Behavioral Biases in Auctions: an Experimental Study

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Behavioral Biases in Auctions: an Experimental Study

This paper investigates implications of some of the well established behavioral biases to the behavior of bidders and sellers in different types of auctions. The experimental study presented in the paper shows that: (1) sellers in all types of auctions are subject to the endowment effect; (2) bidders in English auctions are also subject to the endowment effect and tend to bid more than in second price sealed bid auctions; and (3) bidders in all types of auctions are subject to the anchoring effect. We also test the Engelbrecht-Wiggans (1989) hypothesis that winners of first-price sealed bid auctions can regret “money left on the table”, but find no evidence in its support.

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Key words: auction, anchoring, endowment effect, behavioral economics
1. Introduction

There is a number of evidence that people do not always behave according to the expected utility theory and that they are subject to different behavioral biases. Kahneman and Tversky (1979) noted that people are loss averse and are subject to the endowment effect. In particular, they attach higher values to the objects they already own than to objects they want to buy. The endowment effect is one of the main building blocks of the Prospect Theory (Kahneman and Tversky, 1979, 1991, and 1992), the most known alternatives to the expected utility theory. Bell (1982) and Loomes and Sugden (1982) use the Kahneman and Tversky’s (1979) evidence to develop the Regret Theory, another alternative theory of people’s behavior under uncertainty. The main assumption of the regret theory is that people who made certain decisions in the past may have regrets if these decisions turn out to be wrong even if they appeared correct with information available ex ante. Tversky and Kahneman (1974) argue that when people are not sure about their own valuation of the object, they often begin their assessment at some starting point, an anchor, and then adjust it up or down based on their own assessment and beliefs. Even though this anchor can be just an arbitrary number, it significantly affects the final value that people assign to the object. The list of behavioral biases also includes

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1 For empirical evidence in support of the endowment effect see Kahneman, Knetsch and Thaler (1990), Knetsch and Sinden (1984), Knetsch (1989), Samuelson and Zeckhauser (1988).

2 Russo and Shoemaker (1989) describe an experiment in which subjects were asked to think of the last three digits of their phone number; add 400 to that number; think of the resulting number as a date; and consider whether Attila the Hun was defeated in Europe before or after that date. After that they were asked to guess the date when Attila the Hun was actually defeated. Russo and Shoemaker (1989) found that the answer to the last question positively depends on the date that people calculate based on their home phone numbers. Northcraft and Neale (1987) asked subjects in their experiments to tour a house and appraise it.
(but is not limited to) availability heuristic (Kahneman and Tverski, 1973), mental accounting (Thaler, 1985), house money effect (Thaler and Johnson, 1990).

In this paper we investigate how some of the above-mentioned biases affect the behavior of bidders and sellers in different types of auctions. In particular, we conduct a set of open bid English, first and second price sealed bid, and Dutch experimental auctions and use their results to test the following hypotheses.

Endowment effect in sellers’ behavior

In some of our experiments one of the randomly selected subjects was given an item. He was then asked to set a secret reserve price and to sell the item to other subjects using one of the auction mechanisms. The Kahneman and Tversky (1979) endowment effect, applied to this particular setting, would predict that the seller’s valuation should be higher than the valuations revealed by the bidders.

Endowment effect in bidders’ behavior

Based on the Kahneman and Tversky (1979) endowment effect, Dodonova and Khoroshilov (2005) develop a theory that predicts that bidders in English auctions become emotionally attached to the objects and, as a result, are subject to the endowment effect. Dodonova and Khoroshilov (2005) predict that when bidding starts from zero, they found that the subjects’ appraisal values positively depend on the (arbitrary) posted listing price of the house. Dodonova and Khoroshilov (2004), using data from on-line auction, document that the final price on identical items sold using on-line English auction mechanism positively depends on the posted “but now” price.
bidders in English auctions tend to bid more aggressively than bidders in second price sealed bid auctions.

**Anchoring effect**

The anchoring effect of Tversky and Kahneman (1974), applied to auctions, would predict that when identical items are sold, the bidders’ willingness to bid positively depends on the reference price given to them.

