Robustness of Bidder Preferences Among Auction Institutions

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Abstract

Ivanova-Stenzel and Salmon (2004a) found that bidders strongly prefer the ascending to the first price sealed bid auction on a *ceteris paribus* basis but perhaps surprisingly they are not willing to pay up to an entry price for the ascending auction that would equalize the profits. Risk aversion was proposed as an explanation. In this study we examine two competing explanations for the observed behavior; loss aversion and aversion to the dynamic bidding process. We find that neither alternative explanation can account for bidders' auction choice behavior leaving risk aversion as the only un-falsified hypothesis.

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I Introduction

The answer to the question of how bidders choose to enter one auction versus an alternative competing auction is important to understand in providing a complete picture of the nature of endogenous entry decisions into auctions. The issue of how a bidder chooses which among alternative auctions to enter as well as whether to enter an auction at all is of substantial importance to auctioneers attempting to attract bidders to their auction. There is a growing literature addressing issues in endogenous entry in auctions. There are several papers such as Engelbrecht-Wiggans (1993), Pevnitskaya (2004) and Palfrey and Pevnitskaya (2004) that consider the decision of whether to enter an auction or not and study the effect of endogenous entry on bidding behavior. There is a much larger group, e.g., Harstad (1990), Engelbrecht-Wiggans (1993), Levin and Smith (1994), McAfee (1993), McAfee and McMillan (1987), that consider competition between auctioneers in which the auctioneers are competing along some characteristic such as entry price. We consider the case in which auctioneers may be competing with each other based on the choice of auction mechanism. Our interest is in the degree to which the auction mechanism itself might impact the entry decisions of potential bidders. Of course there would be a direct pecuniary impact of the mechanism in that bidders should be more likely to enter auction mechanisms that they believe allow them to get lower prices but there may be other cognitive issues in regard to the structure of the mechanism that may also impact the choice behavior.
In Ivanova-Stenzel and Salmon (2004a) (ISS) we introduced an experimental design aimed at eliciting and measuring preferences subjects might possess for different auction institutions and applied the design to testing bidder preferences between ascending (a dynamic mechanism) and sealed bid first price auctions (a static mechanism). It seems reasonable to expect bidders to have preferences between these two auction mechanisms due to the strategic differences between them. In a first price auction the winner pays a price equal to his own bid whereas in the ascending auction he pays a price that is an increment above the second highest bid. These differences might result in difficulty of

deciding how to bid and in the possibility of experiencing some form of regret.[1]

The design involved having subjects make a choice between entering into a two bidder sealed bid first price auction versus a two bidder ascending auction, each with different entry prices. By varying the entry prices, we could measure the subjects' willingness to pay for either auction. Our main finding in the paper was that while subjects exhibited strong preferences for the ascending auction at equal entry prices, they were not willing to pay up to the expected profit difference between the two auctions to participate in an ascending auction. Thus they ended up entering the supposedly less preferred sealed bid first price auction even in situations in which they would expect to make a higher net surplus (including the cost of the entry fee) by entering into the ascending auction instead. That paper proposed one possible answer to the puzzle which involved assuming that bidders were risk averse in their bidding behavior and then risk averse to the same degree in their auction choice behavior. This explanation worked because neither risk averse nor approximately risk neutral bidders should be expected to pay much to enter into an ascending auction instead of a sealed bid first price auction just as we observed in the experiments. For the most risk averse bidders this is because while they bid the highest in the first price auction and therefore expected little surplus in the event that they win, they consequently end up winning with higher probability than less risk averse bidders. This is a trade-off risk averse bidders are willing to accept and consequently it is easy to show that highly risk averse bidders should not be willing to pay much to get into the more lucrative, though risky, ascending auction. At the other end of the range, bidders who were less risk averse bid lower in the first price auction which means they expect a larger surplus when they win but it also means that the expected surplus differential between the two formats is not so large. These less risk averse bidders will pay a little to get into the ascending auction because of their lower probability of winning the first price auction but not much. While the hypothesis of risk aversion was able to match with the data, applying risk aversion to explaining bidding in auction data is controversial. There is a long running

debate among auction theorists and experimental economists running back to Cox, Roberson and Smith (1982), Cox, Smith and Walker (1988) and Harrison (1989) regarding whether risk aversion is a reasonable explanation for the bidding behavior in first price auctions. These papers led to a long round of comment articles starting with the December 1992 issue of *American Economic Review* as well as many other related papers. Many of the key points in this debate are summarized in Kagel (1995). Because of the accumulation of so much doubt regarding whether the fundamental bidding behavior itself can be well characterized by risk aversion there is certainly reason to suspect that the compound hypothesis that risk aversion explains both the bidding behavior and the auction choice behavior may ultimately be unsatisfying. This leads us to consider alternative explanations.

Loss aversion

The most plausible alternative explanation is loss aversion. This model of decision making behavior is suggested quite forcefully in Rabin and Thaler (2001) and Rabin (2000) as being superior to risk aversion (at least when losses are possible). In ISS, losses were guaranteed for the losing bidder in the auction because of the fact that they had to pay the entry fee. Even the winning bidder could lose money in a round if they failed to earn enough to offset the cost of entry. If bidders are loss averse then they would be unwilling to pay a higher entry fee for an auction even if the expected value for that auction is higher taking the entry fee into account. This behavior is consistent with the results observed in ISS and those experiments could not disentangle this explanation from the risk aversion explanation.

Structure of the Bidding Process

Another reasonable alternative explanation has to do with the difference in bidding structure between the sealed bid first price (static) and ascending (dynamic) mechanisms. In the first price auction, a bidder sends in a bid and they are done immediately. In the

ascending auction, bidders have to wait for a while as the price clock ticks up which may take a more substantial amount of time. The additional time also requires the subject to actively pay attention to the screen for a longer period of time. Prior lab and field experiments show evidence that bidders in ascending auctions demonstrate non-negligible impatience or perhaps more accurately described, a desire to have the auctions end faster to reduce the amount of time and effort on the bidding process. For example, Lucking-Reiley (1999) finds that bidders in a field experiment often requested that he use higher bid increments in his auctions to push the auctions along faster. Shachat and Swarthout (2002) finds in a lab experiment that sellers in an ascending procurement auction that proceeded in a fairly slow manner drop out of the auction earlier than they should, leading the buyers to pay more than they should have to. The authors state that "We conjecture that the tediousness of the English auction is responsible for the early exit behavior." Evidence confirming that the behavior in both situations is consistent with impatience is found in Isaac, Salmon and Zillante (2005) which presents a test of a model of bidding in ascending auctions that incorporates impatience and finds that it fits the data better than the competing alternatives.[2] In these last two sets of experiments, subjects were willing to give up non-negligible earnings in order to have the auctions concluded faster. This was true even though subjects went through the series of auctions as a group and one auction closing faster did not do much to speed the overall experiment session because it went forward at the speed of the slowest auction each round.

