The Endowment Effect and Repeated Market Trials: Is the Vickrey Auction Demand Revealing?

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Abstract

The difference between people's valuations of gains and losses has been widely observed in both single trial and repeated trial experiments, as well as in survey responses and in commonplace behavior. However, the results of some Vickrey auction experiments indicate that the disparity may decrease, or even disappear, over repeated trials. This paper reports the results of two further repeated Vickrey auction experiments that test the impact of both a second price and a third price auction rule on valuations. Although valuations should be independent of this variation in the exchange price rule, the manipulation had a dramatic impact on subjects' stated values of a common market good. The results suggest that the endowment effect remains robust over repeated trials, and that contrary to common understanding, the Vickrey auction may elicit differing demands dependent on the context of the valuation.

Keywords: endowment effect, learning, Vickrey auctions

JEI Classification: C91, D44

The endowment effect and loss aversion have been among the most robust findings of the psychology of decision making. People commonly value losses much more than commensurate gains independent of transactions costs, income effects or wealth constraints (for example, Knetsch and Sinden, 1984; Kahneman et al., 1990; Boyce et al., 1992; Kachelmeier and Shehata, 1992). In one of a series of experimental demonstrations of the disparity, half the subjects were given embossed coffee mugs and then participated in repeated markets where those endowed with a mug could sell their mug and those without a mug could buy one (Kahneman et al., 1990). Consistent with findings from

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other studies, the mug owners announced minimum selling prices that were about twice as high as the minimum buying prices of those without mugs. The results cannot be explained by transactions costs or wealth effects (which were tiny, and eliminated altogether in other experiments) and the disparity did not diminish over numerous repeated market iterations.

In contrast to these robust findings, two studies have found that if values are elicited using the Vickrey auction the disparity between buying and selling values disappears with repetition (Harless, 1989; Shogren et al., 1994). This finding suggests two possible interpretations: (1) the endowment effect is eliminated under “appropriate” market settings and is, therefore, less important to economics; or (2) there is something very wrong with the demand revealing properties of the Vickrey auction. The evidence reported here supports the second alternative.

While the Vickrey auction is widely understood to have “the remarkable property that each bidder should announce his true willingness to pay for the auctioned object as a dominant strategy”, (Laffont, 1987, p. 170), there may be many circumstances where the incentives to reveal one’s true preferences are rather weak. Consider the following example. Suppose as one of 10 subjects in an experiment, you have been given a coffee mug and are told that one of the mugs will be purchased back by the experimenter using a Vickrey procedure in which the price paid will be the second lowest price asked. This auction will be repeated several times, with one of the trials selected at random to “count”. You are not sure what price to ask for, but you may anticipate that with only one mug to be sold that the going price may be quite low. After some thought you write down a selling price of $5.00 for the first market round. After the experimenter announces the second lowest bid was $0.50, you realize two things: first, you are rather far away from being the marginal trader so the chance that your bid will be relevant is quite small and, second, others like the mug a lot less than you do. For a variety of reasons (confused notions of strategy, perceived peer pressure, anchoring, etc.), you may reduce your bid in the second round. Furthermore, as the market trials continue, this tendency will become stronger since you will become more confident of your intra-marginal status and more tempted to make your bid more like that of your peers.

Based on this intuition, we conjecture that prices offered by participants over repeated rounds may be somewhat context dependent. Anticipated prices of others may influence initial bids and offers, and subsequent prices may be drawn toward prices announced by the auctioneer in successive rounds and away from the participant’s “true valuation”, if such a thing exists.¹ This conjecture is in stark contrast to the hypothesis that repeated trials provide the discipline to help subjects learn their true valuations through interactions with the market (Shogren et al., 1994).

We conducted two experiments to discriminate between these two hypotheses. The test is simple: whether or not a manipulation of the number of mugs being traded will affect the prices at which subjects are willing to trade. In one version ten mug owners were told that one mug will be sold at the second lowest price, while in the other version the ten owners were told that eight mugs will be sold at the ninth lowest price (with groups of potential buyers given comparable instructions). If subjects do indeed learn their correct values by participating in successive market rounds in such experiments then the median offers to sell, or buy, will be the same in the two versions of the experiment. However, if valuations
are influenced by anticipated prices, by desires to conform to what others are doing, by anchoring, by other variations of context, or, as Davis and Holt suggest, by strategies they develop because "the consequences of deviations from a value-revealing bid depend on conjectures about the bids of others" (1993, p. 279), then differences between the bids and offers in the second and ninth price versions may be observed.

