Reservation Values in Laboratory Auctions:

Context and Bidding Behavior

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“If you’ve never been surprised by the effect that a small change in instructions can have, then you’ve never tried it.”

– Vernon Smith, keynote plenary session
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Rome, Italy
June 2007
How to present auction environments?

- What do our subjects see when they participate in a standard (first-price, indivisible object, private values) auction experiment?
  - If you purchase the object, you earn your value minus the price
  - If you do not purchase the object, you earn zero
  - The only way to earn money in the experiment is to purchase units in the auction (“Just win, baby!”)

- Personal experience from classroom experiments
  - “I tried to win the auction.”
  - “I wanted to avoid getting no payoff.” (as distinct from “zero”)

- Is the “standard” framing the best way to interpret or present the theoretical environment to subjects?
Framing the reference point

- There are two ways to interpret the “idiosyncratic private reservation value” in the standard independent private values model:
  1. Represents underlying differences in preferences or tastes
  2. A reserve value generated from the ability to purchase a close substitute outside the auction market

- In our standard methodology of presenting the auction environment, we adopt either interpretation (1), or interpretation (2) at the “interim” stage.

- The zero point in the utility scale, then, is a status quo, against which auction outcomes are compared.
  - But is zero utility perceived the same as zero earnings?
A story

- Consider an agent who is interested in purchasing an iPod.
  - iPods are widely available at consumer electronics shops
  - iPods are also sometimes sold at auction on eBay

- Suppose the agent finds out he can purchase the unit locally at a consumer electronics shop. His “reservation value” is then the total cost (posted price plus travel, etc.) of purchasing locally. He may then decide to try his luck at buying at auction on eBay.

- What is the agent’s reference point?
  - His current iPodless state, or
  - Does he anticipate that he will purchase, and that therefore the status quo is that he buys at his local shop?

- Previous studies have always “reduced” the problem to the latter.
Our implementation

- Our design builds upon our paper with Ray Battalio (EE 2007, hereafter called TWB).

- Cohorts of nine bidders, grouped randomly and anonymously into three \{first-price, Dutch\} auction markets with three bidders each period, for 60 periods
  
  - Will focus on the sealed-bid first-price here; see the paper for discussion of the Dutch results, which are qualitatively similar.

- Same sequence of matching and reservation values used. Values were drawn uniformly from $0.15, \ldots, 5.85, 6.00$; bids were multiples of $0.10$.

- Only difference is in language used in presenting the environment, and the periods which were paid.
Subject interface (RV version)

<table>
<thead>
<tr>
<th>Period</th>
<th>Resale Value</th>
<th>Your Bid</th>
<th>Market Price</th>
<th>Purchase</th>
<th>Earnings</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.05</td>
<td>1.20</td>
<td>1.20</td>
<td>Yes</td>
<td>0.75</td>
<td>5.75</td>
</tr>
</tbody>
</table>
Instructions: Resale Value frame

Your Earnings for a period will depend on whether you purchase the commodity in your market, and on the Market Price. If you purchase a unit of the commodity, your earnings for that period will be calculated according to the equation

\[
\text{Your Earnings} = \text{Resale Value} - \text{Market Price}
\]

If you do not purchase a unit of the commodity, then your earnings for that period will be zero.

- Subjects were paid earnings from all 60 periods.
Instructions: Outside Price frame

You will purchase exactly one unit of the commodity each period. If you purchase the unit of the commodity in the market, your earnings for that period will be calculated as

Your Earnings = $6.20 - Market Price

If you do not purchase the unit of the commodity in the market, then you will purchase a unit outside the market at your Outside Price. Your Earnings for the period are then computed as

Your Earnings = $6.20 - Outside Price

- Subjects were paid 7 of 60 periods, selected at random at the end of the session.
Theoretical considerations

- Symmetric RNNE is unchanged between the two treatments.
- With the outside price interpretation, if we assume a symmetric equilibrium with $N$ bidders having the same utility function:
  - we have that
    \[
    \lim_{x \to 0} b'(x) = \frac{N - 1}{N},
    \]
    where $b(x)$ is the equilibrium bid function, and $x$ the outside option price. Note that this is independent of the utility function. (!)
  - Risk aversion results in bid functions which are convex in the resale value
  - These properties are qualitatively true of best-reply functions in general
- With resale values, symmetric NE with identical CRRA utility functions is linear with slope $> \frac{N - 1}{N}$. 
Symmetric equilibria with CRRA in OP

- Equilibrium bid functions, \( N = 3 \), for two common CRRA utility functions:

  - The lower dotted line plots risk-neutral equilibrium (slope 2/3); the upper dotted line is the 45-degree line.