Based on these findings, it could well have been the case that what was observed in ISS was due to a manifestation of such preferences in the auction choice behavior. Subjects may have substantially favored the outcomes from the ascending auction but their willingness to pay for the ascending auction was diminished due to an aversion to the bid submission mechanism or the time it took to complete an ascending auction. Our prior experiments could not reject this as an explanation.

In this paper, we will extend our experimental design to examine these two hypotheses. To

investigate the possibility of loss aversion we will use a design similar to our previous one but instead of an entry fee that both bidders are required to pay, we will use a surplus tax requiring only the winner to pay a percentage of his surplus from the auction. This will eliminate the possibility of a loss (unless a bidder bids above his value), but still allow us to vary the price of entering into an auction to measure the willingness to pay of the subjects. To determine the effect of the dynamic structure of the bidding process we will use a design similar to our previous one but instead of the ascending (clock) auction, we will use the strategically equivalent and, therefore, outcome equivalent sealed bid second price (Vickrey) auction. By observing preferences between the sealed bid first price and second price auctions we can determine the degree to which the observed preferences in the original experiment depended on the bid submission technology.[3] We are aware of the significant literature finding that while theoretically the ascending and second price mechanisms are equivalent, they are not equivalent behaviorally, e.g., Kagel and Levin (1993) and Harstad (2000). We find in a bridge treatment with the subjects choosing between the second price and the ascending auction that both yield outcomes that are equivalent in expectation and find the same in comparing second price and ascending outcomes across treatments. Consequently, the treatment allowing subjects to choose between the sealed bid first price and sealed bid second price auctions involves the subjects having the same effective choice between outcomes as the (original) treatment in which they choose between the sealed bid first price and ascending auctions. What differs between the treatments is the structure of the bidding process in the auction that adopts the second price rule and generates the resulting outcomes. In one case the bidding technology involves a dynamic process (the ascending auction) and in the other the bidding technology is static (the second price auction) and identical to that used in the first price auction. If the subjects exhibit a greater willingness to pay for the outcomes obtainable through the static bidding process than for the same outcomes obtainable through the dynamic process, it would be reasonable to conclude that the dynamic bidding process

dampened the willingness to pay for the ascending auction in the original treatment.
An alternative might have been to try varying the speed of the ascending auction. While that would have perhaps allowed us to identify the degree to which impatience might have impacted the revealed preferences for formats, it would not have dealt with the issue of people who simply dislike the nature of the clock interface. By changing the interface of the auction that adopts the second price rule from price clock to sealed bid (while keeping the earnings between the ascending and second price formats statistically indistinguishable) and using the same interface between the first price and second price auctions, we have the best chance at identifying any aversion the subjects might possess to the dynamic bidding mechanism used in the ascending auction.
What we will find in both cases is that neither alternative hypothesis demonstrates any ability to provide an explanation of the missing willingness to pay for the preferred ascending auction. In addition, the results will show strong preferences for the second price rule, i.e., the ascending (English) and second price sealed bid (Vickrey) auctions, compared to first price sealed bid auctions.
The remainder of the paper is organized as follows: The next section provides a complete design of the experiments. In Section 3 we present the results and section 4 concludes.

II Design of Experiments

As mentioned, in this study we use the experimental design first introduced in ISS. Due to that and the fact that we will discuss some of the results from that paper in detail, we will explain the design for the original experiments as well as the two new treatments. We will refer to these treatments as the FPvA with entry price (or FPvA_EP), FPvA with surplus tax (FPvA_ST) and FPvSP with entry price (FPvSP_EP). In all three treatments, the experiments were divided into two distinct phases; a learning phase and a preference assessment phase.

The Learning/Training Phase

In this first phase the subjects were randomly paired up to compete against each other in two auctions per round. In the two FPvA treatments the two auction formats were a first price sealed bid and then an ascending clock auction while the FPvSP treatment involved a first price sealed bid and a second price sealed bid auction. This phase lasted for 10 rounds and all of the auctions consisted of two bidders. In each round the subjects would participate in one of each auction type with the same value and against the same opponent. The bidders possessed private values which were independent and randomly drawn from the set $V = \{0, 1, 2, , ...99, 100\}$ with all values $v_i \in V$ being equally likely. In all treatments the subjects observed their value and then submitted a bid for the first price auction. Subjects could choose integer bids between 0 and 150, which did allow them to overbid their highest possible value. All values were denoted in a fictitious currency termed ECU for Experimental Currency Unit. Before bidders were informed about the results of the first price auction, they participated in a second auction. In the FPvA treatments this was a Japanese or ascending clock auction[4] while in the FPvSP treatment this was a second price sealed bid auction which again just asked them to submit a bid in the same range as for the first price. At the end of the round the bidders observed a feedback–window specifying the results from both auction formats indicating whether or not they won, the price paid by the winner in each auction, the private value of the buyer, their own profit in the auction and their total profit in the current round. They were not given cumulative profit numbers at the end of each round, only the gains/losses from the current round. There were 10 participants in each experiment session and in each round subjects were randomly re-paired to bid against a new opponent.

The intention for the learning phase was to allow subjects to practice both formats so that they understood how to bid in them and so that they could form an understanding of the expected profits in both and be able to form preferences between the two. The reason for having subjects play both auctions with the same value was an attempt to minimize any

negative impressions a bidder might receive about an auction format due to a random series of bad draws on one format while getting good draws in the other. At the end of the learning phase there was a summary screen detailing the average profit achieved by the winner across both auction types.[5] The purpose of including this information screen was to aid subjects in learning about the average actual profitability for participating in the two mechanisms.

The Preference Assessment Phase

In the second phase of the experiment in all three treatments, the participants played an extended auction-selection game for 30 rounds. In a single round of this phase, bidders were asked to choose to enter either of the two auction formats used in the treatment, knowing that regardless of which they chose they would be competing against one other bidder.[6] In the two entry price treatments, both auction formats had an entry price attached to choosing them which the bidder had to pay regardless of whether or not they won. In the surplus tax treatment there was a tax level for each auction that indicated the percentage of the winner's surplus that they were obligate to pay. Bidders who lost an auction did not have to pay anything in the surplus tax treatment.

