Fear of Losing in Dynamic Auctions: An Experimental Study

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Dynamic auctions

• *Traditional dynamic auction*. Bidders iteratively announce bids—can name any higher price

• *Clock auction*. Auctioneer names price. Bidders respond with desired quantity. Continue until no excess demand
Market design question

• What is best uniform pricing rule in a clock auction?
  – Revenue
  – Efficiency
  – Simplicity

• Approach
  – Theory, including behavioral theories
  – Experiment
Motivation

• Clock auctions commonly used in practice
  – Electricity
  – Gas
  – Radio spectrum
  – Emission allowances
  – Financial securities

• Sealed-bid uniform-price auction is a single-round clock auction

• Pricing rule is basic issue influencing behavior
Clock auction advantages

• Simple and transparent price discovery process
• Bidders can
  – Base bids on information revealed in the auction
  – Substitute among related products
  – Aggregate complimentary products
  – Manage aggregate constraints such as budget or portfolio risk
• Proven success in the lab and field
Clock auction in practice

• Auction conducted in discrete rounds
  – Simpler and more robust communication
  – Mitigates tacit collusion
• Activity rule: Bidders cannot increase their quantities as price increases
  – Prevents bidders from concealing their intentions
• Information policy: Aggregate demand, not individual bids, announced to bidders
  – Mitigates tacit collusion
• Pricing rule
  – Price that clears market (supply = demand)
Discrete clock auction

- Clearing Price: P6, P5, P4, P3, P2, P1
- Round 1: P1
- Round 2: P2
- Round 3: P3
- Round 4: P4
- Round 5: P5
- Round 6: P6
Problem of overshoot

Price

Overshoot

Round 6

Round 5

Round 4

Round 3

Round 2

Round 1

Quantity

Aggregate demand

Supply
Let bidder name prices of desired reductions

![Diagram showing price and quantity bid by an individual across different rounds. Each round has a specific set of prices (P1 to P6) and a quantity bid by an individual. The diagram illustrates the progression from Round 1 to Round 6.]
Make discrete rounds continuous
Pricing rule in clock auction

• With discrete rounds and items, typically have an interval of clearing prices

• Most common pricing rules are
  – *Highest-rejected bid* (HRB): lowest price that clears the market
  – *Lowest-accepted bid* (LAB): highest price that clears the market
Example: 1 item, 2 bidders

- Round price increases from $70 to $80
- Blue exits at $73; Red exits at $77
Example: 1 item, 2 bidders

- Round price increases from $70 to $80
- Blue exits at $73; Red stays in at $80
Clock auctions without exit bids

• Designate provision winner after each round

• Provisional winner wins at current price if excess supply in next round

• Proposed for India 3G auction

Note: Unlike simultaneous ascending auction, provisional winner must continue bidding in next round to maintain eligibility to bid again
Example: 1 item, 2 bidders

- Blue and Red are both in at $70; Blue provisional winner
- Blue and Red both exit at $80; Blue wins at $70
Experimental setting

• 2 bidders, 1 item
• Independent private values drawn uniformly on [50, 100]
• Clock auction with 6 bid levels
  \{50, 60, 70, 80, 90, 100\}
• Clock ticks up until one or both exit
• 3 treatments (number of subjects)
  – HRB: highest-rejected bid (30)
  – LAB: lowest-accepted bid (32)
  – LABpw: lowest-accepted bid with provisional winner (30)
• 1 practice + 20 real auctions with randomly matched pairs
• Observe winning price and whether you won
• Paid $5 + experimental profits/10 ($19.77 on average)
Standard theory: maximize profit
HRB example and theory

- Truthful bidding is a weakly dominate strategy
- HRB auction is efficient
- HRB auction maximizes revenues
LAB example and theory

- Exit bid is strictly less than value
- LAB auction is efficient
- LAB auction maximizes revenues

Red wins at $77
LABpw example and theory

- Provisional loser stays in if value not reached
- Provisional winner drops out before value reached
- LABpw auction is inefficient
- LABpw auction does not maximize revenues

