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AN EXPERIMENTAL INVESTIGATION OF ENTRY COST EFFECTS IN SEALED BID DOLLAR AUCTIONS

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ABSTRACT. In numerous auction settings potential bidders incur costs to enter the auction. Such costs may potentially influence bidder's behavior subsequently. In this paper we experimentally study the effect of entry costs on bidding and entry behavior, through a complete information common value auction. We run first and second price auctions both with and without entry costs. We find that with entry costs, players on average bid lower in first price auctions, while in second price auctions the average bids are higher, compared to bids in the corresponding no entry fee auctions.

KEYWORDS: Common Value Auctions, Entry Costs, Experiments

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1. INTRODUCTION

Entry costs are often observed in real-life auctions. For example, contractors in procurement auctions may have to pay a registration fee to the auctioneer in order to establish their viability or potential bidders may incur bid preparation costs. We investigate bidding behavior in complete information two player common value auctions, equivalent to a sealed-bid dollar auction, through laboratory experiments. Running such an auction allows us to have a simple design, facilitates analysis and control for winner's curse. We study the effect of entry costs on bidding and entry behavior in both first and second price auctions. While conventional dollar auctions exhibit escalation of commitment effect on bids, sealed bid dollar auctions are not expected to show such effect.

There have been experiments which have studied entry costs and biding behavior in auctions, mostly through private value auctions (see Phillips et al. (1991),Palfrey and Pevnitskaya (2008)). In a format closer to ours, Cox et al. (2001) look at entry, exit and bidding behavior through first price common value auction. But unlike our experimental design, they have an incomplete information common value auction with private signals in order to investigate winner's curse and we study second price auction as well. Another related paper is Levin and Smith (2001) which looks at entry decisions through incomplete information common value first price auction. Apart from the informational difference, in our design the potential bidders face minimal uncertainty regarding the number of players in the auction, when they make the entry decision.[1] Finally, (Drichoutis et al., 2008) analyzes willingness to pay of agents in second price auctions through the use of reserve prices.

In each auction, first and second price, we run a conventional winner pay auction and a fixed entry fee one. We study if this entry cost has an effect on bids. Interestingly, we find that the bids in the first price auction with entry fee falls in comparison to the auction without the entry fee, while in second price auction, the bids in the auction with entry fee increases in comparison to the auction without the entry fee.

2. DESIGN

We ran two-player complete information common value ($25) auctions.[2] The subject pool consisted of students drawn randomly on a volunteer basis. We had a 2×2 design, where one treatment

[1] Post-entry number of players in the auction is explained later in the section on design.
[2] Note all amounts are in HK$, where 1 US$ $\approxeq$ 7.8 HK$.

variable was the nature of the auction (first or second price) and the other was auctions with or without entry costs. In case of the entry fee auctions, subjects had a choice to either enter by paying $5 or not enter. Subsequently, all entrants were randomly assigned to groups of two. If odd number of subjects entered, one group was assigned three subjects. If only one subject entered, then the auction in that round was canceled. Both subjects in a group simultaneously bid for the prize of $25. In treatments without an entry fee, subjects were randomly matched into groups of two, prior to their bid decisions. Each treatment had multiple identical rounds (varying from 6-8 rounds), but all subjects were re-matched after every round. Finally, subjects were given an endowment of $50 at the beginning of each treatment in order to cover their potential entry costs.

In the first price auctions, the highest bidder in a group won the auction and earned a payoff of $25 minus their own bid and entry fee (if any). In the second price auctions, again the highest bidder in a group won the auction, but earned a payoff of $25 minus the other player's bid and entry fee (if any). The other bidder, both in first and second price auctions, earned a payoff of zero or had losses equal to the entry fee (if any). Once all subjects in a group submitted their bids, the highest (winning) bid was revealed to all players within the group and each player's payoff from the auction was privately revealed. To summarize, the following treatments were run:

FP: First Price Sealed-Bid Auctions:

FP NEF: No entry fee

FP FEF: Fixed entry fee of $5

SP: Second Price Sealed-Bid Auctions:

SP NEF: No entry fee

SP FEF: Fixed entry fee of $5

3. RESULTS

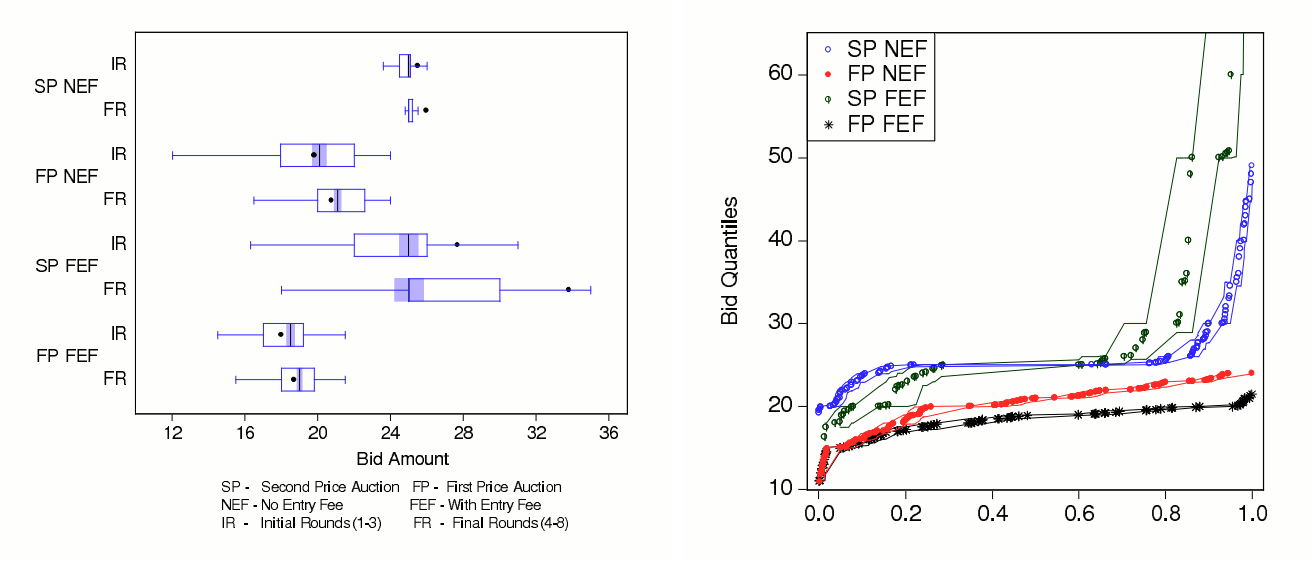
Table 1 provides the descriptive results. To remove outliers, we trim 5% each of the highest and lowest bids for each treatment. The average bid for the first price auction with no entry fee (NEF) is 20.5, while with fixed entry fee (FEF) the mean bid is 18.4. Corresponding median bids are 21 and 19 respectively. A t-test for equality of means confirms that differences in the mean bids are significant (at 1% level), while a Wilcoxon test for equality of median confirms the same for median. For the second price auction the average bid in NEF treatment is 25.8, while in FEF treatment its 30.1. The corresponding median bids are 25 for both treatments. We also find overbidding in the second price auction compared to the weakly dominant strategy of bidding the true

TABLE 1. Descriptive Data from First Price & Second Price Auctions

	First Price Auctions		Second Price Auctions	
	NEF	FEF	NEF	FEF
# of Auctions	451	365[a]	661	141[a]
Entry %	na	58.34	na	39.75
Mean Bid	20.5	18.4	25.8	30.1
Median Bid	21	19	25	25
Mean Entrant Earnings	1.67	-2.17[b]	1.02	-3.93[b]

[a] post-entry
[b] net $5 entry fee

valuation of $25, irrespective of the entry fee. Previously reported overbidding in second price auctions is commonly attributed to winner's curse (see Kagel (1995)), but being a dollar auction there is no winner's curse in our design.



(a) Box-Plot Representation of Bids (b) Empirical Quantile Distribution of Bids

FIGURE 1. Bid Characteristics

The bid characteristics are highlighted through figure 1. Figure 1(a) shows a box-plot for the distribution of bids, disaggregated over initial (1-3) and final rounds (4-8). Figure 1(b) gives the empirical quantile distribution of bids for each of the four treatments. Figure 1 reveals that both in first and second price auction there is a significant effect on bids in the presence of an entry fee[3]. This effect is robust across rounds (initial or final), though it is more robust for first price than for second price price auction.[4] Interestingly, the bids in the first price auction fall on average (conservative bidding) with the introduction of a fixed entry fee, while in the second price auction they rise on average (aggressive bidding) in the presence of the fixed entry fee.

Next, we segment the population of subjects based on their entry decisions separately for the first price and second price auctions. The objective is to ascertain whether the observed difference in bids in the entry fee auctions compared to the no entry fee ones is due to a "self-selection" effect or due to the strategic impact of the entry fee on subjects' subsequent bids. The "self-selection" effect pertains to whether those subjects more likely to enter an auction with participation costs are also the type who are innately more conservative/aggressive in their bidding in general. We first calculate the entry percentage over all rounds for each subject. We then analyze the correlation between the entry percentage for a subject in the fixed fee treatment and the bids for the same subject in the no entry fee treatment of the same auction. If those subjects with a higher entry percentage are also innately more conservative/aggressive bidders, then that behavioral trait should be demonstrated irrespective of whether the auction has an entry fee or not.

