CHAPTER FOUR

Repeated Procurement Auctions

4.1 Introduction

Research on optimal procurement auction design is becoming more important as governments increasingly rely on competitive tenders to procure goods and services from private parties (Rendon 2008). Examples include highway contracting (Stark 1974), pipeline construction (Diekmann et al. 1982), procurement of arms and defense systems (Dasgupta and Spulber 1990, Che 1993), utility contracting (Wolfram 1998, Borenstein et al. 2002) and school milk delivery (Pesendorfer 2000). Procurement auctions are also used to increase the private provision of environmental goods and services (cf. Latacz-Lohmann and Schilizzi 2005, Ferraro 2008, Narloch et al. 2013, Pant 2014) and are receiving ever-increasing attention in policy circles. The European Union intends to rely more on procurement auctions to achieve its environmental objectives (Cooper et al. 2009), while auctioning of nature conservation contracts is common in countries like the United States (Kirwan et al. 2005, Selman et al. 2008), Canada (Brown et al. 2011) and Australia (Rolfe et al. 2009). Agri-environmental contracts targeted at stimulating the provision of nature conservation on private lands are typically of finite duration, implying that auctions need to be implemented repeatedly, allowing farmers to strategically condition their bids on past realizations such as the (distribution of) bids put in by other farmers in a previous auction, and/or the maximum bid that was accepted by the government (Latacz-Lohmann and Schilizzi 2005). Hence, if repetition makes discriminatory price procurement auctions more costly for the conservation agency, the policy advice would be to increase contract length (possibly to perpetuity), but if repetition increases market efficiency, conservation contracts can be procured in (more) stages more often than has been suggested before (cf. Latacz-Lohmann and van der Hamsvoort 1998, Latacz-Lohmann and Schilizzi 2005).

In discriminatory price procurement auctions for nature conservation, landowners submit their bids (or asks), and if their bid is accepted, they receive their bid amount in exchange for supplying environmental goods or services. In principle, discriminatory price auctions allow an auctioneer (e.g. a conservation agency) to purchase a specific amount of goods and services at lower expense than, for example, uniform price auctions, where sellers receive a predetermined strike price if their bid is lower than that strike...
Yet the realized cost savings tend to vary with factors like the number of auction participants and whether auctions are one-shot or repeated (Cason et al. 2003, Stoneham et al. 2003, Cummings et al. 2004, Hailu and Schilizzi 2004, Schilizzi and Latacz-Lohmann 2007). Independent of the acceptance rule used in the auction’s design (accept the $n$ lowest bids, or accept all bids below the auctioneer’s reservation price), participants in a discriminatory price procurement auction have an incentive to ask an amount that is higher than their true valuation, and the extent to which they shade their bids is larger the easier it is for them to collude – for example, if there are few bidders or if the auction is repeated (cf. Latacz-Lohmann and van der Hamsvoort 1998, Latacz-Lohmann and Schilizzi 2005).

In this chapter, we contribute to the literature on procurement auctions (or reverse auctions) by explicitly testing, using an economic laboratory experiment, whether repetition renders these auctions more or less efficient for the auctioneer. Repetition fosters collusion in standard (i.e., one seller, multiple buyers) auctions (Riley and Samuelson 1981, Ashenfelter 1989, Ashenfelter and Genesove 1992, McAfee and Vincent 1993, Phillips et al. 2003), but we hypothesize that repetition is less harmful in procurement auctions. Mathematically, standard and procurement auctions are mirror images (McAfee and McMillan 1987), but prospect theory suggests that there may be important behavioral differences between the two auction types. As is well documented by now, people tend to value objects differently depending on whether they own the object, or not (Kahneman and Tversky 1979, Thaler 1980, Kahneman et al. 1990, 1991, Tversky and Kahneman 1991). According to a survey by Horowitz and McConnell (2002), when given the option to receive a good, participants’ median valuation of that good tends to be less than 40% of the median valuation when they own the good.

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60. Bidding one’s true opportunity cost is a dominant strategy in uniform price procurement auctions while it is optimal to bid an amount higher than one’s true costs in discriminatory price auctions. Yet the rents received by the low-opportunity cost sellers are typically lower in the discriminatory price auctions than in the uniform price ones, and hence the latter typically allows the auctioneer to pay less for a specific amount of goods or services procured (or, alternatively stated, has a higher market efficiency) than when uniform price auctions are employed.

61. Endowment effect theory is one popular explanation for such observed asymmetry in valuations in experimental studies. The term “endowment effect theory” was proposed by Plott and Zeiler (2007) to separate the observation of asymmetry in valuations from the explanation offered by the endowment effect. When we refer to the endowment effect in this chapter, we have the former observation of asymmetry in valuations in mind. For theoretical papers on the role of reference-dependent preferences in auctions (i.e. the explanation), see Filiz-Ozbay and Ozbay (2007), Lange and Ratan (2010), and Rosenkranz and Schmitz (2007).
good, and recent studies have suggested that reference-dependent preferences such as the ‘status quo bias’ (or the endowment effect) are plausible explanations for why participation in procurement auctions is typically lower than expected (cf. Brown et al. 2011, DePiper et al. 2013). Yet, the experimental economics literature also finds that differences in valuation decrease with experience (see for example Shogren et al. 1994, List 2003 – but see also Isoni et al. 2011). Thus, while strategic considerations potentially cause asks to increase over rounds in repeated procurement auctions, the attenuation of the endowment effect potentially causes asks to decrease over time. As a result, if the attenuation of the endowment effect dominates in the initial rounds of repeated procurement auctions, these auctions may have higher market efficiency than has been suggested before.\footnote{Most of the research on the endowment effect is experimental in nature, and one concern may be that the difference in valuation is due to subjects’ misconceptions about the experimental procedures rather than a real phenomenon. Plott and Zeiler (2005) argue that when subjects have perfect understanding of the method used, the endowment effect does not exist. Indeed they find that with subjects receiving proper instructions and training, and after having answered a series of (paid) lottery valuation questions, there is no longer a difference in the valuation of coffee mugs between buyers and sellers. In their replication of Plott and Zeiler’s results, Isoni et al. (2011) also do not find an endowment effect for coffee mugs, but they do observe that valuations in willingness-to-accept (WTA) lotteries are systematically higher than in corresponding willingness-to-pay (WTP) lotteries – and more so than the differences in expected value between these auctions would suggest. Because the WTP-WTA gap remains present even in the last rounds of the lottery treatment, Isoni et al. conclude that the endowment effect is more likely item-specific (mugs or lotteries) than that it is due to misconceptions – as these should have disappeared in the later rounds of the lottery treatment as well. Recently, Cason and Plott (2014) fired up the discussion again by finding that misconceptions in the BDM method persist even after participants are given the chance to learn from their mistakes. They thus reiterate the warning made by Plott and Zeiler that researchers can be misled into believing that they find proof for non-standard theories of preferences such as the endowment effect, while they are essentially looking at misinformed choices. In our experimental setting, participants make repeated choices in the treatments they are allocated to. Mistakes and misunderstandings are likely to affect results in each of the three treatments we implement, but there is no a priori reason to expect that one treatment is more prone to such errors and mistakes than others – the levels in the treatment may thus be affected, but not the treatment differences (see Footnote 68).}

