generating the budget constraints may be affected by a change in auction rules.[4]

If one tries to describe explicitly an agency problem that generates budget constraints for the bidders, it seems that a description of the auction rules should be included as well. Explicitly including a description of the auction rules in the agency problem would allow the budget to vary according to the rules, an effect that cannot adequately be captured in a model that treats the budget constraints as a primitive. The purpose of this paper is to explore how budget constraints might vary between different auction formats when the mechanism generating the budget constraint is made explicit.[5]

I develop a model where the bidder's budget constraint is the endogenous result of an agency problem between the bidder and a principal responsible for funding the bidder's bid (Section 3). The details can be summarized by the following situation. An item is auctioned to one of N firms. Within each firm there is a manager interested in purchasing the asset, but the manager must get funding approval from the firm's board of directors.[6] The board bases its decision on a noisy signal of the asset's value, expecting the manager to have better information about the asset's value at the auction, perhaps due to his specialized knowledge about the industry the asset will operate in. Although the manager receives equity compensation, an agency problem arises because the board of directors knows that the manager will tend to overpay for the asset relative to its true value to the firm because the manager has an empire-building motive or simply receives some private payoff from managing the asset.[7]

[2] For example, there is a large corporate finance literature suggesting that capital market imperfections are the results of agency problems (Shleifer and Vishny, 1997).

[3] The bidders' types are two-dimensional, including a valuation and a budget, distributed according to some commonly known prior distribution.

[4] Strictly speaking, the distribution of the budget constraints could be specified differently for each auction format, but without an explicit description of the mechanism generating the budget constraint it is not clear how to do this.

[5] Although not considered here, if some fraction of a bidder's budget were determined irrespective of the auction rules, then one could imagine that a hybrid model might be appropriate and that elements of the results from both extremes would be present.

[6] Throughout the paper I use the convention that the manager is male and the representative of the board is female.

[7] A modern reference for this description of managerial motives is Jensen (1986), but the idea can be traced back as far as Schumpeter (1934).