TABLE 2. Correlation Coefficients for First Price & Second Price Auctions

	Correlation Coefficients	
	First Price Auctions	Second Price Auctions
entry % and NEF bid	0.09	0.194

[3]Since the entry fee acts as a sunk-cost for the actual action, the difference in bid distribution between entry fee and no entry fee treatments can be characterized as a failure by subjects to ignore sunk costs.

[4]To test robustness we also ran a endogenous entry fee treatment for first price auction, where subjects had to indicate how much they were willing to pay in order to participate in the common value auction. Those subjects whose willingness to pay were in the top 60%, automatically entered the auction after paying their indicated amount. We found that there was a significant negative correlation between subject's willingness to pay in order to enter the auction and their actual bids in the auction subsequent to entry.

Table 2 shows the correlation data for likelihood of entry (in the entry fee treatment) and bids in the no entry fee (NEF) treatment for each of the two auctions. We observe that the correlation between entry and bids (averaged across all rounds for each subject) is close to zero for both the first and second price auctions. We can reject the hypothesis that a predilection towards entry is correlated with bidding behavior.

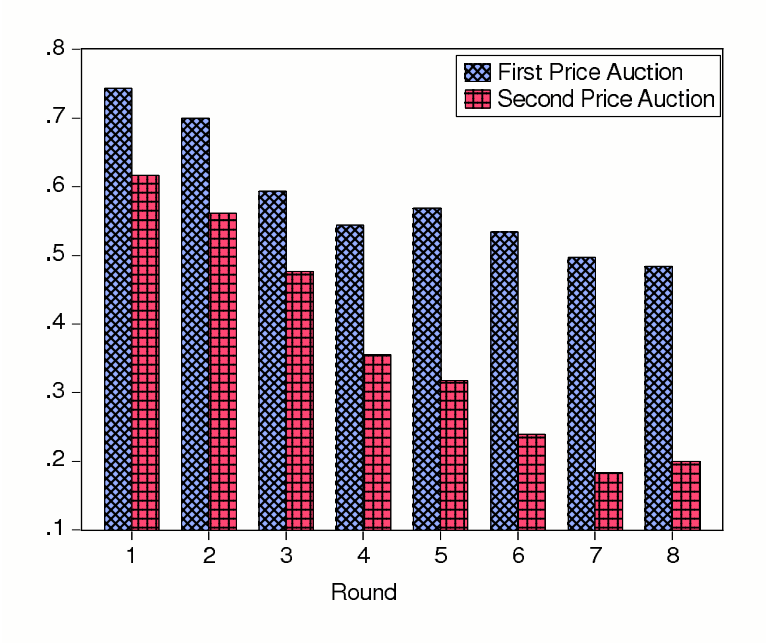


FIGURE 2. Entry Levels in First and Second Price Auctions with Entry Fee

Finally, we analyze the entry decision in both the fixed fee first and second price auctions. Figure 2 reveals that entry levels falls over rounds in both the auctions, though the fall in entry is larger for second price. This can be interpreted as a "learning effect," where subjects 'learn' to stay out of an auction whose equilibrium predicted expected earnings are negative (equal to the entry fee). We should then expect entry in any round to be negatively influenced by cumulative number of losses in previous rounds where entry occurred. Another determinant of entry could be the cash balance of a subject at the beginning of the round. Phillips et al. (1991) interprets this as a variant of the "endowment effect," arguing that those with higher endowments (cash balance at the beginning of the auction) would be less likely to take the risk of entering the auction. This would imply that past losses (i.e., lower current cash balances) would have a positive effect on the current entry decision, contrary to the "learning effect." To test these competing claims we use the following Probit model

for entry:

$$\text{DENTRY} = \alpha_1 + \beta_{11} NUMLOSS + \beta_{22} BEGCASH \quad (1)$$

where, in the above equation 1, DENTRY is an indicator variable that takes the value of one if entry occurs in that round and zero otherwise. NUMLOSS is the ratio of number of cumulative losses in the auction (i.e. failure to win) in previous rounds to cumulative past entries. BEGCASH is the cash balance at the beginning of the round. We run the above regression on the combined data from fixed entry fee first and second price auctions.