**Experiment one**

The first test of the extent to which the Vickrey auction reveals true values was a between-subject comparison in which different individuals took part in the second and ninth price versions of the auction. In the usual second price auction, the buyer willing to pay the most for the good buys it at the price of the second highest bid; and the seller willing to sell at the lowest price sells it at the second lowest offer price. This is the auction used by Shogren et al. (1994), and the design of the first version of the auction, replicates their procedures in nearly all details.

The second version of the Vickrey auction was identical to the first except that it was a ninth price rather than a second price auction. Instead of having one good—a mug—exchanged in each auction, eight were exchanged. Specifically, mugs were bought by eight individuals in each group of ten buyers at the ninth highest bid price; and eight mugs were sold by eight of the ten sellers at the ninth lowest offer price.

If the Vickrey auction is truly demand, or value, revealing, then the manipulation between the second and ninth price versions should have no effect on the bids and offer prices made by the participants. (Of course, the market clearing prices in the two auctions will be very different.) If the subjects are simply learning their true, and invariant, values by interacting in the auction mechanism, then they should do so equally well in either the second or ninth price version.

Eighty participants were recruited among students throughout the Simon Fraser University campus. They participated in eight groups of ten individuals each, with two groups of ten buyers and two groups of ten sellers for the second price version of the Vickrey auction and two groups of ten buyers and two groups of ten sellers for the ninth price version of the auction. The auction took place during eight periods scheduled over two consecutive days.

Each participant was paid $10 (Canadian) for taking part, and sellers and buyers were told, in written and oral instructions, that their "take home income will consist of your initial income ($10) plus [less] the value of any good you sell [buy]". Each subject was given an identification number in the written instructions, which they used for all of their subsequent written bids and offers. After reviewing the general instructions, each participant in the four groups of potential sellers was given an embossed SFU coffee mug—comparable mugs were available in the University bookstore for $7.95—and mugs were passed among and examined by each participant in the four groups of potential buyers. Specific instructions on the conduct of the market, with two questions to test understanding of the procedures, were then handed to everyone and reviewed by the monitor.

Six successive rounds of each auction were conducted. The binding round, which determined the terms of the actual transactions, was selected at random after completion of
a total of 18 auction rounds that included two further manipulations of the market rules (which were of no consequence to the present test). Bids and offers were obtained from the open-ended question: “What is the highest [lowest] price you agree to pay [accept] to buy a [sell your] mug?”. Subjects were told “any price from 0$ to $14 will be considered”. The price at which exchanges would take place—the second or ninth highest price for buyers, and the second or ninth lowest price for sellers—was announced and posted at the front of the room after each trial round of the auction. The binding trial was selected after the last one was completed, and exchanges and payments were made accordingly.

The major results of the experiment show (Tables 1 and 2, and figure 1) very large differences in the bids and offers in the two versions of the Vickrey auction. The second

<table>
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<th>3</th>
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<td>7.45</td>
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<td>6.03</td>
<td>6.72</td>
<td>10.75</td>
<td>3.39</td>
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price version produced results (Table 1) that were quite similar to those reported by Shogren et al. (1994). The buyers apparently anticipated that with one mug to be purchased, it would go to an individual willing to pay a relatively high price and they therefore tended to bid relatively high prices themselves. As subsequent prices were announced after each trial, these perceptions were reinforced and most individuals made increasing bids over time bringing about a generally increasing trend to these prices.

The sellers behaved in a symmetric fashion. Knowing that only one mug would be sold they appeared to expect a relatively low offer to set the price and named their offers accordingly, for reasons analogous to those of potential buyers. There was also a drift down in asking prices over the repeated trials.

The combination of factors just described produces the same pattern of results as observed by Shogren et al. (1994). The ratio of the mean WTA to mean WTP begins just above unity (1.29) in the first trial and by the fourth actually falls below unity (with a similar configuration in the ratio of median values). The similarity in valuations is further indicated by the lack of statistical significance between the WTA and WTP values in even the first trial when the absolute differences were the largest (the two-tail t value is −1.68).4

The ninth price auction produced dramatically different results (Table 2). Buyers apparently expected that with eight out of the ten participants buying a mug at the ninth highest price (next to the lowest price bid), the price would likely be relatively low. For analogous reasons, sellers likely assumed that with eight mugs to be sold at the next to the highest offer the exchange price would therefore be relatively high and submitted offers with this
in mind. This combination of factors yielded average asking prices that were much higher than average buying prices and instead of convergence over time, the bids and asks diverged even further over the six trials.

The disparity between the mean WTA and the mean WTP was 2.35 in the first trial and grew to 7.45 by the sixth trial, with the median values showing even greater disparities. The two-tail $t$ value for the first round was $-4.66$, indicating a highly significant difference. The result of the ninth price auctions was very much the opposite of the one from the second price auctions.

