Economics Bulletin

Volume 29, Issue 3

Behavioral biases in auctions: an experimental study

Anna Dodonova
University of Ottawa

Yuri Khoroshilov
University of Ottawa

Abstract

This paper investigates implications of some of the well-known behavioral biases of bidders' behavior in different types of auctions. It presents the results of an experimental study that tests the endowment hypothesis for English auctions and regret aversion hypothesis for first-price sealed-bid auctions. This study documents support for the former and no support for the latter hypotheses.

Citation: Anna Dodonova and Yuri Khoroshilov, (2009) "Behavioral biases in auctions: an experimental study", *Economics Bulletin*, Vol. 29 no.3 pp. 2218-2226.
Submitted: Jul 29 2009. **Published:** September 04, 2009.

1. Introduction

There is substantial 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 well-known alternatives to the expected utility theory.[1] Bell (1982) and Loomes and Sugden (1982) use 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*. This paper presents the results of experimental study of the effect of endowment and regret aversion on bidders' behavior in auctions.

Despite the growing popularity of behavioral economics and numerous research that documents the irrationality in bidders' behavior, scant research has been undertaken to apply the existing behavioral theories in the auction contexts to investigate their validity and implications for optimal auction design. Engelbrecht-Wiggans (1989) argues that, when bidders do not have dominating strategies, they may feel regret when their bidding decisions turn out not to be the best *ex post* (after the end of the auction) even if they were the best decisions based on the information available at the time of the bidding. For example, a bidder in a first-price sealed-bid auction who values an object at $1,000 and bids only $500 may feel regret ("loser regret") when she learns that the winning bid was only $501 and she could have won by bidding just a little bit more. The anticipation of the loser regret makes the bidder bid more aggressively. Similarly, the same bidder who bids $500 may feel regret for "money left on the table" (or "winner regret") if she wins the auction and learns that the second largest bid was only $100 and she could have won with a much smaller bid. Such anticipated winner regret makes bidders shade their bids in first-price sealed-bid auctions. Bidders in descending Dutch auctions are also subject to the loser regret, but they are free from the winner regret because the second largest bid does not exist in Dutch auctions and the winner never finds out the minimum price at which she could have won the auction. Therefore, according to Engelbrecht-Wiggans (1989), the final price in Dutch auctions should be higher than in otherwise identical first-price sealed-bid auctions. This is the first hypothesis that we test in this paper.

Although bidders' optimal strategies in both second-price sealed-bid and first-price open-bid English auctions are to bid their true values of the object (Vickrey, 1961), and such optimal bidding should result in the same outcome (i.e. the same final price and the same winner), the different formats of these auctions may result in different bidders' attitude toward the object. Ariely and Simonson (2003) and Dodonova and Khoroshilov (2005) argue that bidders in English auctions may feel quasi-endowment effect toward the object for which they are bidding.

---

[1] There is a substantial body of empirical research that documents the endowment effect, which includes but is not limited to Kahneman *et al.* (1990), Knetsch and Sinden (1984), Knetsch (1989), Samuelson and Zeckhauser (1988).

For example, if bidder A bids $1,000, she may feel as if she already owns the object and paid $1,000 for it. Therefore, if she gets overbid by the next bid of $1,001, she thinks of increasing her bid to $1,002, paying just two more dollars for the privilege of keeping the object, whereas dropping out of the auction is considered as losing the object and getting the $1,000 back (i.e. selling the object for $1,000). According to the quasi-endowment effect, a person may prefer to pay two extra dollars (above the $1,000 of her previous bid) in order to keep the object even if she would not buy the same object for $1,002 if facing a simple buying decision. As a result, bidders in open-bid English auctions will bid more aggressively than in otherwise identical second-price sealed-bid auctions where bidders face only one-time bidding decisions and are not subject to the quasi-endowment effect.[2] This is the second hypothesis that we test in this paper.

The design of our experiments also allows us to test the loss aversion hypothesis for sellers. According to Kahneman and Tversky (1979), the seller's revealed valuation of the object should be higher than the average revealed bidder's valuation. This is the third hypothesis that we test.

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

2. Experiment design

In total, we conducted 32 experimental sessions each of which involved five subjects and four different auctions. Subjects were recruited among undergraduate and graduate students of the same university; they were given $25 at the beginning of the session which they were free to use for buying 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.

(1) Monetary lottery awards: Award LA1 was 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 was 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 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 her choice (all taxes included).
(3) Merchandise award - USB: Award USB, a USB memory key
(4) Merchandise award - backpack: Award BP, a backpack.

[2] Consistent with this hypothesis, Heyman *et al.* (2004) show that bidders who participate in multi-stage second-price sealed-bid auctions tend to increase their bids as the auction progresses.