We test whether discriminatory price procurement auctions become more or less costly with repetition by running an economic experiment in which student subjects are endowed with an item, a ‘high-end thermos coffee mug’, upon which we invite them to submit their asks in a discriminatory price procurement auction. We implement the experiment as follows.
At the beginning of the discriminatory price auctions, subjects are given a coffee mug. Next, they are matched in groups of seven, they submit their asks, and the four lowest asks in each group are accepted. Subjects are given only one mug, but the auction is repeated ten times – subjects are informed that from the ten auctions they participate in, one will be randomly selected to be implemented. If the amount they bid was among the lowest four in their group, they have to hand in their mug and are paid their bid; if not, they keep their mug. We conjecture that bids may continuously decrease, increase or be a U-shaped function of the rounds played depending on whether the attenuation of the endowment effect dominates the strategic effect in all rounds, in no round, or only in the first few rounds. We choose to resort to experimental tests for two reasons. First, developing theory on repeated procurement auctions has proven to be difficult, especially because repetition typically gives rise to a multiplicity of equilibria (Hailu and Thoyer 2006, Schilizzi and Latacz-Lohmann 2007; see also McAfee and McMillan 1987, Bernhardt and Scoones 1994, Klemperer 1999). Second, to date, there is no (generally accepted) theory of the endowment effect yet (Isoni et al. 2011).

The experimental results of this chapter show that average asks in the discriminatory price auction continue to fall over time – albeit more so in the early rounds (see also Shogren et al. 2000 and Lusk et al. 2004). In particular, we do not find evidence for an increase in average asks in later rounds – not even so if we use econometric techniques to extrapolate the bid path and predict bids for an additional ten rounds of auctioning. We disentangle the impacts of the strategic effect and of the endowment effect by implementing three treatments – using a between-subject experimental design. In line with Kahneman et al. (1990), we find that the endowment effect has a significant impact on bidding behavior, and we also find that the endowment effect becomes less important with repetition. Interestingly, and in contrast to the outcomes of, for instance, Cason et al.’s (2003) one-seller-multiple-buyers auctions, we do not find the typical result of strategic behavior causing average asks to increase over the auction rounds. On the contrary, the attenuation of the endowment effect goes hand in hand with an increase in the subjects’ competitive behavior and thus reduces the possibilities for collusion.

The insights obtained in this chapter are just a first step in the analysis on the efficiency of repeated auctioning and not the final answer. While
laboratory experiments using student subjects are not suited to make point
predictions about real-world behavior, the comparative statics obtained tend
to generalize to domains outside the laboratory (cf. Levitt and List 2007,
Fréchette 2011, Noussair and van Soest 2014, or see Camerer 2012 for an
overview). As such, our results using student subjects can inform policy
makers about the expected costs of increasing or decreasing the frequency
with which nature conservation auctions are organized (that is, increasing or
decreasing the length of the procurement contracts) prior to setting up
(expensive) pilot studies in the field. If repetition makes procurement
auctions more costly for the conservation agency, the policy advice would be
to increase contract length (possibly to perpetuity). However, our results
show that repetition increases market efficiency, and thus, conservation
contracts can be procured in (more) stages more often than has been
suggested before (cf. Latacz-Lohmann and van der Hamsvoort 1998, Latacz-
Lohmann and Schilizzi 2005).

4.2 Experimental design

The key treatment of our experimental design is a discriminatory price
procurement auction, in which we buy back coffee mugs that student
subjects received at the beginning of the experimental session. After having
been seated (randomly) at a computer cubicle, each participant was handed
a high-end thermos coffee mug in its original packaging. The mug was made
of aluminum and it carried the university logo. It used to be sold at Tilburg
University’s Gift Shop for €12.95 a piece, but at the time of the experiment,
its production had been discontinued. Hence, participants who left the
experiment with a mug could not return it to the Gift Shop in exchange for

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63 At this point, one could argue that farmers are not always asked to part with their land when
considering participation in nature conservation programs, and therefore, farmers’ sentiments
cannot always be interpreted as an ‘endowment effect’ barrier to participation. However, these
programs typically feature irreversible dedication of acreage to nature and the adaptation of
time consuming managerial practices (cf. Vogt and Bizer 2013). For instance, Westerink et al.
(2013) describe the Dutch ‘Boeren voor Natuur’ program as a drastic change of practice for
participating farmers: 30 year contracts stipulate storm water retention, biodiversity and
recreational goals that significantly reduce primary production and require large investment to
dedicate acreage to nature. Furthermore, in their international meta-analyses on the attitudes of
farmers towards conservation programs, both Siebert et al. (2006) and Ahnström et al. (2009)
report that farmers fear the potential restrictions, bans and limitations that may be placed on
their lands when entering conservation contracts (e.g. due to biological surveys that designate
habitat of endangered species on their lands).
money. Participants were not informed of the mug’s retail price, but we did inform them that the mug was no longer on sale. After all participants received a package containing their mug, they were invited to open it and inspect its contents.

Next, subjects were informed that they would have the opportunity to sell the mug back to the experimenters by means of an auction. Subjects were matched in groups of 7, and were informed that the experimenters would buy back the mugs of the 4 subjects with the lowest asks, paying them the price they had submitted in the auction. The following script was shown on their computer screens: “My bid in the auction is €X. If my bid is among the 4 lowest bids in my group, I sell my mug for the price stated in my bid. Otherwise, I keep my mug”, and then they were asked to enter their bid X. Subjects could enter any value between €0.00 and €15.00 rounded to tens of euro cents. After all subjects had entered their bids, they were informed of (i) the bids of all 7 subjects in their group (ranked from highest to lowest), (ii) whether or not their bid was among the 4 lowest bids in their group, and (iii) whether their bid had been accepted, or not.