**Regret in first-price sealed bid auctions**

Engelbrecht-Wiggans (1989) argues that bidders in first price sealed bid auctions can regret “money left on the table”, i.e., the winner may regret if his winning bid is much higher than the second highest bid. Therefore, bidders in first-price sealed bid auctions may bid less aggressively than bidders in Dutch auctions do.

The rest of the paper is organized as following. In part 2 we describe the design of our experiments. In part 3 we use the data collected from these experiments to test the four hypotheses stated above. In part 4 we conclude.

2. **Experiment design**

In total, we run 32 experimental sessions each of which involved 5 subjects and consisted of 4 different auctions. Subjects were recruited from undergraduate and graduate
students; they were given $25 at the beginning of the session which they were free to use to buy any objects (if they wished to do so). Subjects were allowed to keep any bought items and any money left at the end of the session. Subjects were also allowed to use their own funds if they wanted to bid more than the amount they were given at the beginning of the session.

The objects offered for sale are listed below. Subjects were able to see and examine all merchandise awards before the auction.

1) Monetary lottery awards: Award LA1 is a choice between lottery L_{1,1} that gives the holder a 34\% chance to win $24 and lottery L_{1,2} that gives the holder a 33\% chance to win $25. Award LA2 is a choice between lottery L_{2,1} that gives the holder a 45\% chance to win $30 and lottery L_{2,2} that gives the holder a 90\% chance to win $15

2) Merchandise (travel) lottery award: Award TA that gives the holder a 1 out of 32 chance to win a 7-night 2-star hotel stay at any major U.S. or Canadian city of his choice (all taxes included).

3) Merchandise award - USB: Award USB, a 256MB high-speed USB memory key

4) Merchandise award - backpack: Award BP, a backpack.

The auction designs were as following (in chronological order for each session)

1) Open-bid English auction

2) Open-bid English auction
3) Second price sealed bid auction

4) First price sealed bid or Dutch auction.

In all sessions subjects were given all necessary information about Monetary lottery awards (LA1 and LA2) and Merchandise award – USB (USB). In particular, for USB award, they were given a printout from one of the on-line retail stores that sell the corresponding USB drive for a retail price of $29.99. The information on Merchandise (travel) lottery award (TA) and Merchandise award – backpack (BP) was different across sections. Some subjects were given “high anchor” information: they were told the median walk-in price for a 7-night hotel stay in downtown Toronto ($1,342) and suggested retail price of the backpack ($45). Some subjects were given “low anchor” information: they were told the minimum price for a 7-night hotel stay in downtown Toronto ($605) and a both wholesale price of the backpack ($13) and its suggested retail price ($45). Table 1 presents the schedule for all sessions.

(insert Table 1 here)

The course of events in auctions 1, 2, and 3 was as following. First, one of the randomly chosen subjects is given the object. Then he is asked to set a reserve price and to delegate the selling of the object to the auctioneer\(^3\). The auctioneer starts the auction from zero and keeps the reserve price secret. If the final price in the auction is equal to or greater than

\(^3\) One of the authors performed the role of the auctioneer.
the reserve price, the winner of the auction pays the owner (i.e., the subject who was allocated the object) the final price and receives the object. If the final price in the auction is lower than the reserve price, no sale takes place and the subject who was allocated the object keeps it. For auction 4 we played the role of the seller ourselves and set a zero reserve price.

To ensure that subjects correctly understand the rules of the second price sealed bid auction and its equivalency to the open-bid English auction we framed the second price sealed bid auction in the following way. Since English auctions were the first two auctions in any session, we told the subjects that the rules on the second price sealed bid auction are exactly the same as the rules of the English auction with the exception that bidders must secretly tell (to the auctioneer) the price up to which they are going to bid and at which they are going to stop bidding. Then, during the course of the auction, each bidder must bid up to his pre-determined amount and is not allowed to bid above it.