TABLE 3. Probit Regression Results for Entry

	DENTRY
Constant	0.968*** (0.085)
NUMLOSS	-0.236*** (0.069)
BEGCASH	0.001 (0.001)
#Obs	882
S.E. of regression	0.393

*** Denotes significance at 1% level. Number inside parenthesis denotes std. error

Table 3 shows that the coefficient of NUMLOSS is negative and significant while, the coefficient of BEGCASH is positive but not significant. From the data we can conclude that "learning effect" (of past losses) is a significant determinant (negative) of entry, while "endowment effect" is not.

4. CONCLUSION

We find that entry costs influence the actual bids in auctions, contrary to theoretical prediction. Interestingly, we find a strong negative correlation between entry fee and actual bids in the first-price auction and a positive correlation with entry fee and bids in second price auction. So bidding behavior with entry costs is more aggressive in second price auction and more conservative in first price auction.

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APPENDIX A

INSTRUCTIONS FOR THE EXPERIMENT

This is an experiment in market decision-making funded by a research grant. During the experiment you will be called upon to make some decisions. Your earnings will be determined by your decisions and the decisions of the other participants. If you listen to the instructions and follow them carefully you stand to make a substantial sum of money. At the end of the experiment you will be paid in cash all the money you earn including the $50 you get for participating.

The experiment will consist of several games, all of which involve some type of an auction. Each game will consist of a specified number of identical rounds. In each game you will be matched with other participants in a group, such that before each round of a game you will be randomly **rematched** with other participants. If the number of participants are even then you will always be in a group of two[5], otherwise one group will have three participants and the rest will have two. The number of participants in your group will be displayed at the top of the screen. In case there is only one participant, then there is no auction and hence no payoff for that round.

In each round of a game, the participants in a group will submit a bid for a prize of **$25**. The earnings for each participant will depend on their bid and the bids of all other participants in their group. The way the earnings are calculated will vary across games and will be specified before each game. At the beginning of the experiment you will be paid $50. If your earnings fall below -$50 at any point during the experiment, you will not be allowed to continue with the rest of the experiment.

We will have 5 practice rounds at the beginning of each game to enable you to familiarize yourself with the decision-making process of the experiment.

Any questions?

[5]To begin with in all sessions the number of subjects were kept even. But in the auctions with entry fee it was possible that an odd number of subjects could decide to enter.

Second price auction with no entry fee (SNEF)

You have to make a bid, which can be any non-negative number. If your bid is the highest in your group then you win the prize. If your bid is not the highest then you do not win. In case your bid and the bid of the other person in your group are the same, then one of you is chosen at random to be the winner.

The winner in each group earns a payoff of **$25 minus the bid of the other player** in their group. The other player gets zero. At the end of each round you are told if you won and your payoff. You are also told the winning bid.
This is run for x[6] identical rounds, where before each round you are randomly rematched with another participant.

Any questions?

First price auction with fixed entry fee (FFEF)

You are offered participation in an auction with a prize of $25 for the winner in each group. In each round, in order to participate you have to pay an entrance fee of $5. If you decide not to participate you do not have to pay anything and you just sit out for that round. If you decide to participate by paying $5, you enter the auction and get matched in a group with another participant (one group could be of size three).

Once you enter the auction you have to make a bid, which can be any non-negative number. If your bid is the highest in your group then you win the prize. If your bid is not the highest then you do not win. In case your bid and the bid of the other person(s) in your group are the same, then one of you is chosen at random to be the winner.

The winner in each group earns a payoff of **$25 minus their own bid**. The other participant(s) gets zero. At the end of each round you are told if you won and your payoff. You are also told the winning bid. This is run for x rounds, where before each round you are randomly rematched with another participant.

Any questions?

[6]The number of rounds varied from 8-10 for all treatments.

First price variable entry fee auction (FVEF)

You are offered participation in an auction with a prize of $25 for the winner in each group. In each round in order to participate you have to submit an amount you are willing to pay as an entrance fee for the right to participate in the auction. **An amount equivalent to their bid for the entrance fee is automatically deducted for all participants**. The top y[7] amongst you in terms of the entrance fee bids get to participate in the auction. The participants who are unable to make it to the auction have to sit out for that round.

If you are in, you will be matched with another player in a group of size two (one group could have 3 participants). You have to make a bid, which can be any non-negative number. If your bid is the highest in your group then you win the prize. If your bid is not the highest then you do not win. In case your bid and the bid of the other person in your group are the same, then one of you is chosen at random to be the winner.

The winner in each group earns a payoff of **$25 minus their own bid**. The other player gets zero. At the end of each round you are told if you won and your payoff. You are also told the winning bid. This is run for x rounds, where before each round you are randomly rematched with another participant.

Any questions?

The other treatments, first price auction with no entry fee and second price auction with a fixed entry fee had similar instructions.

[7] In each session of this treatment the number y was chosen such that a total of 60% of all subjects got chosen as participants.