Subjects participated in ten auctions, while they only had one mug to keep, or sell. We solved this as follows. Before the start of the experiment, subjects were informed that, at the end of the session, the computer would randomly select one auction round, and that the outcome of that auction would be implemented. At the end of each of the ten auction rounds, subjects were shown a picture of the coffee mug on their screen with or without a large red cross through it – depending on whether their bid was accepted in that auction, or not. If their bid was among the 4 lowest bids in that auction, the picture with the crossed-out mug was accompanied by the following text: “Your bid has been ACCEPTED. If this auction is selected by

\[\text{64}\] The results of Knetsch et al. (2001) suggest that having few (many) bidders who are able to win the auction – i.e. using a low (high) \( n^{th}\) price – can lead to fierce competition to win the auction (coordination on prices). Based on their results we argued that 4 out of 7 bidders (i.e. more than half) being able to win the auction would be sufficient to detect strategic behavior. If we find strategic bidding with more than half of the bidders being able to win the auction, having even more bidders being able to win the auction will most likely lead to more strategic behavior. Furthermore, we decided not to add a chat box (that would facilitate explicit coordination) to this treatment to avoid confounding factors (e.g. due to threatening or inappropriate language), but also because it would require us to add it to the other treatments as well; which does not make sense since collusion is not possible in the other two treatments (by design).

\[\text{65}\] We announced that, in case of ties for the 4\(^{th}\) lowest asks, the computer would randomly decide whose bids would be accepted such that in total, four bids were accepted. We did not have to implement this procedure, though.
the computer at the end of the experiment, you sell your mug for [the amount you asked], and you have to hand it in.” If their bid was not among the 4 lowest bids in that auction, the picture of the mug was not crossed out, and the accompanying text was “Your bid has NOT been accepted. If this auction is selected by the computer at the end of the experiment, you take your mug home.” We chose this procedure because even though the mug remained on their desks throughout the experiment, participants would be aware that if the computer would select this round, the mug would be theirs (not theirs) if their bid was not accepted (accepted). In total, 42 students participated in this treatment, in 6 groups of 7 subjects; the group composition was kept constant throughout all ten rounds of the treatment.

In this treatment, bids can be influenced by several factors – the endowment effect, but also strategic bidding. In addition to the above treatment (which we will refer to as the Discriminatory Price (or D) treatment), we implemented two other treatments to isolate these two effects.

We isolate the strategic effect by means of a second treatment, the Uniform price Sellers (US) treatment. This treatment is identical to treatment D, except that in treatment US we buy back all mugs that are offered at a price below or equal to a specific strike price (that is unknown to the participants). If subjects ask a price that is higher than this strike price, they keep their mug; if it is (weakly) below, their bid is accepted. The strike price varied per round, was determined before the start of a session, and participants only learned its value for a specific round until after they submitted their asks in that round – and hence bidding one’s true value is a dominant strategy. The script on screen in treatment US reads as follows: “My bid in the auction is \( \text{€}X \). If my bid is lower than or equal to the predetermined price, I sell my mug for this predetermined price. Otherwise, I keep my mug”, and then they were asked to enter their bid \( X \).

Because we keep all other aspects of our between-subject auction design constant, including endowing subjects with coffee mugs, the size of the strategic effect is measured by comparing the average asks in the discriminatory price auction in D to those in the uniform price auction in US. To also keep price feedback equivalent between treatments (following Offerman and Potters 2006), we matched groups in the D and US treatments by using the values of the 4th price path in the ten rounds of a group in the D treatment as exogenous prices for the ten rounds of a matched group in the
US treatment. As was the case in the D treatment, 42 students participated in groups of seven in the US treatment, and hence we can base our statistical analysis on six matching pairs of groups that received identical price feedback.

To isolate the size of the endowment effect, we implement a third treatment, the Uniform price Choosers (UC) treatment. This treatment is identical to the US treatment, except that subjects were not given possession of the mugs. After subjects were seated at their cubicles, the experimenters passed around a mug for the participants to examine at their leisure. When the participants were done inspecting the mug, it was put on display at a central location in the computer lab, well visible to all participants. Participants were shown the following script on screen: “My bid in the auction is €X. If my bid is lower than or equal to the predetermined price, I receive this predetermined price. Otherwise, I receive a mug”, and then subjects could enter their bid X. As is the case in the US treatment, bidding one’s true valuation is the dominant strategy in treatment UC – but the (mean and median) valuations may still differ between the two treatments because subjects in the US treatment were endowed with the mug, while those in UC were not. We ensured that subjects did not feel ownership of the mug by keeping the available mugs, fully packaged, in the front of the laboratory; only one mug was exhibited in a prominent place in the laboratory for the students to see during the experiment. Subjects were informed that they would receive either the mug or the predetermined payment in a particular round if the computer would randomly select that auction round. Again, 42 students participated in the UC treatment in groups of seven, and to keep price feedback equivalent, the groups were matched with those in the D treatment (and the US treatment) by using the 4th prices (over ten rounds) in one group in the D treatment as predetermined prices for one group in the UC treatment.

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66 Note that there is no actual competition to win the auction in the UC (or US) treatment – bidders cannot undercut each other to win. Nevertheless, we used similar wording as in the D treatment in order to avoid a double confound between the treatments: the auction institution changes, but the auction framing (e.g., using terms such as “bid” and “auction”) is the same for all treatments.

67 Note that the method used in the UC treatment is in essence BDM’s choice list method (see Becker et al. 1964).
This completes the description of the three treatments. We would like to emphasize that all other experimental procedures were identical between the three types of sessions. That means that participation in the treatments was random, the instructions were handed out to the participants but they were also read out aloud by the experimenter (inviting the participants to read along), and all participants received a show-up fee of €5.

The experiment was implemented in Tilburg University’s CentERLab, and took place in May 2013. We ran two sessions of every treatment (three groups per session), resulting in 6 groups of 7 participants and thus a total of 42 participants per treatment. All 126 participants were students at Tilburg University with different nationalities and different academic backgrounds (economics, legal studies, management, social sciences), and were recruited using a mailing list. We were careful to ensure that individuals who participated in one treatment did not participate in another treatment. Each session lasted about 1 hour and 15 minutes. In each session, 21 participants were randomly matched in groups of seven for the ten auction rounds. We first performed two sessions of the D treatment in order to determine the strings of 4th prices – for each round and for each group – and used these as the predetermined prices for the groups in the US and UC treatments. The experiment was programmed and conducted with z-Tree software (Fischbacher 2007).