To be able to obtain the information about the values that all bidders in English auctions (with the exception of the winner, whose valuation of the object cannot be revealed) assign to the object, we adopt the classical version of the English auction (Vickrey, 1961) in which the auctioneer increases the price by a small bidding increment and bidders must decide if they are willing to buy the object at the current price or they want to drop out of the auction. The bidding increment was set to $0.25 for the first auction and to $0.50 for the second auction. Dodonova and Khoroshilov (2005) argue that bidders in English
auctions experience endowment effect because there are time periods during the course of the auction when their bids are the highest. They argue that the bidder with the currently highest bid feels as if he almost owns the object. In this case, if someone overbids him, he feels as if he loses the item and considers submitting a new bid as paying an extra (small) amount of money in order to keep the item while he treats withdrawing from the auction as loosing the item. To preserve this feature in the classical English auction setting (Vickrey, 1961) we assign each subject a number (from 1 to 4) and, after each incremental price increase, ask only one subject whether he is still willing to bid or if he is out. For example, we ask the first subject if he is willing to bid $0.25; if he is, we ask the second subject if he is willing to bid $0.5; then we ask third subject for a price of $0.75; then we ask the fourth subject for $1; then we go back to the first subject and ask for $1.25, etc. If, at some point, one of the subjects does not want to bid, he is excluded from the auction and we ask the next subject for the same price. For the purpose of our analysis we define the value that any given subject assigns to the object to be equal to the average of his highest bid and the required bid at which he dropped out of the auction. This way we are able to extract valuations from all bidders in English auctions with the exception of the winners.

To prevent any “in-front-jumping” in Dutch auctions (auction #4) the subjects were not allowed to see each other. During the course of the Dutch auction, all subjects were facing the wall and were asked to indicate their desire to bid by a hand signal behind their backs.
3. **Analysis**

To test the existence of the endowment effect in sellers’ behavior (Kahneman and Tversky, 1979), we use the data from auctions 1, 2, and 3. For each award we combine the data from English and second price sealed bid auctions and compare the combined data with the data on the reserve price by using the two-sample t-test. Note that, by the design of the experiments, the reserve price was kept secret and, therefore, did not influence the bidding process. Furthermore, when the final price determined by the auction process was below than the reserve price, no sale took place, i.e., the winner of the auction was not allowed to submit another bid to surpass the reserve price. Therefore, setting the reserve price equal to the seller’s valuation of the object is the optimal sellers’ strategy regardless of the bidders’ strategies and valuations. This information was conveyed to the sellers and each seller confirmed that he understood it. Since the winner’s valuation of the object cannot be observed in English auctions, we exclude the lowest bidders’ valuation in each English auction session as well. Table 2 presents the descriptive statistics (average bidders’ and sellers’ valuations).

(Insert Table 2 here)

As Table 2 shows, sellers’ valuations are significantly higher than bidders’ valuations for all awards. The difference in average sellers’ and bidders’ valuations varies from 30%
Kahneman and Tversky (1984) and Thaler (1985) show that people usually do not experience endowment effect toward money and do not treat the price that they pay for any item as a loss. However, they do treat the selling of an item as a loss. The evidence of endowment effect for lottery awards (LA1 and LA2) presented in this paper implies that people treat lotteries with monetary prices as items, and not as money. In particular, they get emotionally attached to lotteries and experience losses when they have to sell them, even thought they experience no endowment effect toward the money \textit{per se}.

To test the existence of the endowment effect in bidders’ behavior (Dodonova and Khoroshilov, 2005), we use the data from auctions 2 and 3 (English and second-price sealed bid auctions) for items USB and TA. According to Dodonova and Khoroshilov (2005) hypothesis, when bidding starts from zero and bidders understand the equivalence of English and second price sealed bid auctions, they bid more aggressively in English auctions. Since the highest bidders’ valuation in English auctions is unobservable, in order to make the biddings data compatible we eliminate the highest bid for the second price sealed bid auctions. Table 3 presents the descriptive statistics of the data. Consistent with Dodonova and Khoroshilov (2005) hypothesis, Table 3 shows that bidders in English auctions bid more aggressively than in second-price sealed bid auctions, i.e., on

\footnote{Kahneman and Tversky (1992) estimate the parameter of loss-aversion to be equal to 2.25. In the Kahneman, Knetch and Thaler (1990) experiment, sellers valued their objects about 2 times higher than buyers did.}
average a bidder in an English auction will bid more than he would bid in a second price sealed bid auction.

