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Rationalizing Mechanism Preference in Independent Private Value Auctions

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A Thesis by

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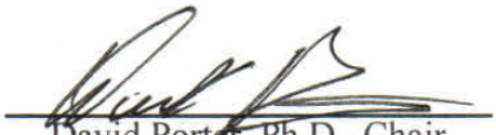

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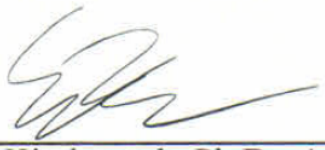

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Vita

"Let there be light."

Abstract

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In this thesis we conduct a laboratory experiment to examine the preferences of sellers and buyers for the reserve price mechanism and test their rationalizability. We use a stylized independent private value environment, a second price auction institution and a first price auction institution to investigate if the preference is monetizable. We find that the revealed preference of the sellers does not translate on the aggregate level and partially on the individual level. Further, sellers who choose public reserve prices set higher reserve prices and achieve higher sales prices. Lastly, we find that buyers are willing to pay to obtain the reserve price information.

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1. Introduction

Auctions constitute one of the most widely used formats for allocation decisions such as housing, spectrum, car parts, etc. Almost all auction formats involve a reserve price mechanism. That is sellers have a price that has to be met before they are willing to sell the item. Reserve prices in auctions can be public, meaning known to all buyers at the beginning of the auction, or private, meaning not known to the buyers at the beginning of the auction. In the field, private reserve prices are almost ubiquitous. However, theoretically it is not well established as to why a seller should choose one reserve price mechanism over the other.

Auction theory suggests that the information should be made known to the buyers. Thus, it is not clear how to rationalize the universal presence of private reserve prices in the field. Experimental evidence suggests that sellers set higher reserve prices when the reserve prices are public which seems contradictory to the current practices in the field.

This research aims at establishing empirically in a stylized laboratory environment if the preference of sellers is rationalizable, the monetizability of the preference of the buyers and the effects of mechanism preference on payoffs.

The rest of the thesis is organized as follows: Chapter 2 reviews the literature and chapter 3 describes the research questions relevant to the experiment. Chapter 4 gives an overview over the experimental design. In chapter 5 and 6 we present the results of the experimental study and discuss them. Chapter 7 concludes.

2. Literature Review

The literature on optimal auction design and reserve prices as a mechanism thereof (see [2] for a general overview and [6] for a technical overview) shows that if buyers set an optimal reserve price, have independent and identically distributed values (IID) and are risk neutral, announcing or concealing a reserve price does not affect revenue.[1] Therefore, under rational choice a preference for a type of reserve price by buyers or sellers ought not have any effect on the revenue.

To investigate the reserve price preference of buyers and sellers we employ second-price auctions (SPA) in a private value environments (IPV) since it constitutes a widely used auction format and has a dominant strategy for bidding and reserve price setting under the assumption of IID and risk-neutrality.

The study of equilibrium in second-price auctions (SPA) private value environments (IPV) goes back to [7] in his seminal work. He demonstrates that given a fixed quantity to be sold and purchased, bidders have a dominant strategy to bid up to their value and then drop-out in a standard second-price auction. This environment therefore allows us to examine, whether agents exhibit a reserve price preference and if we can rationalize this preference through increased revenue.

Empirically, [4] have already shown that subjects do not set optimal reserve prices but that with 2 bidders in a given auction, sellers set systematically higher reserve prices in the public reserve price treatment. In this experiment the mechanism, however, was exogenously fixed. Assuming that higher reserve prices are correlated with a reserve price preference, this result suggests a preference for public reserve prices. Albeit, this is at best indirect and we therefore cannot be sure that this indeed constitutes a preference. Given that higher reserve prices led to higher revenue for sellers as well, it might provide a path to rationalize a mechanism preference.

Since the reserve price information in a SPA with IPV values, in theory has no value to the buyers there is no literature that we are aware of testing whether this information can be monetized.

Concerning mechanism effects on participation [1] find evidence in auctions of Pokémon cards on eBay, that secret reserve prices can decrease the probability of a sale, participation of bidders and consequently reduce revenue of sellers. However, looking at their data, we find that their results seem to be largely driven by a treatment unrelated increase in revenue

[1] For proof of this see [3].

in their public reserve price treatment in week 2. Given the numbers of the first week for the public reserve price this seems to be spurious and not causally linked to the reserve price mechanism. Overall, with a total of 100 auctions on eBay spread out across 4 weeks, the sample size is relatively. Thus, the stylized laboratory environment allows us to control for such spurious effects like exogenous participation fluctuation on eBay and more directly examine whether participation is affected by the reserve price mechanism alone.

3. Research Questions

Given the evidence from the field and the experimental results, we are interested in examining four main questions in this experimental study. Firstly, do we find that the revealed reserve price preference of sellers translates to the simplified environment? Secondly, in absence of field evidence, what is the preference of buyers? Further, can we rationalize the preference through outcome variables related to earnings (sales price, number of items sold)? Furthermore, is the earning-relevant participation effected by the reserve price mechanism and lastly, is a potential preference of buyers monetizable?

3.1 What are the mechanism preferences of agents?

The ubiquitousness of private reserve prices in the field would suggest that this should be reflected in the experimental laboratory environment. However, [4] find that for 2 buyers, sellers set significantly higher reserve prices when a public reserve mechanism is in effect. The mechanism in their experiment was exogenously fixed however and therefore, it is not immediately evident how this reflects the preference of sellers. But it suggests that conditional on a specific number of buyers, sellers seem to prefer public reserve prices. We make the reserve price mechanism selection endogenous to examine this. The field preference would suggest that we should find private reserve prices the majority of the time. Previous experimental results suggest the opposite. Additionally, we allow the buyers to choose the mechanism to examine their preference which is not (directly) observable in the field.

3.2 Are the preferences of Buyers and Sellers rationalizable?

With the conflicting evidence for reserve price preference between the field and the laboratory, the question remains if we can rationalize the existence of such a preference. That is, we examine whether earnings through the sales price or efficiency through variables, like the number of items sold, can justify the preference for a particular reserve price mechanism. Our design allows us to test this for both buyers and sellers. That is, we can also examine a rationalizability for the potential preference of the buyers and whether it is reasonable to give the choice of reserve price mechanism to the sellers as it is in the field. That is are there

earning-relevant outcomes affected by the allocation of the power of choice over the reserve price mechanism?