4.3 Experimental results

Tables 4.1 and 4.2 and Figure 4.1 present our main results. We find large differences in bidding behavior in the three treatments. As expected, Table 4.1 shows that bids, averaged over all subjects and over all ten rounds, were highest in the Discriminatory price treatment (D), and lowest in the Uniform Choosers treatment (UC). With respect to quantity, we find that on average

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68 Subjects also participated in a second treatment in every session, in which they were asked to submit their bids in an induced value token auction. Subjects were informed what amount of money they would receive if they would end up owning a virtual token (the induced value), and then they were asked to submit their bids using the same auction design (D, US, UC) as the main treatment they had participated in before this token treatment – the only difference being that now a virtual token was auctioned instead of a mug. Subjects were randomly reassigned into new groups at the beginning of the token treatment. Obviously, the prediction is that subjects would bid higher than their induced value in the D auction, but that they would bid their induced value in the other two auction treatments.

69 The experimental instructions for the D treatment are offered in Appendix 4.A.1. Instructions for the other treatments are available upon request.
one more mug was sold in the Uniform Sellers (US) treatment compared to exogenously imposed sales of 4 mugs in the D treatment, while on average more than two extra mugs were traded when participants could choose to receive a payment or a mug in the UC treatment. Using groups in different treatments with the same price path as matched pairs, Table 4.2 shows that the average bids in the D treatment were significantly different from bids in the UC treatment (at $p = 0.028$ according to the relevant Wilcoxon matched pairs test). Hence, we find evidence for a combined effect of competitive/strategic motivations and the endowment on bidding behavior. In particular, we find that competitive/strategic motivations are significant drivers (at the 10% level) of bidding behavior (D versus US), and that the endowment effect itself has a significant (10% level) impact on the willingness to accept to part with the mug (US versus UC).

**Table 4.1.** Descriptive statistics.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average bid</th>
<th>Average quantity (sold)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Discr. 4th price (D)</em></td>
<td>7.22</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>(0.82)</td>
<td>(-)</td>
</tr>
<tr>
<td><em>Uniform price sellers (US)</em></td>
<td>5.81</td>
<td>4.97</td>
</tr>
<tr>
<td></td>
<td>(0.54)</td>
<td>(1.34)</td>
</tr>
<tr>
<td><em>Uniform price choosers (UC)</em></td>
<td>3.25</td>
<td>6.25</td>
</tr>
<tr>
<td></td>
<td>(0.33)</td>
<td>(0.98)</td>
</tr>
</tbody>
</table>

42 subjects in each treatment; standard deviations are in parentheses.

**Table 4.2.** Competitive/strategic and endowment effect tests.

<table>
<thead>
<tr>
<th>Treatment comparison</th>
<th>Difference in average bids</th>
<th>Wilcoxon matched pairs test</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>D vs. US treatment</em></td>
<td>1.41</td>
<td>$p = 0.075$</td>
</tr>
<tr>
<td><em>D vs. UC treatment</em></td>
<td>3.97</td>
<td>$p = 0.028$</td>
</tr>
<tr>
<td><em>US vs. UC treatment</em></td>
<td>2.56</td>
<td>$p = 0.075$</td>
</tr>
</tbody>
</table>

The Wilcoxon matched pairs test is based on the null hypothesis that the distributions of the bids are the same for all matched groups (with the same price paths).
Figure 4.1. Average bids per treatment over time.

Figure 4.1 shows the average bids per treatment over time. Visual inspection of the bids in the D treatment shows no sign of bidders coordinating on higher bids in later rounds. This observation is confirmed by the statistical tests presented in Table 4.3. In this table we compare, for each of the three treatments, the average bids at the beginning of the auctions (Rounds 1 and 2) to those at the end (Rounds 9 and 10). We find that (the attenuation of) the endowment effect drives the results. Repetition causes average bids in the US treatment to fall over time, and the combined effect of strategic behavior and competitive motivations in the D treatment only strengthens this decrease in bids – as expected, the decrease in bids in the UC treatment between the first two and last two rounds fails to be significant at conventional significance levels.

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70 Observations at the group level also do not show bidders coordinating on higher bids in later round in the D treatment (but see the analysis of winning bids below). Bids tend to decrease (and converge) over time. There are two exceptions: in one group the average bid increases slightly in the first two rounds only to decrease again in later rounds, while in another group the average bid decreases but is increasing in the last two rounds. In the latter case, this is mainly due to one individual suddenly bidding 15 Euros in the last two rounds while bidding around 5 Euros in previous rounds.

71 Detailed bid information can be found in Appendix 4.A.2 where we offer the distributions of bids over time (by treatment).
### Table 4.3. Average bids of first two vs. last two rounds.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rounds 1 &amp; 2</th>
<th>Rounds 9 &amp; 10</th>
<th>Wilcoxon matched pairs test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discr. 4\textsuperscript{th} price (D)</td>
<td>8.52 (1.46)</td>
<td>6.40 (1.37)</td>
<td>$p = 0.028$</td>
</tr>
<tr>
<td>Uniform price sellers (US)</td>
<td>6.61 (2.03)</td>
<td>5.23 (2.61)</td>
<td>$p = 0.035$</td>
</tr>
<tr>
<td>Uniform price choosers (UC)</td>
<td>3.81 (1.77)</td>
<td>3.01 (0.83)</td>
<td>$p = 0.116$</td>
</tr>
</tbody>
</table>

Standard deviations are in parentheses. The Wilcoxon matched pairs test is based on the null hypothesis that the distributions of bids for Round 1 & 2 and 9 & 10 are the same for all matched groups (with the same price paths).