The choice of which auction to enter was made before bidders observed their private value for the auction. In the first 10 rounds of this phase, the entry fees or surplus taxes for both auction formats were the same (1.40 ECU entry fee and 0% surplus tax). The preferred auction design was identified for each individual as the one they chose in at least five rounds of these 10 rounds. Since each subject was able to actually choose in only nine of the rounds, there was always at most one format chosen five or more times. In the remaining 20 rounds, the entry price respectively surplus tax for the preferred auction format was varied in each round while the less preferred format retained the entry price of 1.40 ECU or the surplus tax of 0%.[7] For the preferred auction format in the entry fee treatments we used a grid consisting of entry prices ranging from 0.7 to 14 ECU with an increment of 0.7. To avoid the possibility that the subjects would see the experiment as a

simple grid exercise and become bored or disinterested, the grid was not presented in an ascending order, rather the order was randomized. To make the grid structure even less apparent, we added an ϵ to each element of the grid, where ϵ is a random variable normally distributed on the range $(-.05, .05)$.[8] Also, by not giving the grid in sequential order, we are able to do consistency checks on the subjects' choices that help to verify if they do have a consistent switch-over price. In the surplus tax treatment, we engaged in a similar design as we used a grid of surplus taxes in the range (0.04 to 0.80) in increments of 0.04 and again did not present them in a fixed ascending or descending order.[9]

After subjects made their choices concerning the auction type, the round was played with 20% probability. This was a session wide determination, not specific to any particular player. At the end of each auction that was actually conducted, subjects were informed whether or not they won the auction, the price paid by the winner, the entry price/surplus tax they had to pay, their private (reselling) value and their own payoff in the current round. An entry price was only charged to a subject and a surplus tax was only charged to the winner if the auction was conducted.

With the learning/training phase occurring before the preference assessment phase, one might conceive it as possible that a subject may behave in some way during the training phase so as to effect the behavior of others during the preference assessment phase. This might take the form of a subject bidding very high in one auction format during the first phase to discourage other subjects from choosing that format in the second phase. This possibility was eliminated since we gave the subjects instructions for the second phase only after the first phase was completed. Thus subjects did not know the second phase was going to exist and therefore be able to respond strategically in this manner. Note as well that subjects do not find out how many other subjects have chosen each format. Since we withheld one subject per round to ensure we could always pair up subjects, a subject can not even infer that at least one subject, their opponent, also chose the same auction format. This further minimizes the ability to engage in any strategic manipulation because

a subject would receive little feedback on its success.

A viable alternative approach to our treatments checking for the effects of loss aversion and impatience would have been to re-conduct our initial experiment adding on external tests regarding the degree to which the subjects were loss averse and impatient. It would then be possible to determine if either characteristic had explanatory power over the observed willingness to pay for the ascending auction. While certainly feasible, these designs run into a potential problem discovered in Isaac and James (2000) which is that preference parameters elicited in one context do not necessarily correlate with the same preference parameters elicited in another.[10] Thus if we found that the parameters could not explain the behavior, we could not have determined if it was because the behavioral forces were really not in effect or if there were a measurement problem with the parameters. In the designs we used, however, we have insulated ourselves from this problem by eliminating either possible losses or the dynamic bidding process and determine if the fundamental behavior remains or not.

Altogether we conducted 16 sessions with a total of 160 subjects: In six sessions we studied FP versus A auctions with entry prices and in a further five sessions with surplus tax; finally, we ran additional five sessions for the comparison FP versus SP sealed bid auctions. Table 1 summarizes the characteristics of our experimental design.

All experimental sessions were computerized. The software programs were created with the use of the software system z-Tree, Fischbacher (2007). All experiments were conducted at Humboldt-University, Berlin and most participants were students of economics or business administration. They had been invited by leaflets to participate in an experiment announced to last about two hours which turned out to be approximately accurate. The conversion rate of the ECU earned by each subject into cash was: 1 ECU = 0.04 EUR (this ranged between US$0.035 to US$0.039 at the time the experiments were conducted). Subjects' total earnings ranged between 5 EUR to 28.50 EUR with a mean of 15.85 EUR (including a fixed participation fee of 2.50 EUR).

[Table 1 Approx Here]

III Results

The original experiment was the FPvA_EP treatment. As shown in table 2 the average number of times the ascending auction was chosen was 7.87 with a median of 9 while the corresponding numbers were 1.13 and 0 for the first price auction. Since one subject was held out from choosing in each of the rounds of this phase and there were 10 total rounds in which subjects chose between auction formats with equal entry prices, each subject made 9 choices. Since the median number of times the ascending was chosen was 9, this represents a strong tendency for subjects to choose it exclusively. In total, 39 (of 60) subjects chose the ascending auction exclusively while there was only one subject choosing the first price auction exclusively. In fact only 5 out of the 60 subjects chose the first price auction more often than the ascending. This preference for the ascending or second price auction transfers to the other two treatments. Over all of the treatments, there were only two subjects (out of 160) choosing the first price auction exclusively, one in FPvA_EP and one in FPvA_ST, while 98 subjects chose the ascending or the SP auction exclusively, 39 in FPvA_EP, 32 in FPvA_ST and 27 in FPvSP_EP. Only 17 out of the 160 subjects chose the first price auction more often than the ascending or the SP auctions (5 in each of the A-treatments and 7 in the SP treatment).

[Table 2 Approx Here]

One immediate reason this preference for the ascending auction might exist can be found in the middle columns of table 2 which contain the average surplus to the winner in the FP and then the A/SP auctions. In every case, subjects made less profit in the FP than the comparison auction. The last two columns contain the benchmark predictions for surplus

the subjects would earn based on the standard risk neutral bid predictions.[11] As expected, subjects do just about as well as the theory predicts in the A and SP auctions, but receive much lower earnings due to overbidding in the FP auctions. This strong preference served as a strong foundation for the rest of the experiment designed to determine how much subjects were willing to pay to enter into the more lucrative auction.

Figure 1 shows a characterization of how much the subjects were willing to pay for their most preferred auction in the original FPvA_EP treatment by displaying a pseudo demand curve indicating how many subjects were willing to choose the ascending auction at each entry price. This pseudo demand curve exhibits the standard characteristics of a normal demand curve. It shows that as the entry price increases, the number of subjects demanding entry into the A auction decreases. The pseudo demand curve is a bit jagged, however, indicating that there are some bidders making choices that are not purely monotonic. For example, a subject may have declined to pay a price of 2.1 for the ascending auction, but agreed to pay a price of 2.8 or 3.5. This is also partially an artifact of not allowing one person to choose at each price.