3.3 "JoeEagleFeather"-Effect: Do Buyers participate differently with respect to the mechanism?

When we investigate participation, it should be noted that we are interested in the earning-relevant participation of buyers. That is, since in a private value second-price auction the equilibrium strategy is for the buyers to bid up to their value and then drop out, we investigate if the mechanism leads to a decreased participation of buyers who have a value draw which is above the set reserve price. Since the optimal bidding strategy is independent of whether a private or public reserve price is in effect, it should not affect the participation.

However, a common argument for the use of one reserve price type over the other is the endogeneity of buyer participation. In as much as participation in an auction is costly, a public reserve price that is above the value of a buyer or a secret reserve price which a buyer thinks might be above the value, might lead a buyer not to participate in an auction. This is particularly relevant to models in which buyer's value for the object is tied to whether there is uncertainty in the value that the object has (interdependent value). Since our experiment has a private value environment with no uncertainty regarding the value the object has to the buyer, the absence of an effect on participation might be thought of as a lower bound of the effect the mechanism has on bidding participation when removing the IID assumption. Thus, if buyers with certain values participate in this environment independently of the reserve price, it seems likely they would do the same in an interdependent value environment with uncertain values where participation necessarily reduces uncertainty about the value.

However, there is some reason from comments of buyers as collected by [5] to suspect that buyers react emotively to reserve price mechanisms.[1] Likely, this would lead to a decrease in participation in auctions which have a specific reserve price mechanism in place. Given that we fix the number of participants and give them no alternative auctions to participate in, this effect is hard to observe in our environment. However, if we find a participation affect that is correlated with a particular mechanism, it would likely constitute an upper bound to this effect in the field.

[1] User **joeeaglefeather** is such an example on p. 5 in [5].

3.4 Is a potential preference monetizable?

Lastly, we generally would expect a preference to be measurable in monetary terms. Therefore, we test if the anticipated public reserve price mechanism preference of buyers is monetizable. Practically, we endow them with an additional budget to be spent on obtaining the private reserve price information. Whatever is not spent, is added to the overall payout from the experiment. Thus, we have a measure of the preference although not prefect.[2]Conditional on equilibrium bidding behavior of all participants in the auction environment, the information ought not provide any benefit. Therefore, this can be viewed as a lower bound on a potential monetizability of this preference since in the field it is likely that the assumption of independent private values is not met.

[2]Since this is a first-price sealed bid auction, the revealed prices understate the value given equilibrium bidding behavior.

4. Model

In the standard second price english auction assuming independent and private values (IPV), any bidder, i, should bid according to the following bid-function:

$$b_i(v_i) = v_i$$

That is any bidder should bid up to their value and drop out at their value with being indifferent at their value.

For the reserve price information treatment, we employ a standard first price sealed bid auction. In this institution any bidder, i, should bid according to the following bid-function:

$$b_i(v_i) = (\frac{n}{n+1})v_i$$

That is any bidder should bid a participant dependent percentage of their value.[1]

Any seller, j, should set their reserve price to the optimal level independent of the mechanism. In our environment the optimal can be shown to be the midpoint of the discrete distribution, F, of 55[2] where $F = [0, 100]$.

[1]Since we did not experimentally induce the value for the reserve price information, we cannot make assumptions about the nature of the affiliation or distribution.

[2]For the proof of this refer to [6].

5. Experimental Design

5.1 Buyer's Choice Treatment

We explain the treatment designs in terms of the buyer choice treatment because it is the one that departs from the field standard of sellers choosing the mechanism. This experiment was conducted at the Economic Science Institute at Chapman University. We recruited 24 subjects for each session of which 6 were sellers and 18 buyers. Subjects stayed in their role for the entire experiment. Thus, we have a between subject design. They participated in an english second price auction and we use a random re-matching (strangers) protocol where we rotated across auctions. One session consists of 25 auctions (with 4 unpaid practice auctions). This leads to a total of 125 independent auctions per session (6 sellers * 25 auctions) and 600 auctions per treatment.

At the start of each auction, buyers are shown two buttons which they can use to indicate their vote for a given reserve price type. The buyers have ten seconds to choose their preferred reserve price mechanism. This is done before their value is drawn, to prevent a value-effect confounding of the preference. Abstention is counted as no vote towards the mechanism. Sellers simultaneously enter their prices for a public and a secret reserve price mechanism without knowing which one will be in effect. The implementation is based on majority rule or random choice as a tiebreaker. After the vote, the auction starts with the respective mechanism and reserve price in effect.

The value of the buyers for the item are randomly drawn from 0,100 in increments of 5. That is, three draws from a uniform[1] distribution between [0,100] are assigned to the three buyers.[2] During the auction, buyers observe the increasing bids on their screen. A screenshot of the interface is provided in Figure A.1 in the Appendix. A button informs the buyers if the standing bid has met the reserve price in effect. The auction continues until no bids are received for ten seconds. If a new bid is received the clock is reset to 10 seconds. If the item auctioned was sold, the buyer receives the value minus the purchase price. Sellers values are 0 and their earnings are equal to the sales price.

[1]The values were drawn uniformly but to increase the effect the reserve price had on the earnings of the seller, the gap between the highest draw and the second highest draw was increased post-draw.

[2]The value draws for the three buyers are the same across the auction treatments and across each group.

5.2 Seller's Choice Treatment

This treatment differs from the first in that sellers select the reserve price mechanism in effect and only set one reserve price. If they do not choose a mechanism, a random mechanism implemented. If they do not choose a reserve price, a zero reserve price is set.[3]

5.3 Reserve Price Bid Treatment

This treatment differs from the previous two treatments in that there is a two-stage auction process. In the first stage buyers submit a sealed bid between $[0, 2]$ to privately obtain the reserve price information. That is, one reserve price is set by the seller and this information is sold to the highest bidder. If everyone bids 0 the reserve price information is randomly allocated. Then in the second stage a regular ascending clock auction is conducted as in the other treatments. In practice this leads to the reserve price being secret for every bidder except the one who obtained the information.

[3]This occurred less than 3% of the time.