To test the anchoring effect of Tversky and Kahneman (1974), we compare bids and reserve prices on Merchandise (travel) lottery award (TA) when subjects were given high anchor (median walk-in price of $1,342 for a 7-night hotel stay in downtown Toronto) and low anchor (minimum price of $605 for a 7-night hotel stay in downtown Toronto) information. We also test the anchoring effect for the backpack award (BP). However, since the reserve price for the backpack award was set to zero and since Dutch auctions did not provide us with a sufficient number of observations for the analysis, we only use the bidding information from the 16 first price sealed bid auctions for the PB award. Table 4 present the result of our analysis.

Consistent with the anchoring hypothesis, the average bids in all auctions are significantly higher when subjects are given high anchor information than when they are given low anchor information. The average reserve price is also higher for the high anchor experiments, although the difference is insignificant. Such insignificance, however, may be due to a small sample size: since we have only one observation for the
reserve price per auction, the sample for the TA reserve prices consists of only 32 observations.

(Insert Table 5 in here)

Engelbrecht-Wiggans (1989) argues that bidders in first price sealed bid auctions can regret “money left on the table”, e.g., the winner may feel regret if there is a significant gap between his winning bid and the second highest bid. These possible regrets make bidders in English auctions bid less aggressively. Since in Dutch auctions the second largest bid does not exist, the winner will never know how much money he could have saved if he waited longer and bid at a lower price. Thus, the winner of a Dutch auction is not subject to the regrets faced by the winner of an English auction. To test the Engelbrecht-Wiggans (1989) hypothesis that the highest bid in the English auction should be lower than the winning bid in the Dutch auction, we compare final prices in these two auctions for the BP award. The results of this comparison are presented in Table 5. Contrary to the Engelbrecht-Wiggans (1989) hypothesis, we find that the average price in first price sealed bid auctions is higher than in Dutch auctions, however, the difference is insignificant. The insufficiency of the difference may be due to a small sample size of only 16 observations for first price sealed bid and Dutch auctions.

4. Conclusion
This paper examines the implications of several well established behavioral biases to auctions. Consistent with the endowment effect of Kahneman and Tversky (1979) we show that sellers value their objects significantly higher than bidder. Consistent with Dodonova and Khoroshilov (2005), who argue that bidders in English auctions also suffer from the endowment effect, we find that the average value that bidders in English auctions assign to the objects is higher than the average bid in second price sealed bid auctions. Consistent with the anchoring hypothesis of Tversky and Kahneman (1974), we find that the bidders who are given a higher anchor (retail instead of wholesale price or median versus minimal retail price) bid more than the bidders who are given a lower anchor. We find no evidence in support of Engelbrecht-Wiggans (1989) hypothesis that the winner of the first price sealed bid auction can regret “money left on the table”, and thus, the final price in the first price sealed bid auction may be lower than the price in the Dutch auction.
References


Table 1: The Schedule of Experiments

<table>
<thead>
<tr>
<th>sessions</th>
<th>Auction 1</th>
<th>Auction 2</th>
<th>Auction 3</th>
<th>Auction 4: 1st price sealed bid</th>
<th>Auction 4: Dutch</th>
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<td>BP</td>
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<td>high anchor</td>
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<td>high anchor</td>
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<td>high anchor</td>
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Table 2: Endowment Effect in Sellers’ Behavior

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<tr>
<th>Award</th>
<th>Sellers’ valuation</th>
<th>Bidders’ valuation</th>
<th>Difference</th>
<th>p-value</th>
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<td>LA1</td>
<td>$8.44</td>
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Table 3: Endowment Effect in Bidders’ Behavior

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<td>in English auctions</td>
<td>in second price sealed bid auctions</td>
<td>Difference</td>
<td>p-value</td>
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Table 4: Anchoring Effect

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Table 5: Effect of Regret

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