As shown in table 2, average profit to winners from the ascending auctions was 37.02 while it was 19.32 for the first price auction.[12] This implies a difference of 17.70. If subjects expected to win half the time, this implies an expected profit differential of 17.70/2=8. 85. Thus, if subjects are risk neutral and care only about maximizing expected profits then they should choose the ascending auction at any price that is less than 8.85 ECU above that of the base entry price for the FP. Since the base price for the FP is 1.40 ECU this means the break-even entry price is at 10.25 and this is represented in the figure by the dotted line. At any entry price below this line average net profits in the ascending are larger than the average net profits in the first price sealed bid auction given its static entry price of 1.4. At any price above this line, the first price yields higher net profits. The key point to note is that only 9 out of the 60 subjects (15%) were willing to pay up to this point to get into the ascending auction.

[Figure 1 Approximately here]

This result is something of an anomaly as the stated preferences of the subjects were heavily in favor of the ascending auction. As shown in table 2 at equal entry prices, choice of the ascending was nearly unanimous. Further, subjects were given the requisite information on the expected profit differential between the two formats since they were informed at the end of the first phase about the session wide average profit achieved by the winner across both auction types. Why then would they not be willing to pay up to the expected profit differential to get into the ascending auction?

It was proposed in ISS that this is explainable by risk aversion. The key point of the explanation is that neither risk averse nor approximately risk neutral subjects should theoretically be willing to pay much to get into the ascending auction. The risk neutral bidders should not pay much as their surplus is approximately equal between the two when they win (they should pay something because they expect to win less often in the first price) while the highly risk averse should not pay much because they are willing to trade off the lower surplus in the first price for the higher probability of winning.[13] While the story and the predictions were shown to fit the observations, there are alternative theories that could also fit the story and likely be shown to fit the observations.

III.1 Loss Aversion

The alternative hypothesis that appears most likely to provide an explanation for the observed phenomenon is loss aversion. A subject who possesses loss averse preferences would be expected to avoid the auction mechanism with the higher entry price due to the fact that this makes it possible for the subject to lose money upon entry. Our FPvA_ST treatment was designed to test whether or not loss aversion could explain the observed behavior. In this version of the experiment, the subjects pay nothing when they lose an auction and when they win they pay a fraction of their surplus. Assuming a subject never

bids above his value, he can not lose money in this design.

An important theoretical point that should be made is that due to the implementation of the tax, the equilibrium bidding behavior is unchanged under any assumption of risk preferences in the ascending case and under reasonable ones in the first price case. This is immediately obvious for the ascending auction because the equilibrium strategy does not depend on risk preferences and is for a bidder to stay in so long as they have positive surplus. Since the tax is based on a percentage of the surplus, the bidder still expects positive surplus at any price less than their value. In the first price auction, the result can be seen in that the utility maximization problem is

$$\max_r U((1-t)*(v-b^*(r)))*F(r)$$

with the equilibrium condition that the derivative must equal 0 where $r = v$. If one uses the CRRA utility function, $U(x) = x^\alpha$, it is quite easy to show that the tax has no impact on the equilibrium. This is sensible because all the tax does is re-scale the value in the function and with CRRA this has no impact on the degree of risk aversion.[14]

As shown in the second row of table 2 the average winner's profit in the phase 1 ascending auctions was 34.18 while it was 16.48 for the first price auctions. If subjects were risk neutral for gains then they should be willing to pay up to the tax that makes their average profits between the two auctions equal, i.e., they should be willing to pay up to a tax of t that solves $16.48 = (1-t)34.18$ or 0.52. This is true even if they are risk loving in the loss domain as suggested by loss aversion. Figure 2 shows the pseudo demand curve derived from this experiment indicating the number of subjects willing to pay each possible tax on their winnings for the ascending auction. The dotted line shows the break even tax or the tax at which expected profits between the two formats are equal. As in the first experiment, we find that fewer than 10 subjects, namely 9 out of 50 (18%) were willing to pay up to this point to enter the ascending auction. Since it is impossible for losses to be involved in this

case, it is impossible for the pattern of behavior depicted in figure 2 to be explained by loss aversion. Since the pattern of behavior observed in figure 1 is practically identical, we can conclude that loss aversion seems to have played no significant role in the unwillingness of subjects to pay the fixed entry price to enter the ascending auction in the first treatment.

[Figure 2 Approximately here]

III.2 Dynamic versus Static Bidding Process

Another alternative explanation for why subjects were willing to pay so little for the ascending auction in the first original experiment is that they disliked the dynamic bidding process, i.e., the extra time involved in conducting an ascending auction. While they may have liked the outcomes better, they may have disliked the additional time it took to get to them and this dislike of the bidding procedure could have decreased their willingness to pay to something below the break-even price. Since the outcomes between the second price and the ascending formats should be equivalent, we can check this hypothesis about the effect of the dynamic structure of the bidding process by comparing the sealed bid first price and the sealed bid second price auctions using the original entry price design in the FPvSP treatment.

Of course a maintained hypothesis underlying this comparison is that subjects view the second price and ascending auctions as equivalent in terms of outcomes. This is an issue widely discussed in the literature due to the repeated findings of overbidding in second price sealed bid auctions. We conducted one session of a bridge treatment in which we compared the SP and A mechanisms. Profit in the training phase was approximately equivalent between both mechanisms, 32.12 for the SP and 31.50 for the A with standard deviations of 23.4 and 19.9 respectively. Standard distribution tests all fail to find a significant difference in the underlying distributions of bidder profits ($p-$values of 0.8867,

0.8146 and 0.9667 from $t-$test, a Wilcoxon rank-sum test and Kolmogorov-Smirnov test). Perhaps due to the slight but statistically insignificant profit advantage in the SP, it was chosen 5.3 times on average compared to 3.7 for the A in the first 10 rounds of the preference assessment phase. In rounds 11-30 of this phase when they are asked to pay for their more preferred mechanism, subjects in the aggregate chose the higher priced mechanism a total of 8 times out of 180 possible choices and 5 of these 8 choices were situations in which the more expensive mechanism cost 2.1 or 2.8 ECUs while the cheaper mechanism cost 1.4 ECUs. The implication is that while there might be a slight preference for the SP on a *ceteris paribus* basis, this preference is not strong enough to induce virtually any payment of a positive price. This is actually a first piece of evidence showing that the bid submission mechanism is unlikely to explain our A vs FP results. The key point though is that the earnings distributions are highly comparable which provides evidence that the SP is close enough to the A in that respect for it to be able to serve in the capacity we require for our test against the FP.[15]

In our FPvSP treatment, when subjects were allowed to choose to enter one of the two auction formats for the same price they overwhelmingly preferred the second price over the first price auction. In total, 27 (of 50) subjects chose the second price auction exclusively while no subject chose the first price exclusively. Altogether only 7 out of 50 subjects chose to enter the first price auction more often than the alternative.