6. Results

6.1 Summary Statistics and Aggregate Preference

Table 6.1: Summary Statistics by Treatment and Mechanism

	Seller Select				Buyer Select			
	Public Reserve		Private Reserve		Public Reserve		Private Reserve	
Reserve Price	48.87	(19.95)	32.88	(20.64)	43.19	(19.44)	40.04	(22.24)
Reserve Price 10+	50.26	(20.86)	36.35	(22.43)	45.83	(19.10)	42.73	(24.04)
Buyer Select Reserve Price	-	-	-	-	40.15	(23.68)	43.27	(19.54)
Buyer Select Reserve Price 10+	-	-	-	-	45.67	(19.09)	41.19	(25.22)
Sales Price	53.34	(18.39)	46.70	(18.32)	50.42	(17.63)	51.59	(19.83)
Sales Price 10+	56.42	(19.31)	50.39	(20.87)	53.76	(18.92)	57.12	(21.34)
Item Sold	0.85	(0.358)	0.90	(0.299)	0.85	(0.360)	0.81	(0.390)
Item Sold 10+	0.89	(0.308)	0.93	(0.260)	0.89	(0.317)	0.86	(0.352)
Item Sold to highest Bidder	0.83	(0.375)	0.87	(0.334)	0.82	(0.383)	0.80	(0.401)
Item Sold to highest Bidder 10+	0.88	(0.332)	0.90	(0.299)	0.87	(0.342)	0.84	(0.365)
Efficiency (Ex Ante)	0.84	(0.363)	0.88	(0.315)	0.83	(0.367)	0.80	(0.394)
Efficiency (Ex Ante) 10+	0.88	(0.313)	0.91	(0.278)	0.88	(0.322)	0.85	(0.355)
Item not sold ($\exists v \geq rp$)	0.08	(0.267)	0.07	(0.258)	0.11	(0.311)	0.15	(0.362)
Item not sold ($\exists v \geq rp$) 10+	0.04	(0.199)	0.04	(0.199)	0.08	(0.278)	0.10	(0.296)
Mechanism Frequency	0.54	-	0.46	-	0.77	-	0.23	-
Vote Share	-	-	-	-	2.40	(0.503)	0.81	(0.390)
Vote Share 10+	-	-	-	-	2.38	(0.501)	0.82	(0.388)
Observations	600		600		600		600	
Observations 10+	360		360		360		360	

mean coefficients; sd in parentheses

Table 6.1[1] gives the overview of all relevant results by treatment and reserve price mechanism. To ensure that the experiment overall has reasonable results we check the efficiency of the institution.[2] We observe that across treatment and mechanism the institution is about 84% efficient and increases to 88% percent when dropping the first 10 periods. When investigating this further we observe that on average 85% of the items are sold (89% for the last 15 periods) across mechanism and treatment. Especially, the Item sold to highest Bidder shows that 83% (88% for the last 15 periods) of the time the item is sold to the buyer with the highest value. Thus, in only 2% (1% for the last 15 periods), conditional on the item being allocated, it is not allocated to the buyer with the highest value. To give a comparison, [4] using an SPA and IPV, averaged 92% efficiency across all auctions and treatments. Therefore, we are assured that the overall results are reasonable for an IPV and SPA auction environment.

Result 1. *Sellers on aggregate do not show a preference for the reserve price mechanism and buyers on aggregate prefer public reserve prices.*

[1] Let the reader notice that the absolute number of observations per treatment and mechanism can be inferred by multiplication of the Mechanism Frequency with the total number, 600, of auctions per treatment.

[2] Efficiency denotes the value of the buyer who obtained the item divided by the highest value drawn in that period.

This result answers our first research question about the preference in this stylized auction environment. Examining the revealed preference for private reserve prices, we observe that it does not manifest in the experimental environment as Mechanism Frequency shows that sellers are indifferent on aggregate with choosing public reserve prices 54% of the time. Buyers however, reveal a preference for public reserve prices by on aggregate 2.4 out of 3 buyers voting for a public reserve price mechanism per group.[3]

6.2 Individual Preference

Since the aggregate preference obfuscates how consistently choices are within subjects over reserve price mechanisms, we examine the preferences at the individual level. To be able to do so, we take the reserve price vote of the buyers and the choice of the sellers across all 25 auctions by subject and run a binomial test whether the distribution of their choices differs significantly from a distribution of $p = 0.5$ with a significance level of $\alpha = 0.05$. With 25 observations per subject, a binomial test reveals a statistically significant preference (p-value < 0.05) at choice probabilities of 0.28 and 0.78. We then plot the resepctive preferences as cumulative distribution functions, slicing the graph into 3 parts, where the roman numerals I, II and III denote the percentage of buyers and sellers which exhibit private reserve price preference, indifference or a public reserve price preference in ascending order.

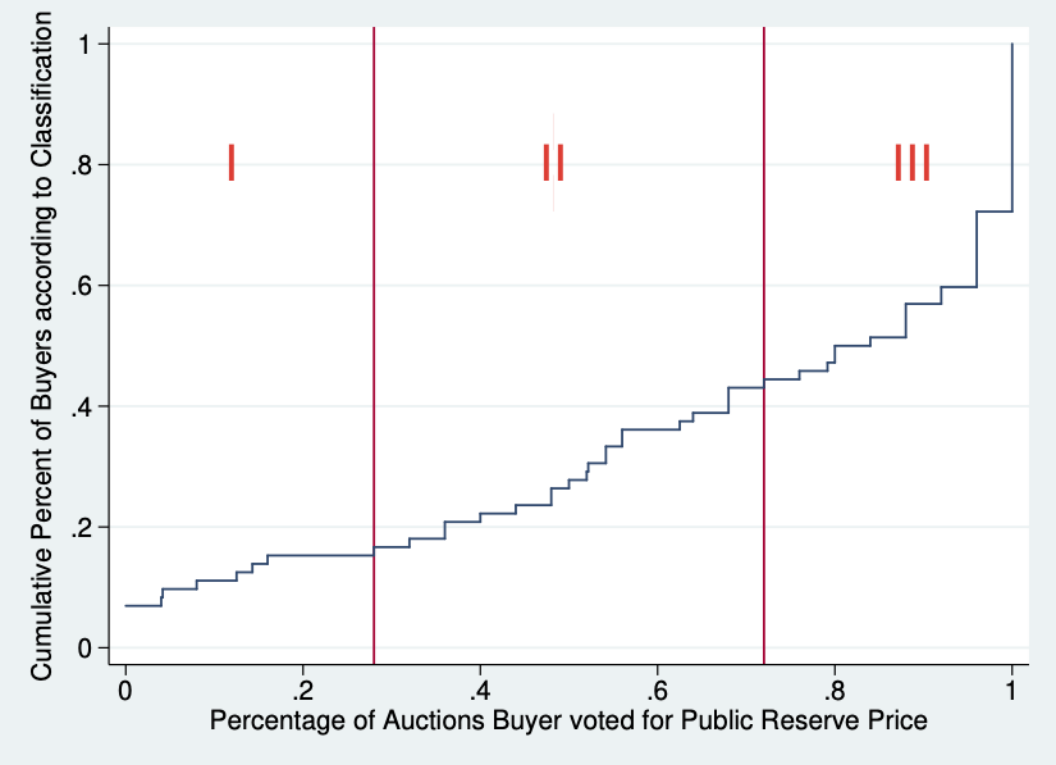
Result 2. *45% of sellers do reveal a mechanism preference at the individual level and 70% of buyers reveal an individual level preference.*