All subjects were given all necessary information about all awards. In particular, subjects were able to see and examine all merchandise awards before the auction. In addition, for the USB award, subjects were given a printout describing its technical characteristics. The auction designs were as follows (in chronological order for each session). Table I presents the schedule for all sessions.

(1) Open-bid English auction
(2) Open-bid English auction
(3) Second-price sealed-bid auction
(4) First-price sealed-bid or Dutch auction.

Table I: The Schedule of Experiments

sessions	Auction 1	Auction 2	Auction 3	Auction 4: 1st price sealed bid	Auction 4: Dutch
1-4	LA2	USB	TA	BP	
5-8	LA1	USB	TA	BP	
9-12	LA2	TA	USB		BP
13-16	LA1	TA	USB		BP
17-20	LA2	USB	TA	BP	
21-24	LA1	USB	TA	BP	
25-28	LA2	TA	USB		BP
30-32	LA1	TA	USB		BP

The timeline for auctions 1, 2, and 3 is as follows. First, one of the randomly chosen subjects ("seller") is given the object. Then she 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 auction price is equal to or greater than 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 auction price is lower than the reserve price, no sale takes place and the seller keeps the object. For auction 4 we played the role of the seller ourselves and set a zero reserve price.

To insure that subjects correctly understand the rules of the second-price sealed-bid auction and its equivalence 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 for the second-price sealed-bid auction were 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

[3] One of the authors performed the role of the auctioneer.

the course of the auction, each bidder must bid up to her pre-determined amount and is not allowed to bid above it.

To obtain the information about the values that each of the bidders in English auctions (with the exception of the winner, whose valuation of the object cannot be revealed) assigned to the object, we adopted 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 if 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 quasi-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 she almost owns the object. In this case, if someone overbids her, she feels as if she is losing the item and considers submitting a new bid, paying an extra (small) amount of money in order to keep the object, whereas she treats withdrawing from the auction as losing the object. To preserve this feature in the classical English auction setting (Vickrey, 1961) we assigned each subject a number (from one to four) and, after each incremental price increase, asked only one bidder whether she was still willing to bid or if she was out. For example, in the first auction we asked the first bidder if she was willing to bid $0.25; if so, we asked the second bidder if she is willing to bid $0.5; then we asked the third bidder for a price of $0.75; then we asked the fourth bidder for $1; then we went back to the first bidder and asked for $1.25, etc. If, at some point, one of the bidders did not want to bid, she was excluded from the auction and we asked the next bidder for the same price. For the purpose of our analysis we define the value that any given bidder assigns to the object to be equal to the average of her highest bid and the required bid at which she dropped out of the auction. This way we are able to extract valuations from each of the bidders in English auctions with the exception of the winners.

To prevent any “in-front-jumping” in Dutch auctions (auction #4) based on other bidders’ physical movements, the subjects were not allowed to see each other. During the course of the Dutch auction, all subjects faced 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 for sellers (Kahneman and Tversky, 1979), we used the data from auctions 1, 2, and 3. For each award we combined the bidding data from English and second-price sealed-bid auctions and compared the combined data with the reserve prices by using the two-sample t-test. Since the reserve price was kept secret, it did not influence the bidding process. Furthermore, in the case when the final auction price was below 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 her own valuation of the object was the optimal seller’s strategy regardless of the bidders’ strategies and valuations. This information was conveyed to the sellers and each seller confirmed that she understood it. Since

the winner's valuation of the object cannot be observed in English auctions, we excluded the lowest bidder's valuation in each English auction session as well. Table II presents the descriptive statistics (average bidders' and sellers' valuations).

Table II: Endowment Effect in Sellers' Behavior

Award	Sellers' valuation	Bidders' valuation	Difference	p-value
LA1	\$8.44	\$6.51	\$1.93	0.021
LA2	\$11.63	\$6.90	\$4.73	0.000
USB	\$16.52	\$8.58	\$7.94	0.000
TA	\$13.83	\$8.18	\$5.65	0.002

As Table II shows, sellers' valuations are significantly higher than bidders' valuations for all awards. The difference in average sellers' and bidders' valuations varies from 30% (for lottery award LA1) to 90% (for merchandise award USB).[4] 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. They do, however, 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 become emotionally attached to lotteries and experience losses when they have to sell them, even though they experience no endowment effect toward the money per se.