According to the third row of table 2 the average winner's profit for the phase 1 second price auctions was 31.70 while it was 11.84 for the first price. Given that the static entry price for the first price was 1.4 and that subjects only expect to win half of the time, to find the entry price, e, for the ascending that yields equivalent average profits, we must solve $(31.7)/2 - e = (11.84)/2 - 1.4$ which yields $e = 11.33$. This tells us that if subjects are willing to pay up to the entry price that yields equivalent average profits between the two formats, they should be willing to pay up to 11.33. Figure 3 shows the pseudo demand curve derived from the sessions of the FPvSP_EP treatment with the dotted line once

more indicating the break-even price. Once more we see that just under 10 subjects (9 out of 50) or 18% are willing to pay up to this point. All other characteristics of both figures 1 and 2 are duplicated in this figure. This shows a fairly strong indication that the structure of the bidding process had little effect on the preferences of the subjects.

[Figure 3 Approximately here]

It is worthwhile to comment on the very low average earnings our subjects realized in the FP auctions in this treatment. We attribute this to a bias in the learning process introduced by having the subjects engage in the same mechanical bidding process for both formats so close together in the training phase.[16] Due to the difference in the process, this effect did not occur in the FPvA treatments, but in the FPvSP treatment it took some subjects longer to learn to bid their value in one mechanism while bidding well below their value in the other. While this was a less than desirable side effect in certain respects, the effect works against the finding. This bias to overbidding the risk neutral level even more than usual in the FP auction should have made the SP even more desirable to bidders who were basically risk neutral but for some reason could not stop themselves from bidding too high in the FP. The evidence, however, is that the subjects were no more willing to pay for the SP auction in this environment than they were for the A auction before.

III.3 Summary

Putting the results of all treatments together in figure 4 shows that the three pseudo demand curves are almost identical. The figure is likely difficult to even read due to how much the lines overlap.[17] The null hypothesis of no differences between the choices in the three experiments cannot be rejected (Kolmogorov-Smirnov test; $p > 0.3$). In fact, the structure of all pseudo demand curves is truly striking. In all three cases, there is a very flat slope at the bottom of the line indicating that some subjects stop picking the

ascending auction very quickly upon seeing the price or tax rise while there are about 4-5 subjects that are willing to pay practically anything to enter into the ascending or the second price auction. Fewer than 10 subjects in each treatment (15-18%) are willing to pay more than the level that equalizes the expected profit of the two auctions. Since getting rid of losses or the dynamic bidding process leads to no change in the results, it should be clear that neither loss aversion nor aversion to the time consuming dynamic bidding procedure is capable of explaining the low willingness to pay for the preferred ascending or second price auction.

[Figure 4 Approximately here]

Another characterization of the willingness to pay of the subjects for their most preferred auction would be to estimate a switch-over point in terms of entry prices and surplus taxes for each of the subjects by finding the price at which each subject would switch from choosing the ascending/second price sealed bid auction to the first price sealed bid auction. For subjects who exhibited perfectly consistent behavior, this estimation is trivial. For the other subjects who were not monotonic in their choice behavior, it amounts to finding the price that best divides the observed choice behavior. The full technical details on how this is done for the EP treatments can be found in ISS. For the ST treatment, the procedure is analogous and amounts to finding the tax that best describes when the subject switches from choosing the ascending auction to the sealed bid first price auction.

The average prices that lead people to switch from the ascending to the first price auction are 6.33 in the FPvA_EP treatment and 7.32 for the FPvSP_EP treatment while the average profit differences between the two institutions were 8. 85 and 9.93 leading to implied switch-over prices of 10. 25 and 11.33 respectively if the subjects were only concerned about average profits. The corresponding numbers for the FPvA_ST treatment are an average switch-over tax of 0.35 and average profit difference between the two auction formats of 0.52. This is simply a different way of characterizing the same point

made in a simpler and more elegant manner with the pseudo-demand curves. It is quite clear that in none of these treatments were subjects willing to pay an entry price or surplus tax up to the level that would equalize profits. Most subjects started choosing the FP auction at prices for the A or SP at which the latter two were still more profitable than the FP. They did this when we eliminated the possibility of losses and when we equalized the bid submission procedure leaving the only differences between the mechanisms the fundamental strategic differences as well as the differences in risk.

IV Conclusion

This paper began with a puzzling result found in Ivanova-Stenzel and Salmon (2004a) that while subjects seem to like ascending auctions more than first price auctions, they were not willing to pay entry prices to enter into an ascending auction rather than a first price that would have left the ascending auction more profitable than the first price auction. This is an intriguing finding and it is important to understand it if we are to have a complete understanding of how bidders choose among competing auctions.

We had previously proposed risk aversion as a possible solution and found that it could provide a reasonable match with the data. Due to the acknowledged difficulties with this solution, we sought out alternative explanations. Here we advanced two further possible solutions to the anomaly. The first was that subjects feared making losses due to the fact that they had to pay the entry fee regardless of whether or not they won the auction. We replaced the entry fee with a surplus tax which could not cause a loss and we observed exactly the same phenomenon of subjects being unwilling to pay surplus taxes at which the ascending auction would still be more profitable than the sealed bid auction. The second solution was based on the possibility that the subjects could have been impatient or possessed some other aversion to the dynamic bidding mechanism used in the ascending auction. We replaced the ascending auction with the strategically and payoff equivalent

sealed bid second price auction where the bidding process is static and identical to those in the first price auction. When we compared sealed bid second price with first price auctions using the entry price design we again found the same result as we did with our original experiments. Subjects began choosing the first price auction at prices for the second price would still have lead to the second price being the more profitable. This is an amazing consistency of results across quite different treatments.

With the failure of these two alternative explanations this leaves our original explanation of risk aversion as the only unfalsified explanation. It is of course possible that other forces could be driving both bidding behavior and auction choice behavior than risk aversion and due to the many other studies finding that risk aversion may have difficulty capturing certain elements of bidding behavior it is certainly worth continuing to search for alternatives.