Figure 6.1 and Figure 6.2 reveal that at the individual level about 45% of the sellers do reveal a preference which is about half and half a preference for private reserve prices and public reserve prices. About 18% of buyers prefer a private reserve price and 55% prefer public reserve prices. This shows that the aggregate indifference in fact conceals an individual level preference of sellers albeit the direction is not uniform and a large indifference persists. For buyers the aggregate level results agree with the fact that a plurality of buyers prefer public reserve prices although about a fourth of them prefer private reserve prices.

[3]The reason the means of the variable Vote Share and Vote Share 10+ do not add to 1 is because of 27 cases in which the mechanism was allocated randomly due to a tie in votes.

Figure 6.1: CDF of Seller Preference on the individual level

Figure 6.2: CDF of Buyer Preference on the individual level



6.3 Rationalizability of Preference

Having discovered the pattern of preference at aggregate and individual data level, we turn to whether we can rationalize these findings in terms of patterns in relationship to earnings. Given the environment the earning-relevant factors are sales price (distributive effect between sellers and buyers) and the efficiency. The last aspects include all cases of inefficiency which are unsold items and items sold to a buyer who does not have the highest value draw. We first turn to sales prices.

Firstly, Table 6.1 suggests that sellers are choosing 16 points higher reserve prices on average when implementing a public reserve price in the seller select treatment. This difference between the mechanisms is smaller in the buyer select treatment (3 on average) but still present. It suggests, that the power of choice is affecting the reserve price set and that sellers set higher public reserve prices irrespective of the power to choose the implemented mechanism. Concerns as to whether this is an effect driven by unfamiliarity with the auction environment and mechanism, are addressed by dropping the first 10 auctions. The average reserve price increases between 3 and 4 points across all treatments and mechanisms and thus the previous inferences hold at a first glance.

This difference seems to translate into higher sales prices in accordance with the level of the reserve prices though the effect of the higher reserve prices seems to diminish.

Since sales price indicates the revenue conditional on the item selling, we examine the number of items sold as another revenue determining variable. Unexpectedly the number of items that are sold is higher in the seller select treatment for both mechanisms. This holds true even when dropping the first 10 periods. Further, the number of items that are not sold in spite of a buyer having a value higher than the reserve price seem to not differ based on mechanism but are uniformly higher in the buyer select treatment. It seems to suggest that participation is negatively affected by the power of choice for the buyers which is an unexpected result.

6.4 Effect on Reserve Price and Sales Price

Following the indications of Table 6.1 we establish if the seemingly positive correlation between public reserve prices and the power of choice over the mechanism are significant predictors of reserve prices and sales prices. Thus, we estimate the following model:

$$R = \alpha + \beta_1 M + \beta_2 T + \epsilon \tag{6.1}$$

$$S = \alpha + \beta_1 M + \beta_2 T + \epsilon \tag{6.2}$$

Where R, S, M and T denote the reserve price, sales price, reserve price mechanism and the select treatment respectively.

Table 6.2: Regression of Reserve Price, Sales Price on Treatment and Mechanism

	Reserve Price	Reserve Price [Period 10+]	Sales Price	Sales Price [Period 10+]
Seller Select	1.034	0.577	0.305	-0.505
	(0.968)	(1.164)	(1.178)	(1.469)
Public Reserve	8.418***	6.504***	2.610*	0.718
	(1.285)	(1.564)	(1.378)	(1.780)
Constant	35.96***	40.05***	49.16***	54.59***
	(1.239)	(1.531)	(1.375)	(1.735)
Observations	1200	720	1028	644
Overall R^2	0.0554	0.0408	0.00797	0.00239

Bootstrapped standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Result 2. *Sellers set higher reserve prices when choosing public reserve prices but the mechanism is not a strong predictor of sales prices. Whether buyers or sellers choose the mechanism is not correlated with the reserve price nor the sales price.*

Table 6.2 shows that the mechanism choice is a significant and positive predictor of the reserve price including when we drop the first 10 periods.[4] Sales Prices are weakly higher when public reserve prices are in effect although the effect is small (2.6).[5][6]

The treatment variable does not significantly predict either the reserve price or the sales price for any model. Since this is a pooled estimate by treatment, this result is likely concealing the differences by mechanism which we found in Table 6.1. We observe that the constants of sales price are significant and higher with respect to the constant terms of the reserve price. A likely explanation for this is that the values of the buyers are determining the sales price rather than the reserve price. This is to be expected as the expected value of the second highest buyer is 50 given the order statistics and the distribution.

[4]Since we do not have a model whether the mechanism is first chosen or the reserve price, this relationship can also be interpreted inversely.

[5]The two models in Table 6.2 for the Sales Price are not significant at $\alpha = 0.05$.

[6]Let the reader notice that this excludes all items which in effect had a 0 sales price because the item did not sell.