At the end of a session, subjects also participated in a one-shot auction using the same auction design (D, US, UC) as the main treatment they had participated in – the only difference being that now a ‘virtual token’ was auctioned instead of a mug (see Footnote 68). The purpose of this induced value auction was to check whether subjects understood the auctioning mechanism of the treatment they participated in. We find that, on average, the difference between a subject’s bid and her induced value was less than 10 points (from a range between 0 and 150 points) in the US and UC treatments, and only 2 of the 42 participants in the D treatment submitted a bid below their induced value. As a robustness check, we also calculated the numbers in Table 4.1 using the bids of only those subjects who were labeled as having made optimal decisions in the virtual token auction. ‘Optimal’ was defined as ‘the difference between one’s bid and one’s induced value is either zero or +1’ in the US and UC treatments, and as ‘one’s bid being strictly larger than one’s induced value’ in the D treatment. We find that the average bids of those who meet these definitions are 7.24, 5.27 and 3.68 in the D, US and UC treatments, respectively. The averages for these participants are thus not significantly different from those in the full sample in Table 4.1.\textsuperscript{72}

To study the development of bids in more detail, we run two regression models – one that estimates an asymptote for the bids and the convergence process towards that asymptote, and one that tests whether the relationship

\textsuperscript{72} Similar to Cason and Plott (2014) we thus find some evidence for misconception of a BDM method (in our UC treatment), but the number of participants that do not bid ‘optimal’ is not significantly different between the UC and US treatment (or ‘BDM + endowment’), and the average bids of ‘optimal’ bidders are also not significantly different from those that do not bid optimal (within treatments). Hence, if the number and the level of measurement errors are equal between these treatments, we can attribute the remaining difference in average bids to the endowment effect.
is U-shaped. The two competing model specifications are presented in equations (4.1) and (4.2).

\[
Bid_{it} = \beta_1 + \beta_2 \, t + \beta_3 \, t^2 + u_{it} \tag{4.1}
\]

\[
Bid_{it} = \beta_1' \frac{1}{t} + \beta_2' \frac{t - 1}{t} + u_{it} \tag{4.2}
\]

In these specifications, \(Bid_{it}\) is the amount asked by subject \(i\) in period \(t\), the \(\beta\)'s are the coefficients to be estimated, and \(u_{it}\) is the random error term distributed normally with mean zero. Model (4.1) is a standard regression model with a linear and a quadratic term, implying that the round with “maximum efficiency” (from the buyer's perspective) is equal to \(\bar{t} = -0.5\beta_2/\beta_3\) (if \(\beta_2 < 0\) and \(\beta_3 > 0\)). Model (4.2) is based on Noussair et al. (1995), and assumes that the bids converge to an asymptote equal to \(\beta_2'\) – note that model (4.2) does not have an intercept, and that the weight on \(\beta_1'\) (\(\beta_2'\)) is largest in the earlier (later) rounds. We use models (4.1) and (4.2) to estimate the pattern of bids in the D treatment using Generalized Least Squares (GLS) with residuals that are robust for subject specific AR(1)-processes and heteroskedasticity.\(^73\) Table 4.4 presents the results.

<table>
<thead>
<tr>
<th>Dependent variable: Bid</th>
<th>Quadratic (4.1)</th>
<th>Noussair et al. (4.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\beta_1, \beta_1')</td>
<td>9.03 ***</td>
<td>8.44 ***</td>
</tr>
<tr>
<td></td>
<td>(0.159)</td>
<td>(0.142)</td>
</tr>
<tr>
<td>(\beta_2, \beta_2')</td>
<td>-0.345 ***</td>
<td>6.59 ***</td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
<td>(0.0927)</td>
</tr>
<tr>
<td>(\beta_3)</td>
<td>0.00392</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.00483)</td>
<td></td>
</tr>
<tr>
<td>(N)</td>
<td>420</td>
<td>420</td>
</tr>
<tr>
<td>(\chi^2)</td>
<td>264.04</td>
<td>169.39</td>
</tr>
</tbody>
</table>

\(^{***}\) indicates significance at the 1% level. Standard errors are in parentheses.

Model (4.1) fails to provide support for bids to be a U-shaped function of the rounds played. Its quadratic specification implies that the 'number of

\(^73\) A Wooldridge test for autocorrelation in panel data rejects the null of no first-order autocorrelation in the residuals in both specifications. The likelihood ratio test for nested models rejects the null of no heteroskedasticity in the residuals – again for both specifications.
rounds with maximum efficiency’ is estimated to be way out of sample ($\bar{t} = 44$) – if anything, the regression model indicates that bids decrease linearly over rounds. Comparing the two models’ $\chi^2$ statistics, model (4.1) is the superior model, but it is still insightful to have a look at the coefficient estimates of model (4.2) as well. This model predicts that bids converge to a long-run level of about €6.60, with a rather high convergence rate in the earlier periods.

Using the fitted values of the models estimated in Table 4.4, we can predict the average bids in the discriminatory price sessions as if participants continued playing an additional ten rounds; see Figure 4.2.

**Figure 4.2.** Predicted and observed bids based on the models in Table 4.4.

In Figure 4.2, the observed average bids from the D treatment are displayed as squares connected by the solid line, the dashed line represents the fitted values of model (4.1), the dotted line represents the fitted values of model (4.2), and the asymptote of (4.2) is depicted by the solid horizontal line. This figure reveals why the quadratic model has a better fit than the model by Noussair *et al.* (1995). Observed average bids fall almost linearly over the first 8 periods before they plateau in the last two rounds. Competition among bidders and an attenuating endowment effect are thus
found to have had the upper hand in reducing bids over time in our experiment.  

Finally, let us focus our attention on accepted bids – those cases in which the mug was sold (D and US treatment) or a payment was received (UC treatment). Figure 4.3 shows the average accepted bids per treatment over time. Visual inspection of the accepted bids in the D treatment shows some sign of bidders coordinating on higher bids in the initial rounds, but also here we find that competition to become (or to remain) one of the sellers combined with an attenuating endowment effect makes strategic behavior unsustainable.

**Figure 4.3.** Average accepted bids per treatment over time.

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74 We also used models (4.1) and (4.2) to analyze the bid patterns in the US treatment, where the endowment effect is present, but the strategic effect is not. The results are quite similar as those in D. The coefficient on the quadratic term in (4.1) is again not significantly different from zero, and both the intercept and the coefficient on the linear term are smaller in US than in D.

75 For the US and UC treatment, although average accepted bids are obviously lower than the full sample depicted in Figure 4.1, the graphs are equivalent: again we see decreasing bids for US and stable bids over time for the UC treatment.