The overall importance of the issue of how bidders might choose between alternative auctions is of course substantial. The main interest of an auctioneer would take one of two paths. One might be for an auctioneer to attempt to take advantage of any preference bidders have for his mechanism by charging an entry price. In Ivanova-Stenzel and Salmon (2004b), we show that this will not be possible. Alternatively, once bidders are allowed to choose which auction to enter, an auctioneer using a more preferred mechanism might be able to increase his profits due to increased entry. If we make the assumption that the bidders in our experiments were guided by risk aversion and allow for the fact that there may be some utility for the ascending auction or disutility for the first price due to cognitive differences between the two then we can show that many of our subjects would have been willing to choose to enter into ascending auctions with 2, 3 or more other bidders rather than a first price auction with only a single other bidder for competition.[18] Because revenue is quickly rising as n rises for low numbers of bidders, this suggests an auctioneer may benefit from running a more preferred mechanism in this manner if the rise in n compensates for the lack of overbidding. The results we present here further solidify

our prior results regarding the existence of strong preferences for auctions using a second price rule, e.g. the ascending and second price sealed bid auctions, compared to first price sealed bid auctions. This leads to an important implication for auctioneers which is that choice of an auction format may have important implications for bidder turnout. Since the competition for the pool of potential buyers can be fierce in certain markets, an auctioneer may be able to choose a format more likely to encourage bidder participation and thus achieve an increase in revenue. Our current results are suggestive that the choice of the ascending auction over a first price auction could accomplish such a goal. We explore that implication further in Ivanova-Stenzel and Salmon (2006).

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Additional Captions for Figures and Tables

Table 1: None

Table 2: None

Figure 1: None

Figure 2: None

Figure 3: None

Figure 4: None

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Notes

[1]Regret may occur in a first price auction when a bidder loses to a bid that is below their value as they may think that if only they had bid higher, they could have won. Such a scenario should not reasonably occur in an ascending auction. Regret has been proposed as an explanation for overbidding in first price auctions in Engelbrecht-Wiggans and Katok (2007).

[2]The experiments for this paper involved adjusting the bid increment as well as whether or not bidders could place bids above the minimum increment to move the auction along at a faster pace and it was found that subjects did prefer the higher increments and that when low increments were used and bidding above the increment disallowed, revenues decreased from some bidders exiting the auction early.

[3]While there are other approaches to test for the possibility of the aversion to the time spent in an ascending auction, our approach allow us to answer two further intriguing questions: (i) Which auction mechanisms are favored if bidders have the possibility to choose between two of the three standard auction formats used in the field - the sealed bid first price auction, the ascending, and the sealed bid second price auction; (ii) Which aspects of the design, i.e., the structure of the bidding process and/or the price rule, are important for this choice?

[4]The price started at 0 and began increasing at the rate of 1 ECU every 2 seconds. The auction concluded when one of the bidders clicked on a button to indicate they were withdrawing from the auction with the remaining bidder winning the auction at the price the first bidder dropped out at.

[5]In the FPvA_EP treatment, there were two sessions where this screen was not shown. In ISS we tested whether or not this screen affected the results and we found no evidence

that it did.

[6]To guarantee that an even number of subjects participated in each mechanism, only 9 out of the 10 participants were able to choose an auction type in each round. The 10^{th} participant was automatically assigned to whichever auction type had an odd number of people selecting it. The identity of the "10^{th}" player was changed in each round, so that each subject played the balancing role once every ten rounds and three times among the 30 rounds.

[7]In the EP treatments all subjects entering an auction pay the entry fee. Therefore, having to pay a positive entry fee for the chosen format versus having it for free (zero entry fee) can effect a subject's decision by more than just the difference in actual prices due to what is sometimes known as the "zero effect". This is of particular concern if subjects are loss averse. In the tax treatment only the winner pays the tax and no losses are possible. Both should minimize any problems from a possible "zero effect".

[8]The actual entry price order all subjects saw was {8.39, 2.10, 0.70, 4.92, 12.61, 1.42, 6.27, 4.20, 9.79, 11.15, 13.27, 5.59, 11.90, 9.07, 2.80, 10.49, 7.01, 3.50, 13.98, 7.74}.

[9]The actual sequence used was {0.48, 0.12, 0.04, 0.28, 0.72, 0.08, 0.36, 0.24, 0.56, 0.64, .0.76, 0.32, 0.68, 0.52, 0.16, 0.60, 0.40, 0.20, 0.80, 0.44}.

[10]Isaac and James (2000) observed this for first price auctions and the Becker-Degroot-Marshak procedures for estimating risk preferences and it is quite reasonable to suspect similar problems for loss aversion parameters and certainly for impatience parameters between our choice environment and other standard elicatitation procedures.

[11]Note we used the same value pairings in the FPvA_ST and FPvSP_EP treatments accounting for the identical theoretical predictions. We used a different set of values for the FPvA_EP treatment which delivered the oddly high surplus prediction for the ascending auction. As will be obvious below, the overall results in that treatment were not impacted

by this difference in values.

[12]These numbers are average profits to winners from the first phase. If we look at the numbers for all auctions from both phases, excluding any entry price payments, the results are 37.02 and 19.78

[13]Bidders who are more risk averse than others have a higher probability of winning because for a given value, they will bid higher than a bidder less risk averse.

[14]If subjects possess a different form of risk aversion, such as CARA, then this will impact equilibrium behavior. CRRA, however, is a legitimate assumption because Matthews (1987) shows that the form of risk aversion consistent with preferring the ascending auction is DARA which CRRA satisfies.

[15]That point can be further confirmed by comparing the earnings in the training phase of the ascending and second price auctions in the FPvSP with the FPvA_ST sessions. The value draws were constant across those treatments allowing for a clean comparison. Table **??** shows that the average earings were 34.18 in the A and 31.70 in the SP and again all standard distribution tests fail to find significant differences between the distributions.

[16]Harstad (2000) has observed that when playing back-to-back different auction formats subjects often transform the experience gained from the one auction to the other. In his experiments, for example, subjects tend to overbid less in second-price auctions if they first gain experience in first-price auctions.

[17]Since the FPvA_ST treatments had entry costs measured in different units than the other two, we could be accused of manipulating the overlap of it by our choice of axis scale for it. The axes were, however constructed so that the entry cost increments (in ECU's or tax percentages) were horizontally aligned across all treatments. This seemed the least manipulative way of presenting the information.