As we noted that Table 6.2 might be obfuscating the differences within treatment for the reserve prices by mechanism, we estimate the interaction of mechanism and treatment, through the following model:

$$R_a = \alpha + \beta M * T + \epsilon \tag{6.3}$$

$$S_a = \alpha + \beta M * T + \epsilon \tag{6.4}$$

Table 6.3: Regression of Reserve Price and Sales Price on interaction of Treatment and Mechanism

	Reserve Price	Reserve Price [Period 10+]	Sales Price	Sales Price [Period 10+]
Buyer Select × Public Reserve	2.774	2.569	-1.291	-4.033
	(1.689)	(2.279)	(1.889)	(2.734)
Seller Select × Private Reserve	-5.950***	-4.626*	-4.327**	-6.403**
	(1.973)	(2.549)	(2.126)	(3.073)
Seller Select × Public Reserve	7.270***	5.530**	1.240	-2.002
	(1.810)	(2.472)	(2.189)	(2.876)
Constant	40.33***	43.15***	52.22***	58.38***
	(1.563)	(2.071)	(1.769)	(2.506)
Observations	1200	720	1028	644
Overall R^2	0.0746	0.0535	0.0171	0.0135

Bootstrapped standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Result 3. *Sellers choice of private reserve prices is correlated with lower reserve prices and with lower sales prices.*

Table 6.3 shows that the power of choice for sellers leads to mixed effects for the reserve prices and sales prices. This is evidenced by the positive coefficient for the interaction of the public reserve price mechanism and the negative coefficient for the private reserve price mechanism with the treatment.[7] This result is robust when dropping the first 10 periods. This interaction of the treatment variable and the mechanism shows the separation that takes place for the seller select treatment. Interestingly, the interaction of the seller select treatment with private reserve prices is the only significant interaction that negatively predicts sales prices. This result is robust. That is, we see the results from Table 6.1 confirmed that Sellers who choose a public reserve price mechanism set systematically higher reserve prices. Inversely, when sellers choose the private reserve price mechanism, the reserve price and sales prices are lower.

We find that contrary to our expectations based on the revealed preference in the field, sellers choose lower private reserve prices which significantly predict lower sales prices. The in-laboratory preference is partially aligned and rationalizable for those sellers who choose public reserve prices but is contradictory for those who choose private reserve prices.

[7]The last model for the Sales Price in Table 6.3 is not significant at $\alpha = 0.05$.

6.5 Effect on Item selling

Sales Prices, however, are not the only factor to rationalize a preference as they do not reflect the unsold items. Therefore, we estimate the following model to test the effect of the treatment and mechanism on the item selling.

$$Pr(Item\ Not\ Sold = 1) = \alpha + \beta_1 M + \beta_2 T + R + \epsilon \tag{6.5}$$

$$Pr(Item\ Not\ Sold = 1 | \exists v \geq rp) = \alpha + \beta_1 M + \beta_2 T + R + \epsilon \tag{6.6}$$

Where $Pr(Item\ Not\ Sold = 1 | \exists v \geq rp)$ denotes the probability of an item not selling conditional on at least one value being above the reserve price and R is the reserve price in a given auction.

Table 6.4: Regression of Number of Unsold Items on Treatment and Mechanism

Pr(Item Not Sold)	Full Sample (A)	Full Sample (B)	$R \leq v$ (C)	$R \leq v$ (D)	$R \leq v$ & [10+] (E)	$R \leq v$ & [10+] (F)
Buyer Select	0.163*	0.246**	0.285**	0.319***	0.385*	0.472**
	(0.0970)	(0.110)	(0.114)	(0.118)	(0.206)	(0.214)
Private Reserve	-0.0565	0.260**	0.101	0.312**	0.0549	0.244
	(0.103)	(0.116)	(0.110)	(0.123)	(0.179)	(0.208)
Reserve Price		0.0396***		0.0278***		0.0342***
		(0.00398)		(0.00401)		(0.00795)
Constant	-1.213***	-3.262***	-1.540***	-2.874***	-1.827***	-3.657***
	(0.0949)	(0.248)	(0.110)	(0.246)	(0.219)	(0.550)
Observations	1200	1200	1138	1138	688	688

Bootstrapped standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Result 4. *When sellers choose the mechanism more items are sold. When conditioning on the reserve price both the seller select treatment and the public reserve price mechanism are positively correlated with the probability of an item selling.*

Table 6.4 can be thought of as a hierarchical regression which tests if the mechanism or treatment variable are themselves effecting the likelihood of an item not selling or if it is through the reserve price. Models A and B estimate the overall likelihood of an item not selling based on the mechanism and treatment. It should be noted that models A and E are not significant at the $p < 0.05$ and model C is barely significant with $p = 0.04$. That is, without the reserve price variable, the explanatory power of the treatment and the mechanism, are not sufficient.

That being said, overall the results confirm the previous impression from Table 6.1 that the buyer select treatment has a significant positive impact on the likelihood of the item not selling. The mechanism itself is not significant in model A. However, if we include

Reserve Price as a variable the private reserve price mechanism significantly predicts a higher likelihood of the item not selling in model B. Of course, the reserve price itself also is a positive predictor.

Model C and D examine the subset of cases in which at least one buyer had a value that was higher than the reserve price independent of the mechanism. The results do not differ qualitatively except for a uniform increase in strength of the predictors. Lastly, models E and F check the robustness of this result by dropping the first 10 periods. We find that the results are qualitatively the same except that the mechanism effect on the probability of the item selling is not robust.[8]

There is significant evidence that the likelihood of an item not selling is positively correlated with the power of choice for the buyers and some evidence for the mechanism effecting the likelihood of an item not selling when conditioning on the reserve price. This finding runs contrary to the field preference for private reserve prices.

6.6 Effect on Participation

Lastly, we examine the sources of inefficiency in which the buyer with the highest value did not obtain the item and as a subset of the first, the case in which the buyers with the highest bid had a value above the reserve price but the item was not sold. According to Table 6.1 this accounts for about 15% across treatments and mechanisms. That means this is the largest source of inefficiency and its overall effect is greater than reserve prices that are set above any buyer's value (roughly 7% on average).

To estimate if the mechanism affected the participation of buyers, we estimate whether the difference between the value of the buyers and their final bid is predicted by the mechanism for the buyers with the highest values.