76 This claim is supported by the results on 'switching roles' between rounds. Out of 42 subjects who participated in the D treatment, 32 did not switch from keeping to selling (or selling to keeping) their mug in between rounds 1 and 2, and 2 and 3, and 28 did not switch roles between rounds 3 and 4. Also for the following rounds the average of participants who do not switch roles remains similar: on average two-thirds of the participants did not switch roles in between rounds 4 and 10. Hence, since group composition of participants with accepted bids did not change that much over time there were clear possibilities to increase the value of accepted bids as a group. Figure 4.3, however, shows that even when more than half of the bidders (4 out of 7 per group) are able to win the auction, collusion did not occur.
4.4 Conclusion

This chapter examined whether the result that repetition reduces efficiency in standard (or one-seller-multiple-buyers) discriminatory price auctions also applies to discriminatory price procurement auctions, where one buyer tries to purchase goods or services from multiple sellers. Repetition facilitates strategic behavior in both auction types (cf. McAfee and Vincent 1993 and Phillips et al. 2003 for standard auction; Stoneham et al. 2003 and Schilizzi and Latacz-Lohmann 2007 for procurement auctions), but we hypothesize that outcomes may differ because repetition has also been shown to reduce the endowment effect – the phenomenon that humans tend to attach higher values to goods that they own (Kahneman et al. 1990). With repetition, the ‘ownership premium’ tends to fall as agents discover that no longer possessing the item is not as painful as anticipated, and hence the likelihood of trades taking place increases with experience (see for example Shogren et al. 1994, List 2003).

We implemented an economic experiment to explicitly test whether or not repetition of discriminatory price procurement auctions renders these auctions less or more efficient for the conservation agency. This depends on whether or not the attenuation of the endowment effect has a larger influence on bid patterns than an increase in strategic behavior over time. We give student subjects high-end aluminum coffee mugs that they can sell back to us in repeated auctions. We find that average bids in the discriminatory price procurement auction fall with repetition. In particular, we do not find evidence for an increase in bids in later rounds – not even when we use econometric analysis to predict bids for an additional ten rounds of auctioning. We ran three treatments that help us isolate the strategic effect and the endowment effect, and we find that the attenuation of the endowment effect renders the discriminatory price auction more competitive over time.

Lab experiments are not able to perfectly predict outcomes in the real world, and hence the results of this chapter only provide a first step in answering the question whether it is efficient for policy makers to resort to more frequent procurement of (shorter term) contracts using discriminatory price procurement auctions. We find that unlike in the case of standard (one-seller-multiple-buyer) auctions, repetition does not reduce efficiency in procurement auctions – the attenuation of the endowment effect more than
compensates any increases due to strategic bidding. This is comforting news for governments that want to use repeated discriminatory price auctions for nature conservation (Latacz-Lohmann and van der Hamsvoort 1998, Latacz-Lohmann and Schilizzi 2005) and other repeated auctions in which the endowment effect could play a role, such as the buyback of fishing licenses (Squires 2010, DePiper et al. 2013) or the buyback of irrigation licenses in case of droughts (Hailu and Thoyer 2007, Iftekhar et al. 2013). Although there is substantial support for the external validity of lab experiments (cf. Fréchette 2011, Noussair and van Soest 2014, or see Camerer 2012 for an overview), it is an open question whether the ‘ownership premium’ (e.g. sentimental value) farmers attach to their land is larger or smaller than the premium students attach to a coffee mug they just received. Whether or not repetition reduces efficiency in real-world conservation auctions can only be answered using field experiments. Yet our results indicate that, given the costs associated with for-once-and-for-all auctions, researchers and/or policy maker should seriously consider setting up field experiments to test this in practice.
4.A Appendix

4.A.1 Experimental instructions

The experimental instructions for the Discriminatory price treatment (D) are presented below. The experimental instructions for the Uniform price Sellers (US) and Uniform price Choosers (UC) treatments are available upon request. They are very similar to the instructions for the D treatment. The key differences are in (i) successful bidders getting paid their bids or receiving the predetermined price (i.e. the auction design), and (ii) the way in which the bid question is formulated – as discussed in Section 4.2.

INSTRUCTIONS:

You are about to participate in an experiment on individual decision-making. Before we start, we would like to ask that you do not communicate with other people during this session. Please also turn off your mobile phone.

The experiment consists of two parts. The instructions for the first part, Part I, will be read out aloud now, and you are invited to read along. After completion of Part I of the experiment, you will receive the instructions for Part II, and then Part II will take place.

INSTRUCTIONS FOR PART I:

You receive a show-up fee of €5 for being here today. The mug that you just received, is yours. Depending on your decisions in Part I, you can take your mug home, but you may also decide to sell it back to the experimenters for a monetary payment.

Whether you take your mug home or sell it back for a payment in Part I is determined in a special kind of auction. In the auction format used in this session, the auction participants are not bidding to BUY an item, but to SELL an item. In this auction, you decide what price you are willing to sell your mug for. The price that you submit is called your bid.
There are 7 participants in your group, you and 6 other individuals in this room. All participants submit their bids simultaneously. That means that at the moment that you submit your bid, you do not know what bid any other participant submits.

After all participants have submitted their bids, the computer will rank all bids of the seven participants in your group from the lowest bid to the highest bid. We buy back the mugs from the participants who ask the lowest price in their bid.

If your bid is among the LOWEST four bids in your group, your bid is ACCEPTED in this auction.

If your bid is NOT among the lowest four bids in your group (but among the highest three), your bid is NOT accepted in this auction.

The auction will not just take place once; it will be repeated ten times. However, you only have one mug that you can keep, or sell. We implement this as follows. After both Part I and Part II have been completed, the computer randomly selects which of the ten auctions you participated in in Part I, will be implemented.

If, in that randomly selected auction, your bid was NOT accepted (that is, if it was NOT among the LOWEST four bids in your group), you take your mug home, as well as the €5 show-up fee plus any earnings you receive in Part II. If, in that randomly selected auction, your bid was ACCEPTED (that is, if it WAS among the LOWEST four bids in your group), you have to hand in your mug, but you receive the price that you stated in your bid, as well as the €5 show-up fee plus any earnings you receive in Part II.

All earnings will be paid to you via bank transfer within 48 hours. Each of the ten auctions is independent, because the outcome of only one will be implemented.

We will now explain the auction rules that apply in each of the ten auctions you will participate in in more detail.
CHAPTER 4

THE PROCEDURES:

Auctions take place with 7 participants in a group – you, and six other individuals in this room. You are matched with the SAME six participants in each of the ten auctions in Part I.