To summarize, the convergence in WTP and WTA values with repetition, as observed by Shogren et al., appears to be attributable to the Vickrey auction second price mechanism that they employed. When a theoretically equivalent 9th price auction is used, the WTA and WTP values diverge. We conclude that participants were not learning to value the good over the repeated auctions, nor were the results consistent with participants receiving mainly "meaningful feedback from an endogenous market price that provides the opportunity to learn from market experience" (Shogren and Hayes, 1997, p. 243). They seemed instead to be responding to strategic motivations, quite apart from valuations, and to context influences that were induced by this auction design.

**Experiment two**

Experiment One used a between-subjects design in which the behavior of the participants in the second price auction were compared to those in the ninth price auction. Experiment Two replicates this result using a within-subjects design in which the same participants named both a second and a ninth price in each round. The participants were recruited in economics classes at the National University of Singapore (NUS).

Four groups of ten participants each took part in this experiment, two of the groups were potential buyers of a mug and two groups were potential sellers of their mug. As in the first experiment, each potential seller was given a NUS mug. (Comparable mugs were available in the University bookstore for S$3.09). A mug was also passed among the potential buyers to acquaint them with its characteristics. The participants were led through instructions and examples in which everyone was required to correctly answer questions testing their understanding of the procedures. Unlike the first experiment, the subjects were not paid a fee to show up for the experiment, but all transactions were real. Also, no upper limit was set on amounts of the bids and offers. Six rounds of the auctions were conducted, one being selected randomly at the end to be the basis of the real exchanges.

Participants were told their bids and offers for each auction "should be based on how much you are willing to pay for a mug [accept to give up your mug]". After completing instructions concerning the six repetitions and random selection of the round for which actual exchanges would be made, potential buyers were then told:

"For each round, the auction will be conducted in one of two ways.

1. One rule is that only the person bidding the highest price will buy an NUS mug, but this person will pay the second highest price bid."
(2) The other rule is that the 8 people bidding the highest 8 prices will buy an NUS mug, but all 8 will pay the 9th highest price bid.

The rule that "counts" will be determined later by a random flip of a coin. Therefore, you will need to make two bids in each round, the prices you are willing to pay for each rule—these can be the same or different.”

Potential sellers were given analogous instructions.

Again, if the Vickrey auction motivates people to accurately reveal their valuations and to learn from the active market feedback provided, there should then be no difference in the bids and offers for a second and ninth price auction. Buyers and sellers should indicate their same true valuations of a mug regardless of the price rule. However, very few subjects submitted identical bids in any round. Apparently, they viewed the two price rules as calling for different bid and offer strategies. Only one of the forty individuals taking part in the experiment consistently used the same price for both auction price rules, and just six used the same price for three or more of the six rounds. Of the 240 pairs of bids and pairs of offers made over the six trials by the forty subjects, only 38 (15.8 percent) were the same. The auction rules did not induce a single, consistent, and presumably truthful, valuation as much as they apparently motivated strategic behavior or prompted valuations that differed with the different contexts of a second or ninth price auction.

The results of the experiment are shown in Table 3 and figure 2. Even though the same person was making two bids to buy or two offers to sell in the two auction regimes, the valuations varied greatly over the repeated trials depending on whether a second or a ninth price bids and offers would determine the actual price.

The second price WTP valuations fall modestly over the repetitious, going from a median of SS$3.00 in the first round to SS$2.60 in the last. The ninth price WTP values decrease from an initial median of SS$2.00 to SS$1.00. The valuations over the trials were quite different for WTA values. The second price WTA values decreased a bit more than the second price WTP values, going from a median of SS$3.40 to SS$2.00; but the ninth price values not only started higher but increased, and substantially so, from an initial SS$5.00 to a final SS$12.50.

The consequence of the different evaluations is a very different pattern of differences between WTA and WTP valuations over repeated trials. The apparent valuations of subjects buying a mug and those selling a mug using a second price Vickrey auction were very similar to those in Experiment One and those reported by Shogren et al. (1994). The mean and median sell prices (WTA) slightly exceeds the mean and median buy prices (WTP) in the initial round, but there is convergence, and even reversals in the case of medians, of valuations over the remaining five rounds. The lack of a significant difference between the WTA and WTP values is further indicated by t value of only 1.45 for even the first round valuations which exhibited the largest disparities.