[18]Across all three treatments, there were 48 risk averse bidders that were found to posess a disutility from participation in the frist price auction. Of these 48 bidders, 45 (94%) were willing to enter into either an ascending or second price auction with at least three or higher number of bidders instead of participating in a two bidder first price sealed bid auction.

TABLE 1

Summary of experiment sessions.

Treatment	**Auction Mechanism**	**Auction Formats**	**Preference Measure**	**# of sessions**	**# of subjects**
FPvA_EP	Static versus Dynamic	First price & Ascending	Entry fee	6	60
FPvA_ST	Static versus Dynamic	First price & Ascending	Surplus tax	5	50
FPvSP_EP	Static versus Static	First price & Second price	Entry fee	5	50

TABLE 2

Summary of entry choices in the first 10 rounds of phase 2 and average winner surplus from phase 1.

	Number of Choices (Phase 2: Rounds 1-10)				**Average Winner's Surplus (Phase 1)**		**Theoretical Winner's Surplus (Phase 1)**	
	Average		**Median**					
Treatment	**FP**	**A/SP**	**FP**	**A/SP**	**FP**	**A/SP**	**FP**	**A/SP**
FPvA_EP	1.13	7.87	0	9	19.32	37.02	33.28	37.64
FPvA_ST	1.26	7.74	0	9	16.48	34.18	34.34	33.12
FPvSP_EP	1.54	7.46	0	9	11.84	31.70	34.34	33.12

FIGURE 1

Pseudo-demand curve for ascending auction in FPvA_EP treatment.

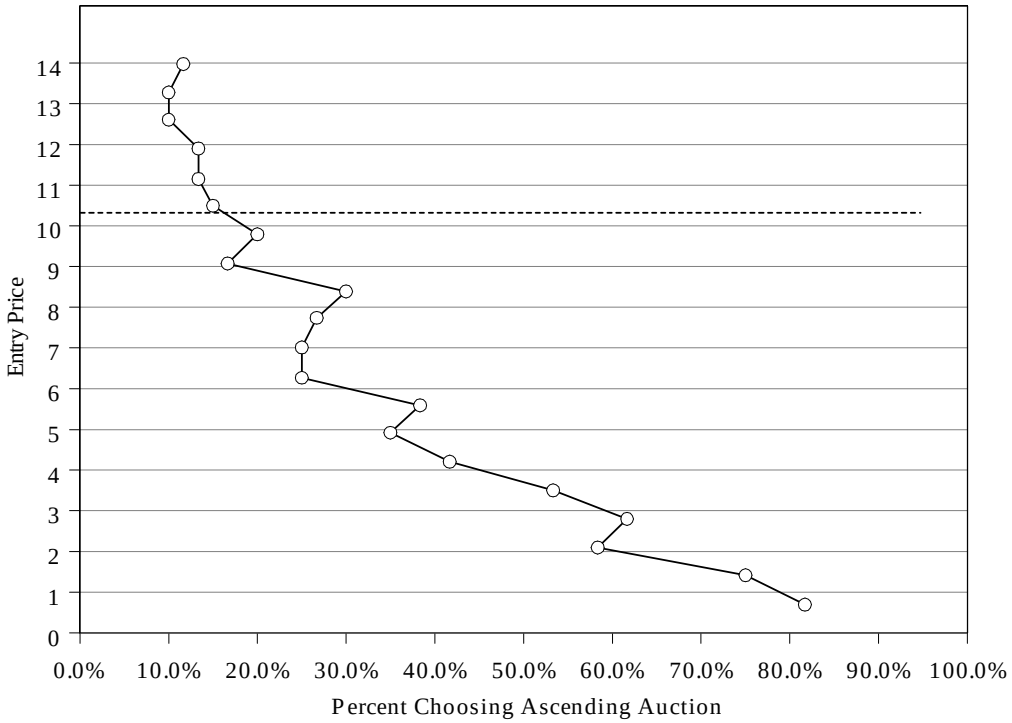


FIGURE 2

Pseudo-demand curve for ascending auction in FPvA_ST treatment.

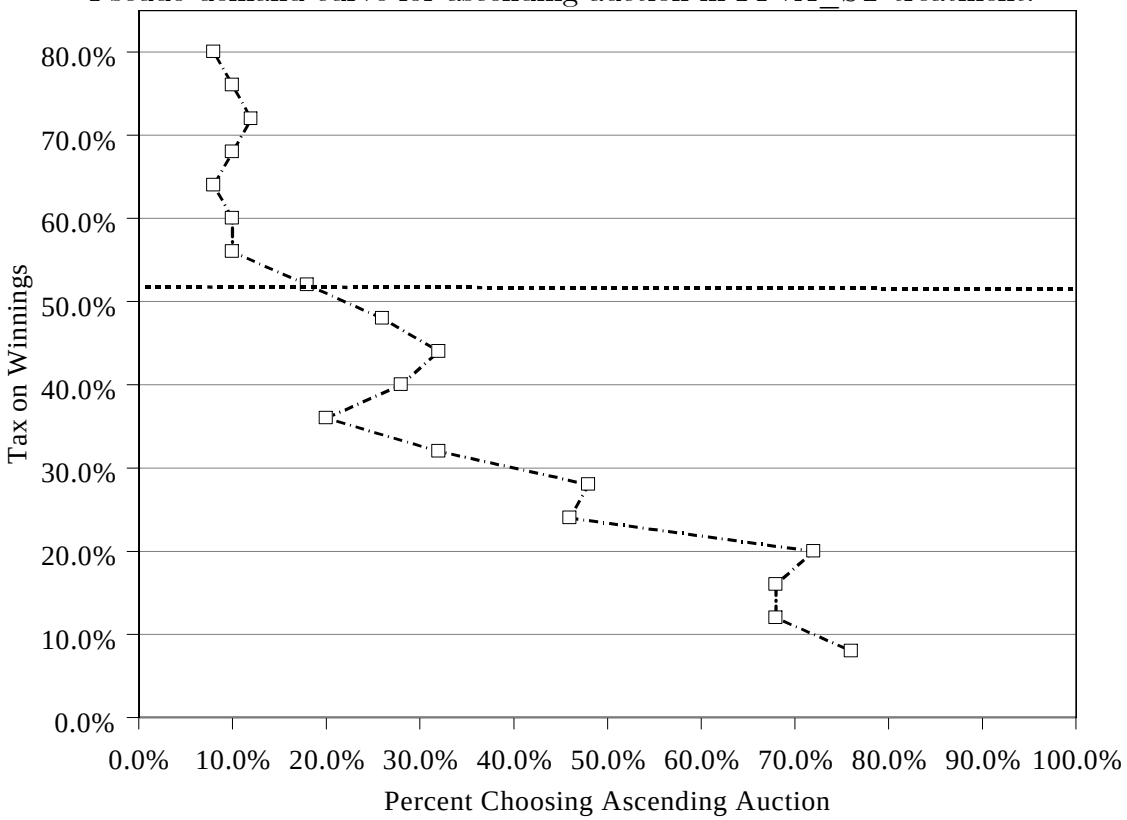


FIGURE 3

Pseudo-demand curve for second price auction in FPvSP_EP treatment.