In each auction, you can bid any amount between 0.00 and 15.00 Euros. Bids can be in full Euros, but also in tens of euro cents. For example, you can bid Z Euros and 10 cents, Z Euros and 20 cents, etc., but not Z Euros and 15 cents, or Z Euros and 16 cents.

All participants submit their bids simultaneously. At the moment that you submit your bid, you thus do not know what bid any other participant submits.

After all participants have submitted their bids, the computer will rank the bids of the seven participants in every group from the lowest bid to the highest bid.

After the computer has ranked all bids of your group, you will be informed of the bids of the six other participants in your group. You will then also be informed whether your bid was ACCEPTED, or NOT.

If your bid is ACCEPTED in this auction (that is, if it is among the LOWEST four bids in your group in this auction) and if, at the end of the session (after both Part I and Part II have been completed), this auction is randomly selected by the computer, you receive the price that you asked for in your bid, and you have to HAND IN your mug.

If your bid is NOT accepted in this auction (that is, if your bid is among the highest three bids in your group in this auction) and if, at the end of the session (after both Part I and Part II have been completed), this auction is randomly selected by the computer, you KEEP your mug, and you do not receive the price that you asked for in your bid.

In case of “ties”, the computer will randomly determine which bids are accepted. If, for example, the 4th and 5th lowest bids are the same, the
computer will randomly determine which of the two will be accepted. If the 3\textsuperscript{rd}, 4\textsuperscript{th} and 5\textsuperscript{th} lowest bids are the same, the computer will randomly determine which two of the three bids will be accepted, etc.

This completes the description of the auction. The procedure is repeated ten times. The outcome of each of the ten auctions is thus whether your bid was ACCEPTED, or NOT, and one of these ten outcomes will be implemented at the end of the session. As stated before, the other bidders in all the auctions you participate in, are always the same six individuals.

Let us now have a look at the screens.

**SCREENS:**

The first screen is the following.

**SCREEN 1:**

On the top-left part of this screen, you are informed about which of the ten auctions you now participate in. On this screen you are requested to submit a bid. You can enter a value for Euros (in round numbers, 0, 1, 2, …, 15) in the left field and a value for euro cents (in multiples of ten cents, 0, 10, 20,
... 90 cents) in the right field – note that the 0 is preprinted, so enter “1” if you want to enter “10 cents”. Suppose you entered a bid of X.x0 Euros. After clicking on the “Update value” button, the next screen will appear.

**SCREEN 2:**

The bid that you entered will appear in the top line on the screen. If you are certain that you want to bid this amount, then click on the “Submit bid” button in the middle of the screen. Your bid will then be entered on your behalf in this auction. If, however, you want to revise the number you entered, do not press the “Submit bid” button yet. Instead, enter the revised number in the squares in the lower half of the screen, and press the “Update value” button. Then the screen will be refreshed, and you have again the choice between “Submit bid” and “Update value”. You can revise your bid as many times as you want before finalizing it. Clicking the “Submit bid” button makes the chosen value your final bid for this auction.

After you and all other participants have clicked the “Submit bid” button, the computer ranks all seven bids in your group. Depending on whether or not your bid is among the lowest four bids in your group, one of two screens will appear.
Example 1. Suppose that your bid is NOT among the four LOWEST bids in your group. Then the following screen will appear.

On this screen, you are informed about the bids of all seven participants in your group, and also what the 4\textsuperscript{th} lowest bid was – the highest bid that was accepted in this auction. You are also informed that your bid has NOT been accepted in this auction, because in this example we assumed that your bid was NOT among the four lowest bids in your group. That means that if, at the end of this session (after Part II has been completed too) the computer randomly selects this auction, you KEEP your mug and you can take it home with you.

In the bottom right corner, you can click on the “Continue” button to proceed to the next auction. We will come back to this after the second example.
Example 2: Suppose that your bid IS among the four LOWEST bids in your group. Then the following screen will appear.

Of course, this screen is very similar to the previous one. You receive the same information. That means that you are informed about the bids of all seven participants in your group, and also what the 4th lowest bid was – the highest bid that was accepted in this auction. However, in this case, you are informed that your bid has been ACCEPTED in this auction, because in this example we assumed that your bid was among the lowest four bids in your group. That means that if, at the end of this session (after Part II has been completed too) the computer randomly selects this auction, and you have to HAND IN your mug. You do receive the price that you asked for in your bid.

In the bottom right corner, you can click on the “Continue” button to proceed to the next auction. The screen that will appear looks the same as Screen 1, except that in the top right corner of that screen, you will see the history of your bid decisions and auction outcomes in all previous auctions. This completes the description of the screens.

Are there any questions at this point? Please raise your hand, and we will come to you to answer your questions.
If there are no further questions, we now continue with a short test. Please answer the following questions. When you have finished answering them, please raise your hand and we will come by to check your answers.

TEST QUESTIONS PART I:

1. In Part I, you participate in 10 auctions. The six other participants in one auction are not necessarily the same individuals as the six participants you are matched with in another auction. Y/N

2. After you have entered your bid and pressed the “Update value” button, you can no longer revise it. Y/N

3. After you have pressed the “Submit bid” button, the value that is shown on the top line of the associated screen is the bid that you entered. You can no longer revise it. Y/N

4. Please circle the correct option. Suppose that, in an auction, your bid is the lowest bid. If, at the end of the session, this auction is randomly selected by the computer, you

   a) can take your mug home with you, but you do not receive the amount of money that you asked for in your bid.
   b) have to hand in your mug, but you do receive the amount of money that you asked for in your bid.

5. Please circle the correct option. Suppose that, in an auction, there are three participants that bid an amount smaller than your bid, and the bids of the remaining three participants are higher than your bid. If, at the end of the session, this auction is randomly selected by the computer, you

   a) can take your mug home with you, but you do not receive the amount of money that you asked for in your bid.
   b) have to hand in your mug, but you do receive the amount of money that you asked for in your bid.
6. Please circle the correct option. Suppose that, in an auction, there are four participants that bid an amount smaller than your bid, and the bids of the remaining two participants are higher than your bid. If, at the end of the session, this auction is randomly selected by the computer, you

a) can take your mug home with you, but you do not receive the amount of money that you asked for in your bid.
b) have to hand in your mug, but you do receive the amount of money that you asked for in your bid.
INSTRUCTIONS FOR PART II:

In this second and last part of the experiment, you participate in a similar auction as in Part I. In this auction, the item you can decide to sell is NOT the mug on your desk. The item is a “virtual good”: a token.

