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Behavior in all-pay auctions with incomplete information

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Abstract

This paper analyzes the behavior of single-unit all-pay auctions within the independent private values environment in the laboratory. We study revenue, individual bidding behavior, and efficiency, in relation to theoretical benchmarks and to a similar study of winner-pay first-price sealed-bid auctions. We conclude that the all-pay auction yields significantly higher revenue than both the risk-neutral Bayesian equilibrium and the winner-pay auction. Bidders' decisions move closer to equilibrium levels over time in the auction.

JEL classification: C92; C72

Keywords: All-pay; Auction; Experiment

1. Introduction

Many examples of competition exist with the property that multiple players exert effort or expend resources in an attempt to gain a benefit, and the losers' effort or expenditure goes uncompensated. Students vying for grades in a class with a curve, lobbyists attempting to gain a favor from politicians, or rival companies battling to release a new innovative good on the market, are just a few instances of this type of interaction. An auction, in which

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all players pay the amount of their bids, but the person or the firm that bids the highest wins the prize, is a simple and natural way to model such competition. Bidders' expenditure in the auction can be interpreted as a monetary cost or a non-monetary cost of effort.

The theoretical analysis of auctions, beginning with Vickrey (1961) is one of the richest and most highly developed research areas of applied game theory. The main focus has been on winner-pay auctions, where only the player(s) who obtain units are required to make payments. However, in the past decade, economists have begun to study auctions where bidders forfeit their bids even if they do not obtain an item (see for example Baye et al., 1993 or Krishna and Morgan, 1997). In a single-prize all-pay auction, each player submits a nonrefundable bid, but only the highest bidder receives the prize. As mentioned above, this logic can represent many types of winner-take-all contest, such as those described in the first paragraph.

All experimental studies of all-pay auctions of which we are aware have found that participants tend to bid more aggressively than in Nash equilibrium, implying overdissipation of the rent available for sale in the auction (Potters et al., 1999; Davis and Reilly, 1998; Gneezy and Smorodinsky, 1999; Barut et al., 2002). This tendency to overbid is not specific to all-pay auctions; results from studies of first-price winner-pay auctions (Coppinger et al., 1980; Cox et al., 1982; Harrison, 1989; Kagel et al., 1987; and Kagel and Levin, 1993), have indicated overbidding relative to equilibrium levels as well. Most previous experimental studies of all-pay auctions (Potters et al., 1999; Davis and Reilly, 1998; Gneezy and Smorodinsky, 1999) have studied environments with complete information, in which all bidders' valuations of the unit(s) for sale are common knowledge,[1] while Barut et al. (2002) consider a multiple-unit all-pay auction under incomplete information. The experiment reported here focuses on the properties of single-unit all-pay auctions in an environment with incomplete information.

We find that bidders with low valuations for the object tend to bid close to, though usually below, equilibrium predictions. However, bidding higher than equilibrium levels is common for bidders with high valuations. Many participants bid as if they do not want to commit substantial amounts of money unless they have a high probability of winning the auction. These patterns of behavior are consistent with the presence of risk aversion (Fibich et al., 2004), as well as analogous to the pattern observed by Barut et al. (2002), who studied behavior in multiple-unit all-pay auctions under incomplete information. It also corresponds to the phenomenon observed in recent experimental work on effort in organizations by Mueller and Schotter (2003), in which high-ability workers exert greater than optimal effort, and low-ability workers drop out of the competition. Our revenue results are also consistent with the previous literature, in that the auction yields higher revenue than in equilibrium. Furthermore, we conjecture that the all-pay auction generates higher revenue than a winner-pay auction under similar parameters. A dynamic pattern of behavior is evident as the game is repeated. Many bidders suffer considerable losses in the first few periods of their session, but quickly make the adjustment to bid lower than they

[1] Anderson et al. (1998) show that in the case of complete information, overdissipation is consistent with a logit equilibrium, in which agents may commit "errors" by choosing actions that do not have the highest expected payoffs, but the probability of choosing a particular action is increasing in its expected payoff.