<table>
<thead>
<tr>
<th>$100</th>
<th>Out</th>
<th>Out</th>
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<tbody>
<tr>
<td>$90</td>
<td>In prov. win</td>
<td>In</td>
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<tr>
<td>$80</td>
<td>In prov. win</td>
<td>Out</td>
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<tr>
<td>$70</td>
<td>In prov. win</td>
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<td>$60</td>
<td>In prov. win</td>
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<tr>
<td>$50</td>
<td>In prov. win</td>
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Comparison under standard theory

• Revenues
  HRB = LAB > LABpw

• Efficiency
  HRB = LAB > LABpw

• Simplicity
  HRB > LAB > LABpw

So why is LAB so often used in practice?

Why has India proposed LABpw for its 3G spectrum auction?
Behavioral theory: fear of losing
Fear of Losing

- Negative emotion of losing at a profitable price is salient (loser’s regret)

  - Payoff
    - Win at a profitable price: \( v - p \)
    - Lose at an unprofitable price: \( 0 \)
    - Lose at a profitable price: \( -\alpha(v - p) \)
Fear of losing

• Loser’s regret explains overbidding in first-price auction
  – Filiz-Ozbay and Ozbay 2007
• Fear of losing, not joy of winning, explains overbidding
  – Delgado et al. 2008
• Loss aversion with a reference point of winning does same
  – Koszegi and Rabin 2006
  – Ratan 2008
Fear of losing

- **HRB**
  - No loser regret, so bid to full value
  - No change in revenues

- **LAB**
  - Still shade bid, but loser regret mitigates shading
  - Revenues increase in regret coefficient $\alpha$

- **LABpw**
  - Provisional winner exits early
  - Revenues increase in regret coefficient $\alpha$
Comparison with fear of losing

• Revenues (for sufficiently large $\alpha$)
  $\text{LAB} > \text{LABpw} > \text{HRB}$

• Efficiency
  $\text{HRB} = \text{LAB} > \text{LABpw}$

• Simplicity
  $\text{HRB} > \text{LAB} > \text{LABpw}$

*With revenue objective, may prefer LAB*
Revenue as a function of $\alpha$
Results
# Outcomes by treatment

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<thead>
<tr>
<th></th>
<th>HRB</th>
<th>LAB</th>
<th>LABpw</th>
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<tbody>
<tr>
<td>Efficient allocation</td>
<td>92%</td>
<td>90.31%</td>
<td>85.33%</td>
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<tr>
<td>Maximum gain from trade per auction</td>
<td>84.04</td>
<td>83.82</td>
<td>83.05</td>
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<tr>
<td>Gain from trade per auction</td>
<td>83.34</td>
<td>83.37</td>
<td>82.25</td>
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<tr>
<td>Realized gain from trade</td>
<td>99.17%</td>
<td>99.46%</td>
<td>99.04%</td>
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<td>Payoff per auction</td>
<td>15.99</td>
<td>13.52</td>
<td>12.92</td>
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<tr>
<td>Revenue per auction</td>
<td>67.35</td>
<td>69.85</td>
<td>69.33</td>
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<tr>
<td>Seller’s share</td>
<td>80.81%</td>
<td>83.79%</td>
<td>84.30%</td>
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<tr>
<td>Number of auctions</td>
<td>300</td>
<td>320</td>
<td>300</td>
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Actual and theoretical revenue
HRB: valuation vs. exit bid
LAB: valuation vs. exit bid

MLE
\[ \alpha = 1.29 \]
\[ \text{s.e.} = 0.16 \]
LABpw: actual vs. theoretical exit

![Histogram showing the comparison between actual and theoretical exit rounds. The x-axis represents the difference in exit rounds, and the y-axis represents the number of observations. The histogram indicates that most actual exits are close to the theoretical exit, with a peak at 0 difference.](image-url)
Conclusion

• First-price overbidding extends to dynamic auctions
• LAB may yield higher revenues than HRB
• In practice, LAB revenues may be higher if bids are limited by budget constraints
• HRB is preferred if main objectives are efficiency and simplicity (spectrum auctions)