We estimate the following model:

$$\Delta_{value-bid} = \alpha + \beta \; RP_{Quintiles} M + \epsilon \tag{6.7}$$

$\Delta_{value-bid}$ is equivalent to the difference between the final bid and the value of the buyer. M denotes the dummy for the mechanism and $RP_{Quintiles}$ denotes the 5 equal partitions of the interval $[0, 100]$ for the reserve price.

[8] Table B.1 in the Appendix shows that the same models with interaction effects are equivalent qualitatively.

Table 6.5: Regression of Participation on Reserve Price Quintiles and Mechanism

$\Delta_{value-bid}$	Did not sell to v_h (A)	Did not sell (B)	[10+] (C)
Public Reserve × 40 ≤Reserve Price < 60	-29.10*	0.0955	31.76***
	(15.67)	(8.463)	(7.406)
Public Reserve × 60 ≤Reserve Price < 80	-25.45*	6.426	32.57***
	(15.11)	(8.499)	(4.954)
Public Reserve × Reserve Price ≥ 80	-38.33*	4.126	25.46
	(20.22)	(18.28)	(21.59)
Private Reserve × 20 ≤Reserve Price < 40	-36.04*	1.837	0
	(18.65)	(11.43)	(0)
Private Reserve × 40 ≤Reserve Price < 60	-31.45**	-4.056	21.87***
	(15.31)	(7.600)	(6.395)
Private Reserve × 60 ≤Reserve Price < 80	-41.67***	-12.32	11.22
	(15.73)	(9.578)	(16.78)
Private Reserve × Reserve Price ≥ 80	-76.67***	-49.76***	-28.42***
	(16.20)	(9.428)	(9.816)
Constant	81.67***	54.32***	30.00
	(15.11)	(7.149)	(0)
Observations	138	110	44
Overall R^2	0.158	0.173	0.365

Bootstrapped standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Result 5. *There is some suggestive evidence that public reserve prices in the upper tail of the distribution deter participation of buyers.*

Table 6.5 model A includes both model B's data and the additional 28 cases in which the item sold but not to the buyer with the highest draw. We observe that the coefficients are all at least weakly significant and negative. This would suggest that the mechanism and quintile have a negative influence on the difference between the value and the bid, consequently a positive increase in bidding participation, where the effect is stronger for private reserve prices when comparing the coefficients for the same quintiles. Also, the effect is more pronounced for reserve prices in higher quintiles.

Model B shows similarly that the difference between the value and the bid decreases significantly for the highest quintile of reserve prices if the reserve price is private. However, the coefficients for the public reserve price mechanism are no longer significant. If we drop the first 10 periods, we find that the effect is significant for the mechanism both ways. That is for public reserve prices the difference increases and for private reserve prices the difference decreases with large effect sizes. We want to remind the reader that in all these cases the buyer has a value that is above the reserve price and therefore, is able to obtain the item. We suspect that this is due to buyers observing very high reserve prices when they are posted publicly and deciding (for reasons of their own) not to bid on the item as the profit

margin is relatively small. This is a plausible explanation given the size and direction of the coefficients.[9]

Thus, we find some suggestive evidence that on the margins there is a positive correlation between bidding participation and the private reserve price mechanism which would lend some rationalizability to the field preference of sellers.

6.7 Monetizing Mechanism Preference

Lastly, we examine whether the buyer preference we have found can be monetizied. That is, are buyers willing to pay for the reserve price information in this environment. To test this we run the same auction while enabling buyers to purchase the reserve price information before they observe their own values.

Table 6.6: Summary Statistics Reserve Price Bid Treatment

Reserve Price	34.24	(17.71)
Reserve Price 10+	35.48	(19.56)
Sales Price	47.06	(18.84)
Sales Price 10+	50.96	(20.84)
Item Sold	0.82	(0.385)
Item Sold 10+	0.87	(0.341)
Item Sold to highest Bidder	0.93	(0.252)
Efficiency (Ex Ante)	0.78	(0.398)
Efficiency (Ex Ante) 10+	0.82	(0.362)
Item not sold ($\exists v \geq rp$)	0.16	(0.368)
Max infobid	1.20	(0.705)
Max infobid 10+	1.12	(0.740)
Mean infobid	0.59	(0.438)
Mean infobid 10+	0.53	(0.405)
Observations	450	

mean coefficients; sd in parentheses

Result 6. *Buyers are willing to pay on average more than half of the endowment for the reserve price information.*

In Table 6.6 Mean Info Bid depicts the mean info bid across all buyers while Max Info Bid shows the average maximum bid for the reserve price information per group. Both these variables have means that differ significantly from zero and these findings are robust when

[9]Given that these are relatively small sample sizes we wish to treat this as suggestive evidence.

dropping the first 10 periods.[10] This is a rather surprising result as the reserve price can be discovered during the auction process without having to ex-ante purchase it.

To better understand the distribution of these bids and assure the reader that this is not driven by outlier behavior, Figure 6.3 displays the mean info bids by group. We observe that almost half of them bid 0 for the information which is assuring that subjects understood the mechanism. However more than half of them are willing to pay for the information and as much as 25% are willing to pay 1 for the information.[11]