In the ninth price auction, in contrast, these same individuals buying a mug indicated a maximum willingness to pay that was much less than the minimum compensation those subjects selling a mug demanded to give up their mug. This was the case even in the first round, in which the difference was large and significant—a t-value of 5.14. Further, the ratios of both the mean and median WTA and WTP prices increased very substantially over
Table 3. Experiment two: Mean and Median WTP and WTA values for second and ninth price Vickrey auction.

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</table>

\(^a\) Result of replacing $500 offer of one subject in two trials with mean of subject’s offers in other rounds—see text note.

the six trials, going from about 2.4 in the initial round to around 12 in the last trial. Again, we see that we can obtain either divergence or convergence of WTP and WTA depending on which version of the Vickrey auction is used.

**Conclusions**

Rather than showing that the buying-selling disparity disappears when subjects engage in repeated markets, the results of the second and ninth price manipulation of a Vickrey
auction suggest instead that this auction fails to produce a consistent revelation of values. It appears that the values subjects announce in a Vickrey auction depend greatly on the rules being used. Furthermore, repeating the auction may well make things worse as participants may adjust their bids and asks to the behavior of the other participants in the auction. This behavior is observed even though the items being traded, coffee mugs, are commonplace, so we would not expect participants to learn much about the "true" value of the item from the behavior of others (as opposed to the bidding on a rare painting, for example.)

Contrary to common understanding, a Vickrey auction may not be demand or value revealing, and changes in valuations over repeated trials may have more to do with (possibly misguided) strategic concerns or the context of the valuations than with more accurate expressions of a single value arising from market feedback. Consequently, findings that WTA and WTP values converge over repeated Vickrey auction trials may largely be artifacts of the particular assessments. The disparity between gain and loss values may well be robust over repeated trials as demonstrated by experiments using other designs (e.g., Kahneman et al., 1990). This is consistent with the finding, "...that while a WTA/WTP disparity exists in the first trial for both auctions, the gap closed quickly in the Vickrey auction, but remained in the BDM² auction" (Shogren and Hayes, 1994, p. 242).
Appendix

Instructions for experiment one

General instructions (Equivalent wording for buyers)
You are about to participate in an experiment in the economics of market decision making. The instructions are simple; please follow them carefully.
You will receive $10 for participating in this experiment. Your take home income will consist of your initial income ($10) plus the value of any good you sell.
You will be asked to decide the lowest price you are willing to accept to sell a SFU Mug. You will submit your selling price on a recording sheet. Do not reveal your selling price to any other participant.
Please pay attention at all times to the monitors and do not hesitate to ask any question about the instructions.
Your identification number, which must be written on each recording sheet, is: ID#

Specific instructions for sellers (Equivalent wording for second price sellers and for ninth and second price buyers)

1. You now have, and own, the SFU mug in front of you which you can keep and take home. You also have the option of selling it and receiving money for it.
2. There will be repeated rounds, or trials, of a “market”. In each trial you will write the lowest price you are willing to accept to sell the mug on a recording sheet. One trial will be randomly selected and all transactions will actually take place at the selling prices recorded for that trial. Any price from $0 to $14 will be considered in determining whether or not you will sell your mug.
3. After you have finished filling out the form for each trial, the monitor will collect the sheets from all participants. For the first six trials, the eight potential sellers offering a mug for eight lowest prices will sell their mugs at the ninth lowest price offered (the second highest price). This price will be displayed at the front of the room and the identification numbers of the eight sellers will be announced.
Note: For example, if the eight lowest offer was $A and the ninth lowest offer was $B, the 8 lowest offerers would receive $B in exchange for their mugs.
4. After six trials a change in the market rules will be announced.
5. Only one trial will be binding. After all trials are completed, a number will be randomly selected to determine which trial is binding. If one of these first six trials is selected, the lowest 8 offerers for that trial will actually sell their mugs and each will receive the displayed price for that trial.
Note: - It is in your best interest to indicate your true willingness to accept in each trial.
    - In the event that there is a tie for the lowest price, the sellers will be determined by a random draw.

Questions. Please answer the following questions, which are designed to help you understand the procedures in the experiment.
1. If a person A has one of the eight lowest offers in the first trial, person B has one of the lowest offers in the fifth trial, and the fifth trial is selected as the binding trial, who will sell a mug? 

2. If your $X offer is the eighth lowest in the fifth trial and the ninth lowest offer is $Y, what is the price you will receive for your mug? 

Recording sheet for sellers  (Equivalent wording for buyers)

ID#: 
Trial #: 
What is the lowest price you agree to accept to sell your mug? $ 

Instructions for experiment two

(Equivalent wording for buyers, with offer of credit availability)

There are no right or wrong answers or any “approved” behaviour—we want you to act just as you would in any common everyday situation.