At the beginning of Part II, you will be informed what the value is of your virtual token. This value is expressed in points.

In this Part II, 1 point is worth 5 euro cents. 100 points are thus worth 5 Euros.

The value of your virtual token is randomly selected from a range between 0 and 150 points. The value is drawn independently for each participant.

In the auction, you can decide for how many points you are willing to sell your virtual token. The number that you submit is called your bid.

In this auction, there are again 7 participants; you and six others. The six others are NOT the same six individuals as in Part I. The computer will randomly rematch all participants in groups of 7 at the beginning of Part II.

You can bid any number between 0 and 150 points. The computer ranks the bids of all seven participants in your group from the lowest bid to the highest bid. All participants submit their bids simultaneously. That means that at the moment that you submit your bid, you do not know what bids are submitted by any other participant.

If your bid IS among the lowest four bids in the auction, your bid is ACCEPTED. You sell your virtual token, and you receive a payment equal to the number of points that you asked for in your bid.

If your bid is NOT among the lowest four bids in the auction, your bid is NOT accepted. You keep your virtual token, and you receive the value of your virtual token that you were informed about at the beginning of Part II.
In this Part II there is JUST ONE auction. After all participants have submitted their bids, you are informed of the outcome of the auction you participated in, and you are informed about your earnings in this Part II.

This completes the description of Part II.

Next, the computer will randomly select which of the 10 auctions you participated in in Part I is implemented. You will be shown the outcome of that auction. Then the experiment is completed.

As stated before, all earnings will be paid to you via bank transfer within 48 hours.

This completes the description of the session. Let us now have a look at the screens of Part II.

**SCREENS:**

The first screen is the following.

**SCREEN 1:**
This screen informs you about value of your virtual token. The computer assigns a random value between 0 and 150 points to the virtual token of each participant. The value assigned to the virtual token of each of the other six participants in your group is thus unlikely to be the same as the value assigned to your virtual token. Click the “Continue” button to proceed to the next screen.

**SCREEN 2:**

In this screen, you are requested to submit a bid. You can enter your bid (between 0 and 150 points) in the square field. Upon clicking the “Update value” button, the next screen appears.
SCREEN 3:

The bid you entered is shown on the top line. If you indeed want to submit this bid, press “Submit bid”. If you want to revise your bid, enter a new number in the field, and press “Update value” again. You can revise your bid as many times as you want before finalizing it. Clicking the “Submit bid” button makes the chosen number your final bid for this auction.

After you and all other participants have pressed “Submit bid”, the computer ranks all seven bids in your group. Depending on whether or not your bid is among the lowest four bids in your group, one of two following screens will appear.
Example 1. Suppose that your bid is NOT among the four LOWEST bids in your group. Then the following screen will appear.

On this screen, you are informed about the bids of all seven participants in your group, and also what the 4th lowest bid was – the highest bid that was accepted in the auction. You are also informed that your bid has NOT been accepted in this auction, because in this example we assumed that your bid was NOT among the four lowest bids in your group. That means that you do NOT sell your virtual token, and that your Part II earnings are equal to the value of your virtual token, as was conveyed to you in Screen 1 of Part II.

In the bottom right corner, you can click on the “Continue” button to finish the auction and proceed to a screen that summarizes your results in Part I and II. We will discuss this in a moment.
Example 2: Suppose that your bid IS among the four LOWEST bids in your group. Then the following screen will appear.

This screen is very similar to the one before. You are informed about the bids of all seven participants in your group, and also what the 4th lowest bid was – the highest bid that was accepted in the auction. However, in this case, you are informed that your bid has been ACCEPTED in this auction, because in this example we assumed that your bid was among the lowest four bids in your group. That means that you SELL your virtual token, and that your Part II earnings are equal to the bid that you submitted.

In the bottom right corner, you can click on the “Continue” button to finish the auction and proceed to a screen that summarizes your results in Part I and II. It will also show you which auction of Part I is randomly selected to be implemented, and what your total earnings are in this session.

This completes the description of the screens.

Are there any questions at this point? Please raise your hand, and we will come to you to answer your questions.
If there are no further questions, we now continue with a short test. Please answer the following questions. When you have finished answering them, please raise your hand and we will come by to check your answers.

**TEST QUESTIONS PART II:**

1. In Part II, you participate in only one auction. The six other participants in this auction are the SAME six individuals you were matched with in the auctions in Part I. Y/N

2. Please circle the correct option. In Part II, the item that is auctioned, is
   a) the mug in front of you.
   b) a virtual good: a token.

3. After you have entered your bid and pressed the “Update value” button, you can no longer revise it. Y/N

4. After you have pressed the “Submit bid” button, the value that is shown on the top line of the associated screen is the bid that you entered. You can no longer revise it. Y/N

5. Please circle the correct option. If my bid in Part II is ACCEPTED, I receive
   a) the value of my virtual token that I was informed about at the beginning of Part II.
   b) the number of points I asked for in my bid.

6. Please circle the correct option. If my bid in Part II is NOT accepted, I receive
   a) the value of my virtual token that I was informed about at the beginning of Part II.
   b) the number of points I asked for in my bid.
4.A.2 Distributions of bids over time

The distributions of bids by treatment are presented below. Averages, standard deviations, and statistical tests can be found in Tables 4.1-4.3. Figure 4.4 shows that the lowest bid in treatment D is equal to €3.40 and that two bids equal to €15.00 were made in the last two rounds (by one bidder). Although treatment US (Figure 4.5) and treatment UC (Figure 4.6) show more bids equal to €15.00, the largest differences between treatments can be found in the lower bid range. Comparing Figures 4.4 and 4.6, we observe that bidders in treatment D indeed tend to bid higher than their true valuation. Bidding one’s true valuation is the dominant strategy in treatment UC, and although valuations may differ between the two treatments due to the endowment effect, the same holds for treatment US. Closer inspection of the data shows that bidders who bid (close to) zero in the US and UC treatments consistently submit low bids in every round (including the first), indicating a stable preference to part with the mug.

Figure 4.4. Bids over time in treatment D.

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77 In the US treatment, 10 out of 14 of these bids were made by one bidder who submitted bids equal to €15.00 in every auction round. In the UC treatment, one bidder submitted 5 bids equal to €15.00.
Figure 4.5. Bids over time in treatment US.

Figure 4.6. Bids over time in treatment UC.