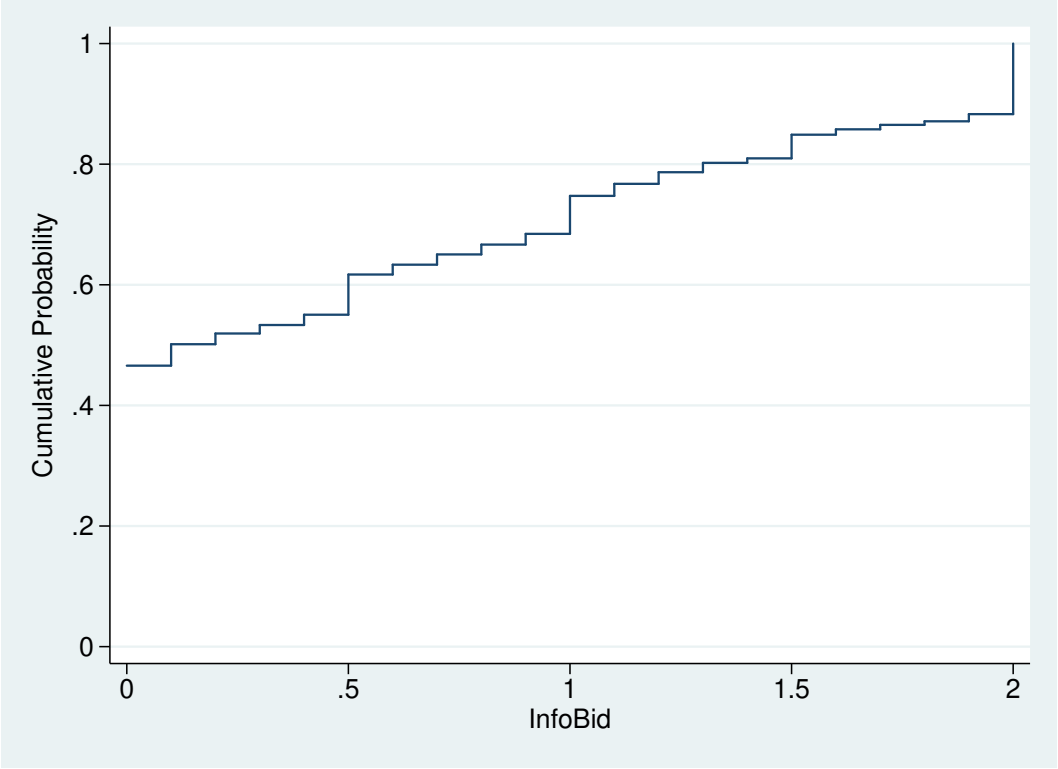


Figure 6.3: Info Bids CDF

[10]The T-Test for the Mean Info Bid and Max Info Bid being different from zero, is $p < 0.001$ across all 25 auctions and also when dropping the first 10.

[11]This decreases with time but remains significant as Figure C.1 in the Appendix shows.

7. Discussion

7.1 Preference for Mechanism and Rationalizability

Contrary to what the revealed preference in the field suggests, we find that sellers choose public and private reserve prices roughly equally often on the aggregate level and on the individual level we find half of the sellers being roughly indifferent and the rest divided between the two mechanisms. Also, sellers implement significantly higher reserve prices when choosing public reserve prices. This is in contradiction to what the field evidence would suggest but is in line with the previous findings of [4].

We find that buyers prefer the mechanism to be public both on the aggregate level and individual level which seems to confirm the ex-ante intuitive idea that a buyer would rather have more information than less. This preference is further rationalized by the fact that the likelihood of an item not selling and the sales price are higher in the private reserve price treatment. It is puzzling that the sales price difference between the mechanisms switches direction across treatments. It might however be explained by the fact that the relative sample size of the private reserve price mechanism is comparably smaller which could lead to some disproportionately higher value draws being present in these auctions. This idea receives some credibility from the higher standard deviation for the relevant estimates, such as Reserve Price, Sales Price 10+ compared to the treatment equivalent public reserve price mechanism.

This leaves us with the question why private reserve prices are ubiquitous in the field. As noted in the literature, participation is an argument presented in favor of private reserve prices. Since we have fixed participation by assigning people to groups in auctions with a fixed number of buyers, our findings can be understood to lend some credibility to the assumption that private reserve prices might induce participation vis-a-vis a higher public reserve price. Our finding that bidding participation is potentially negatively correlated with a public reserve price mechanism (see Table 6.5) would support this theory for the use of private reserve prices.

The presence of lower reserve prices in the seller select treatment for the private reserve price mechanism, which is significantly predicting lower sales prices, makes the choice of private reserve prices in the field difficult to rationalize. There is some concern that a misunderstanding of the function of the reserve price mechanism[1] or unfamiliarity with the

[1]Post experimental surveys suggest that some sellers did not understand the exact nature of the privacy

environment, might be leading to this result even though [4] find the same effect. At least the latter explanation, seems unlikely given the increase in the reserve price level for the last 10 periods which suggests that though a certain learning effect takes place, the uniformity of the increase across mechanisms and treatment it is not tied to a better understanding of any mechanism specifically.

Rationalizing the use of private reserve prices in the field, is not supported experimentally by the results we found for the likelihood of an item not selling. The likelihood of an item not selling increases for private reserve prices. This makes the preference for public reserve prices of sellers in the laboratory rational but contradicts the revealed preference in the field. One possible explanation here is that this is a spurious effect as its significance disappears when we drop the first 10 periods.

Lastly concerning the rationalizability of the power of choice over the mechanism, we discuss the unexpected negative correlation of buyer participation and the buyer select treatment. This seems counterintuitive and we propose two explanations. One explanation is that we are simply suffering some bias due to variations which are affecting our relatively small subsample for the cases in which a buyer did not participate in spite of a sufficient value draw. Given that the number of cases in which an item did not sell, is a small sub-sample and is even smaller when dropping the first 10 periods, this might explain our finding. The alternative explanation is that on average there were more cases in which high public reserve prices deterred participation due to a small profit margin for the buyers. Given the substantial variance in the reserve prices and the high frequency of public reserve prices this explanation is somewhat supported by the results we found for the reserve price quintiles in Table 6.5.

7.2 Monetizing Preference of Buyers

The strong evidence to suggest a willingness to pay for the reserve price information is contrary to the theory. There is some rationale that sellers are actually setting lower reserve prices in this treatment which might be understood as a compensatory reaction. However, keeping in mind that we have a between subject design, this seems a very unlikely explanation. It is reassuring to observe that many buyers do not bid for the information and some anecdotal excerpts from the post-experiment survey suggest that many subjects viewed the information as not relevant to the earnings. That being said, the presence of a significant

of the reserve price mechanism.

number of subjects purchasing the information throughout the experiment would suggest a willingness to pay for the information in other auctions settings. It is possible that this effect is due to a lack of understanding the earning-relevancy of the information. However, the persistence across sessions and periods, would contradict this explanation.

8. Conclusion

In our experiment we are able to show that sellers exhibit an aggregate indifference but have some preference for both private and public reserve price alike on the individual level. Buyers prefer public reserve prices both on the aggregate and individual level.