This exercise consists of a series of 6 “auctions” in which you will be given the opportunity to sell a NUS mug (which will be given to you). All exchanges will be real, and not hypothetical; that is, you will actually exchange real goods for money.

Your bids in each auction should be based on how much you are willing to accept to give up your mug. After all 6 of the repeated auctions have been completed, one auction will be selected at random as being the one that “counts”. Real exchanges of mugs and money will be based on what prices you and others offer in that particular round.

For each round, the auction will be conducted in one of two ways. The way that “counts” will be determined later by a random flip of a coin.

(1) One rule is that only the person offering to sell a NUS mug at the lowest price will sell a mug, but this person will receive the second lowest price offered.
(2) The other rule is that the 8 people offering the lowest 8 prices to sell their NUS mug, but all 8 will receive the 9th lowest price offered.

The rule that “counts” will be determined later by a random flip of a coin. Therefore, you will need to make two offers in each round, the prices you are willing to accept for each rule—these can be the same or different.

The following example, of offering to sell a mobile phone, illustrates how these rules work.

Assume the 10 prices offered for the case of one seller, arranged in order from the lowest up, are:

$801, $810, $814, $823, $853, $855, $876.50, $879, $888, $899

Assume the 10 prices offered for the case of 8 sellers, arranged in order from the lowest up, are:

$802, $814, $833, $855, $863, $870, $875.50, $882, $888, $901
If the one seller auction is randomly selected as the rule that “counts”, then the person offering to accept $801 would sell the phone, not at $801, but at $810, the second lowest price offered.

If the 8 seller auction is randomly selected as the rule that “counts”, the 8 people offering to accept the 8 lowest prices will each sell a phone and each will receive, not the price they offered, but $888, the 9th lowest price offered.

In order to help you better understand the rules, please answer the following questions. Suppose you are in an auction for pagers with the same rules as above.

The 10 offers for the round that “counts”, using the rule that only one individual will sell a pager at the second lowest price offered, are:

$17, $18, $20, $21, $22.50, $24, $24.25, $25, $29, $33

The 10 offers for the rule that 8 individuals will sell a pager at the 9th lowest price offered are:

$16, $17, $20, $21, $22, $23, $24, $29, $30, $32

(1) What will be the price received by the 8 successful sellers if the 8 seller rule is chosen as the one that “counts”? $________

(2) What will be the price received by the one person who sells a pager if the one seller rule is chosen as the one that “counts”? $________

**Recording sheet for sellers** (Equivalent wording for buyers)

Your Auction ID#: __________

<table>
<thead>
<tr>
<th>Round</th>
<th>My Offer Price for One Seller Rule</th>
<th>My Offer Price for 8 Seller Rule</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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</table>

**Notes**

1. There is a growing consensus in psychology that people do not have well-formed valuations but rather construct preferences on the fly when asked questions. One bit of evidence for this view is the so-called preference reversal phenomenon, wherein subjects announce that they prefer A to B but announce a higher selling price for B than for A. See, for example, Tversky and Thaler (1990).

2. The ninth price auction is “Another interesting case [that] occurs where there is more than one identical object to be sold, but each bidder has use for at most one.” Vickrey (1961, p. 24).

3. The $14 ceiling did not prove to be a binding constraint, as no bids or offers of $14 were made by any of the participants in any of the six rounds.
4. Similar t values for subsequent rounds provide less of a test because of the lack of independence due to the positive relationship between people's bids and offers and those they made in previous rounds. However, these other t values are even smaller except for the 1.93 for round 5 in which the WTP values exceeded the WTA values by substantial amounts. The Mann-Whitney U values revealed a similar pattern.

5. The t values for subsequent rounds, while again a weaker test due to the lack of independence of individual's bids and offers in subsequent rounds, were even larger, and the t value for all of the repeated auctions was −8.38; and the Mann-Whitney U values indicated similar significance levels.

6. The first extensive application of this "dual market technique" was reported in Smith (1980).

7. The t values for subsequent rounds showed the same decreasing pattern as those for the first experiment, but these are also subject to the limitations posed by the lack of independence as noted above (See footnote 4).

8. One subject submitted what appears to be a speculative or strategic offer to sell at a minimum of $5100 in rounds 3 and 4, while asking around $510 in the other rounds. The average price of the same subject in the other rounds (in all rounds except the outliers) were used to replace the outlier data points. The outcome of this filtering, or smoothing, of these results in calculations of the means, standard deviations, and ratio of means, are reported in Table 3.

9. This is a random price Becker-DeGroot-Marschak auction (Becker et al., 1964).

References