Table III: Endowment Effect in Bidders' Behavior

	Average bidders' valuation (excluding bidders with the highest valuation)			
Award	**English auctions**	**Second-price sealed-bid auctions**	**Difference**	**p-value**
USB	\$8.70	\$5.99	\$2.71	0.002
TA	\$7.23	\$5.95	\$1.38	0.049

To test the existence of the quasi-endowment effect for bidders in open-bid English auctions (Ariely and Simonson, 2003; Dodonova and Khoroshilov, 2005), we used the data from auctions 2 and 3 (English and second-price sealed-bid auctions) for items USB and TA. According to the quasi-endowment hypothesis, in the case when bidding starts from zero and all bidders

[4] 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 twice as high as buyers did.

understand the equivalence of English and second-price sealed-bid auctions, the bidders bid more aggressively in English auctions. Since the highest bidders' valuation in English auctions is unobservable, in order to make the bidding data compatible with bidding data for second-price sealed-bid auctions, we eliminated the highest bids for the second-price sealed-bid auctions. Table III presents the corresponding descriptive statistics. Consistent with the quasi-endowment hypothesis, Table III shows that bidders in English auctions bid more aggressively than in second-price sealed-bid auctions, i.e. on average a bidder in an English auction will bid more than she would bid for the same item in a second-price sealed-bid auction.

Table IV: Regret in Bidders' Behavior

	Final price			
Award	**Dutch auction**	**1st price sealed-bid auction**	**Difference**	**p-value**
BP	$9.59	$11.90	-$2.31	0.19

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 her 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 of the Dutch auction will never know how much money she could have saved if she had waited longer and bid at a lower price. Thus, the winner of a Dutch auction is not subject to the regret 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 compared final prices for these two auction designs for the BP award. The results of this comparison are presented in Table IV. 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, although the difference is insignificant.

4. Conclusion

This paper examines the implications of several well-established behavioral biases of bidders' and sellers' behavior in auctions. Consistent with the endowment effect of Kahneman and Tversky (1979) we show that sellers value their objects significantly higher than bidders. Consistent with Dodonova and Khoroshilov (2005), who argue that bidders in English auctions 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. We find no evidence in support of Engelbrecht-Wiggans's (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 should be lower than the final price in the Dutch auction.

References

Ariely D and I. Simonson (2003) "Buying, bidding, playing or competing? Value assessment and decision dynamics in online auctions" *Journal of Consumer Psychology* **13,** 113-123.

Bell, D. (1982) "Regret in Decision Making under Uncertainty" *Operations Research* **30**, 961-981.

Dodonova, A. and Y. Khoroshilov (2005) "English Auctions with Loss Averse Bidders" SSRN working paper number 922534.

Engelbrecht-Wiggans, R. (1989) "The Effect of Regret on Optimal Bidding in Auctions" *Management Scienc*e **33**, 685-692.

Heyman, J., Y. Orhun, and D. Ariely (2004) "Auction Fever: The Effects of Opponents and Quasi-Endowment on Product Valuations" *Journal of Interactive Marketing* **18**, 7-21.

Kahneman D., Knetsch, J., and R. Thaler (1990) "Experimental Tests of the Endowment Effect and the Coase Theorem" *Journal of Political Economy* **48**, 1325-1348.

Kahneman, D. and A. Tversky (1979) "Prospect Theory: an Analysis of Decision under Risk" *Econometrica* **47**, 263-291.

Kahneman, D. and A. Tversky (1984) "Choices, Values, and Frames" *American Psychologist* **39**, 341-350.

Kahneman, D. and A. Tversky (1991) "Loss Aversion in Riskless Choice: A Reference-Dependent Model" *Quarterly Journal of Economics* **106**, 1039-1061.

Kahneman, D. and A. Tversky (1992) "Advances in Prospect Theory: Cumulative Representation of Uncertainty" *Journal of Risk and Uncertainty* **5**, 297-323.

Knetsch, J. (1989) "The Endowment Effect and Evidence of Nonreversible Indifference Curves" *American Economic Review* **79**, 1277-1284.

Knetsch, J. and J. Sinden (1984) "Willingness to Pay and Compensation Demanded: Experimental Evidence of an Unexpected Disparity in Measures of Value" *Quarterly Journal of Economics* **49**, 507-521.

Loomes, G. and R. Sugden (1982) "Regret Theory: an Alternative Theory of Rational Choice under Uncertainty" *Economic Journal* **92**, 805-824.

Samuelson, W. and R. Zeckhauser (1988) "Status Quo Bias in Decision Making" *Journal of Risk and Uncertainty* **1**, 7-59.

Thaler, R. (1985) “Mental Accounting and Consumer Choice” *Marketing Science* **4**, 199-214.

Vickrey, W. (1961) “Counterspeculation, Auctions, and Competitive Sealed Tenders” *Journal of Finance* **16**, 8-37.