We find mixed evidence for rationalizing the ubiquitousness of private reserve prices in the field. On the one hand, sellers who choose private reserve prices set lower reserve prices and consequently, earn lower profits. This effect is mitigated through a pooling when giving the power of choice over the mechanism to the buyers. On the other hand, we find some marginal evidence that suggests that the participation of buyers is negatively affected by public reserve prices in the upper tail of the value distribution. Given that in our environment participation has no conceivable additional costs, it is likely that this factor is significant in the field where participation is endogenously determined by its cost to the buyers. As we have learned from the different sales prices, this in turn potentially influences revenue of the sellers.

Further, the rationale of giving the seller the power to choose the mechanism and the reserve price can be justified by leading to overall higher efficiency and fewer unsold items. This is a desirable result for both participants and auctioneers whose revenue depends on a combination of the number of items sold and their respective sales prices'.

Lastly, we find strong evidence to suggest that buyers are willing to pay for the reserve price information. This is a surprising result in light of the strong theoretical assumption of independent private values which in turn suggests that this might constitute a lower bound on the willingness to pay of buyers in the field.

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Appendices

A. Experimental Interface

A.1 Screenshot of Buyer Interface

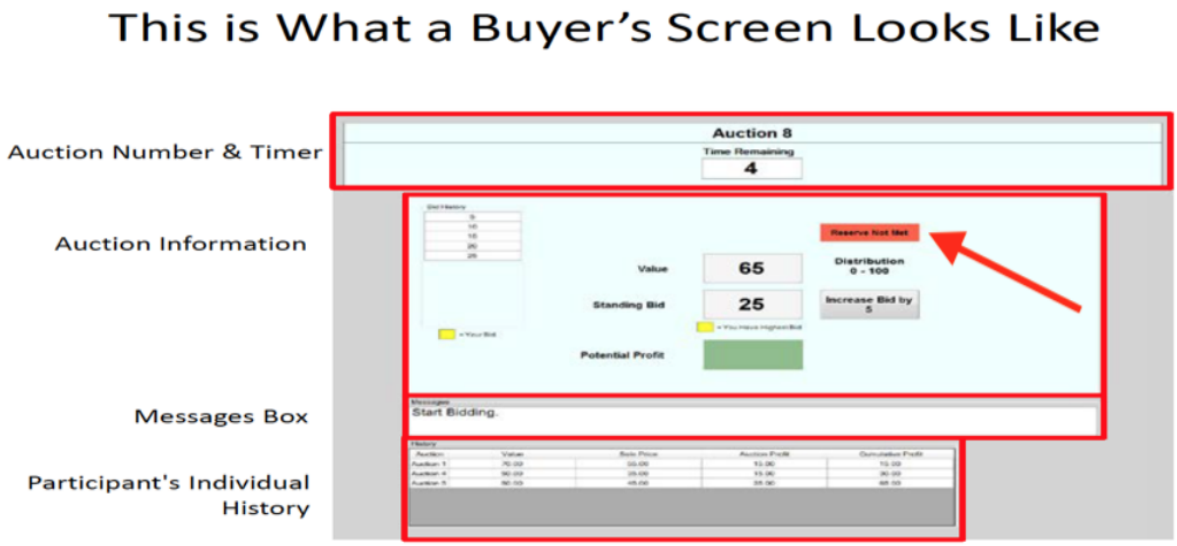

Figure A.1: Buyer auction screen

B. Probability of Item Selling

B.1 Effect on Probability of Item Sold Interaction Effects

Table B.1: Regression of probability of not selling on treatment and mechanism

Pr(Item Not Sold)	Full Sample(A)	Full Sample(B)	$R \leq v$ (C)	$R \leq v$ (D)	$R \leq v$ & [10+] (E)	$R \leq v$ & [10+] (F)
Seller Select × Private Reserve	-0.230	0.282*	-0.0350	0.326	0.0299	0.358
	(0.152)	(0.169)	(0.162)	(0.202)	(0.357)	(0.418)
Buyer Select × Public Reserve	0.0484	0.260**	0.188	0.328**	0.370	0.539*
	(0.121)	(0.125)	(0.138)	(0.153)	(0.265)	(0.277)
Buyer Select × Private Reserve	0.172	0.496***	0.418**	0.628***	0.446	0.691**
	(0.156)	(0.190)	(0.177)	(0.191)	(0.296)	(0.319)
Reserve Price		0.0397***		0.0278***		0.0345***
		(0.00397)		(0.00411)		(0.00775)
Constant	-1.138***	-3.274***	-1.476***	-2.882***	-1.816***	-3.720***
	(0.0971)	(0.244)	(0.110)	(0.267)	(0.269)	(0.566)
Observations	1200	1200	1138	1138	688	688

Bootstrapped standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C. Willingness to Pay for Reserve Price Information

C.1 Willingness to Pay for Reserve Price Information 10+

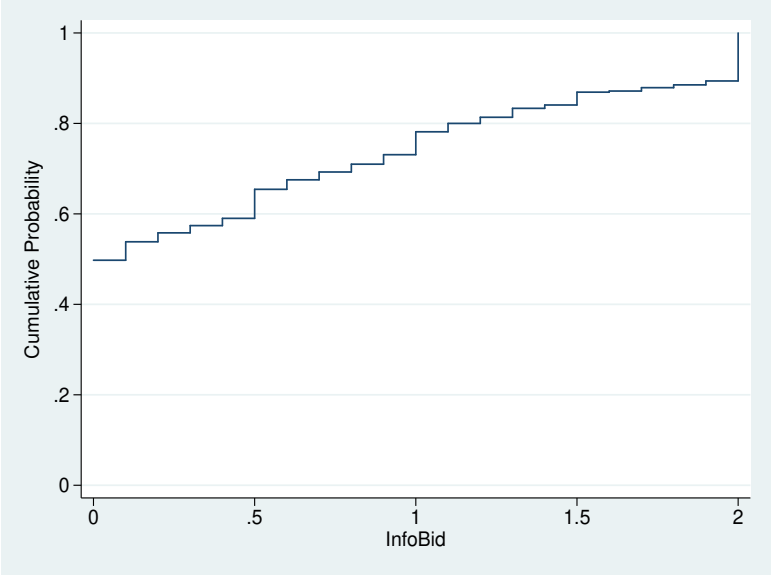

Figure C.1: Info Bids CDF Auction 10+