![Diagram showing equilibrium bid functions for Log utility and Square root utility](image)
Results: Market Performance (sealed)

- Significantly (statistically and visually) lower under OP.
Results: Market Performance (Dutch)

Percentage of surplus extracted: RV (solid) vs. OP (dashed)
## Results: Market Performance (quantitative)

<table>
<thead>
<tr>
<th>Type</th>
<th>Cohort</th>
<th>Revenue (All Periods)</th>
<th>% of surplus extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1-10</td>
</tr>
<tr>
<td>Sealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RV-1</td>
<td>377.2</td>
<td></td>
<td>86.0</td>
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<tr>
<td>RV-2</td>
<td>378.6</td>
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<td>87.9</td>
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<tr>
<td>RV-3</td>
<td>376.1</td>
<td></td>
<td>85.8</td>
</tr>
<tr>
<td>Mean</td>
<td>377.3</td>
<td></td>
<td>86.6</td>
</tr>
<tr>
<td>OP-1</td>
<td>344.7</td>
<td></td>
<td>74.3</td>
</tr>
<tr>
<td>OP-2</td>
<td>339.4</td>
<td></td>
<td>74.6</td>
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<tr>
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</tr>
<tr>
<td>RV-1</td>
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<td>OP-1</td>
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<td>70.8</td>
</tr>
<tr>
<td>Mean</td>
<td>310.2</td>
<td></td>
<td>64.6</td>
</tr>
</tbody>
</table>
Results: Individual Behavior, RV frame

Typical resale value bid functions

Reservation value vs Bid

S20041201-3

S20041201-4

S20041201-6
Results: Individual Behavior, OP frame

Typical outside price bid functions

Reservation value

Bid

S20060802–5
S20060802–8
S20060911–8

0 100 200 300 400 500 600

0 100 200 300 400 500 600

0 100 200 300 400 500 600
Results: Individual behavior

- In both treatments, approximately 50% of subjects employ a linear bid function, and 50% of subjects employ a “concave” bid function.
  - “Concave” here means we can reject linearity in favor of a piecewise-linear bid function where the slope at higher reservation values is lower than the slope at lower reservation values.
- Under OP, estimated slopes at the high end of the bid function are very low – between .2 and .4.
- This is a rational response (in a comparative statics sense): the best-reply function to the empirical distribution of bids under OP is very flat above $4.00.
- Consistent with a simple cognitive-hierarchy style story:
  - About 50% of subjects are “nonstrategic,” in that they employ a simple heuristic;
  - About 50% are strategic, in that they approximately best reply to the empirical distribution of bids.
Best-response functions (for risk-neutral bidder)

Best response against empirical bid distribution

Expected earnings-maximizing bid vs Reservation value
Related literature

- **Schram** (Journal of Economic Methodology 2005) discusses “internal” versus “external” consistency in laboratory experiments.

- **Plott and Zeiler** (AER 2005) on the extent to which the “willingness to pay/willingness to accept” gap is robust to framing and procedures.

- **Harrison, List, Towe** (Ecma 2007) on the difference between auctions where the object’s value is known with more or less ambiguity or uncertainty.
(Somewhat) related literature in auctions

- **Palfrey and Pevnitskaya** (forthcoming, JEBO): outside options with risk-averse bidders
  - Their outside option is implemented ex ante; therefore, there is selection based upon risk preferences
  - Illustrates why simply allowing bidders to “opt-in” to the auction doesn’t solve the “experiment(er)-induced demand” issue.

- **Kirchkamp, Reiss, Poen** (2004-): combine private values with outside options
  - Essentially, their presentation reduces to the standard model with nonuniform values or nonuniform outside prices

- **Kirchkamp and Reiss** (2004): allowing bids below minimum value reduces overbidding – a Pyrrhic victory?
Summary

• We investigate an alternate method of framing the process of inducing values in standard private-values auction environments

• We find that
  – Market prices are significantly lower when using a presentation where reservation values are explained as outside prices.
  – This is driven primarily by a segment of the population of bidders doing a better job of tracking the empirical best-reply function.