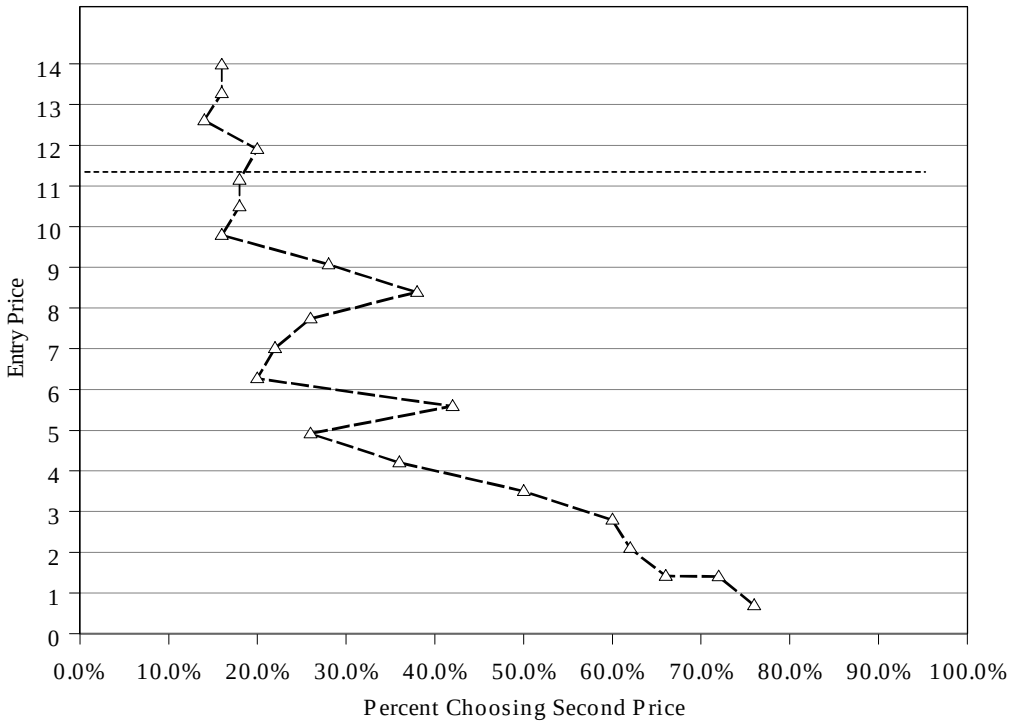
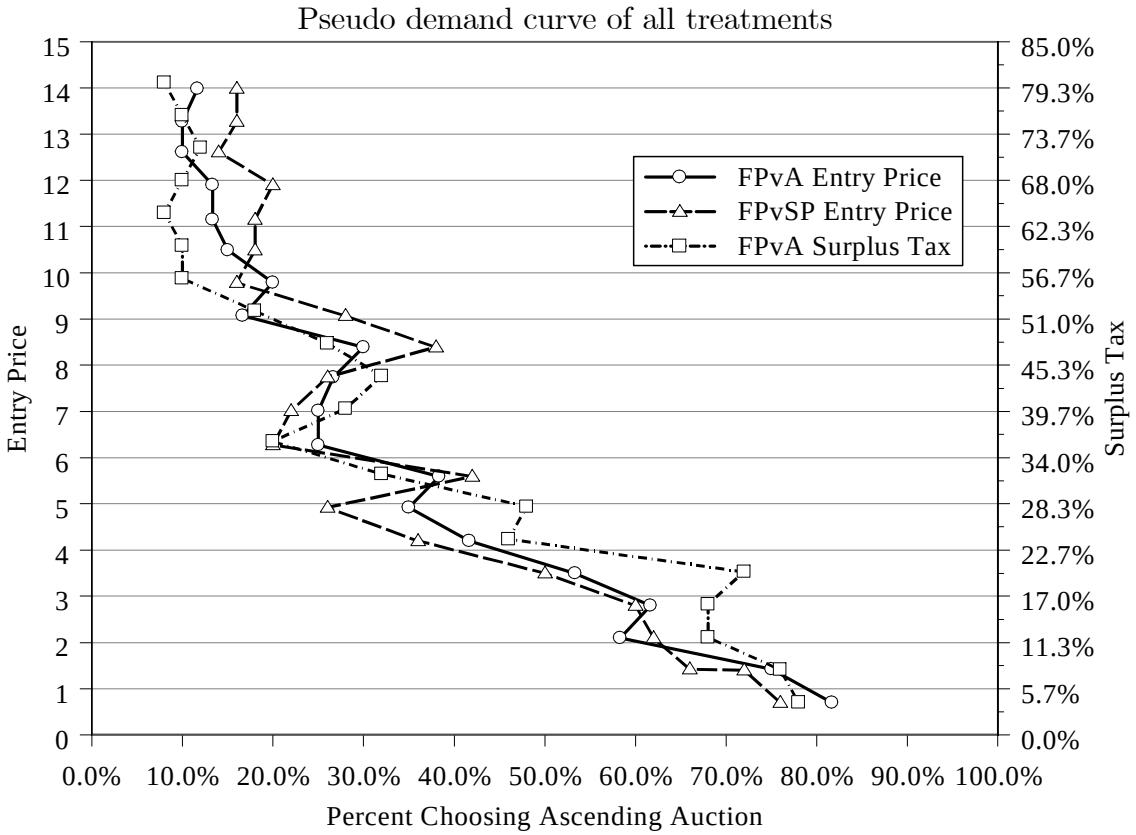


FIGURE 4


Pseudo demand curve of all treatments
Entry Price
Surplus Tax
Percent Choosing Ascending Auction
FPvA Entry Price
FPvSP Entry Price
FPvA Surplus Tax
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
0.0%
5.7%
11.3%
17.0%
22.7%
28.3%
34.0%
39.7%
45.3%
51.0%
56.7%
62.3%
68.0%
73.7%
79.3%
85.0%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0% 90.0% 100.0%