Information Asymmetries in Pay-Per-Bid Auctions: How Swoopo Makes Bank

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Apple iPad 64GB WiFi

The 9.7-inch high-resolution screen makes iPad perfect for watching HD movies, TV shows, podcasts, music videos, and more.

Price: $50.85
Bidders in the last 15 minutes: 25
Bidding History

1 BidButler + $0.01 + 00:00:03

00:00:07

BID

It costs $0.60 to place a bid. Each bid raises the auction price by $0.01.

This auction will end latest on Jul-11-2010 at 04:17 PDT

Recently sold for $48.94

Savings:
Price: $829.00
Auction Price: $50.85
Savings: $778.18

Have you tried using our BidButler yet?

In case you haven't, check out this helpful bid agent now!

Want to know more?
In 25 secs Swoopo earned $9.60 in bid fees.
In 25 secs Swoopo earned 11 * 60 cents = $6.60 in bid fees
In 25 secs Swoopo earned 11 * 60 cents = $6.60 in bid fees

Not bad. That’s about $1000/hour.
(...but of course not all auctions are as profitable)
2008 revenues were $28,300,000
"Take your time in finding the right auction, don’t rush into it."

Adam O. - Story, IA

"I won a new Mino Flip camera. I use my flip every week."

Geoffrey M. - Summit, OH

"I received my item less then 5 days after my auction."

Ken B. - Canyon, ID

"Can you say excited? I told a couple of close friends immediately ..."

Marvin W. - Wake, NC

"Love the site and so far I have won 3 Items."

Julio G. - Alameda, CA
The New York Times
“...a scary website that seems to be exploiting the low-price allure of all-pay auctions.”
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The New York Times
“...devilish...”

msn money
“The crack cocaine of online auction websites.”
Previous work predicts *profit-free equilibria*

[Augenblick ’09, Platt et al. ’09, Hinnosaar ’09]

Some of this prior work tries to explain the profit using risk-loving preferences and sunk cost fallacies.
Previous work predicts profit-free equilibria

[Augenblick ’09, Platt et al. ’09, Hinnosaar ’09]

**OUTCOMES dataset**

(121,419 auctions)

- Total number of bids
- Bid fee
- Price increment
- Retail price
- Winner
Previous work predicts profit-free equilibria
[Augenblick ’09, Platt et al. ’09, Hinnosaar ’09]

Overall profit margin: 85.97%

From OUTCOMES dataset
Previous work predicts profit-free equilibria
[Augenblick ’09, Platt et al. ’09, Hinnosaar ’09]
Basic symmetric pay-per-bid model

- $n$, number of players
- $b$, bid cost (60 cents for Swoopo)
- $v$, value of the auctioned item ($10s$ to $1,000s$)

Fixed-price auctions

- $p$, fixed purchase price (usually $0$)
- last bidder acquires item for price $p$

Ascending-price auctions

- $s$, price increment (between 1 and 24 cents/bid)
- last bidder acquires item for $sq$
- where $q$ number of bids

Predicts zero profit!
Symmetric equilibrium for fixed-price auctions

**Indifference condition:** A player’s expected profit per bid should be zero.

\[
\mu, \text{ probability that somebody places a subsequent bid} \quad b = (v - p)(1 - \mu)
\]

\[
\mu = 1 - \frac{b}{v - p}
\]

\[
\beta, \text{ probability that an individual player places a subsequent bid} \quad 1 - \mu = (1 - \beta)^{n-1}
\]

\[
\beta = 1 - \left( \frac{b}{v - p} \right)^{\frac{1}{n-1}}
\]
Symmetric equilibrium for ascending-price auctions

**Indifference condition:** The player making the \((q+1)\)st bid is betting \(b\) no future player will bid.

\[
\mu_{q+1}, \text{ probability that somebody places the } (q+1)\text{st bid}
\]

\[
b = (v - sq)(1 - \mu_{q+1})
\]

\[
\mu_{q+1} = 1 - \frac{b}{v - sq}
\]

\[
\beta_{q+1}, \text{ probability that a player bids after } q \text{ bids have been placed}
\]

\[
1 - \mu_{q+1} = (1 - \beta_{q+1})^{n-1}
\]

\[
\beta_{q+1} = 1 - \left( \frac{b}{v - sq} \right)^{\frac{1}{n-1}}
\]

Time varying
Expected revenue in equilibrium is $v$

- A player puts a value of $b$ at risk with each bid for an expected reward of $b$.
- This implies zero profit per bid in expectation.
- Since players are symmetric the expected profit across all bids is also zero.
- At the end of the auction an item of value $v$ is transferred from the auctioneer to the winner.
- This has to be counterbalanced by a total cost of $v$ in bid fees which is the auctioneer’s revenue.
Our contribution: Asymmetric players

3 key parameters

- population estimate, $n$
- bid fee, $b$
- item valuation, $v$

1) What if these parameters vary from player to player?
2) What if some players aren’t aware that they vary?
Mistaken population estimates for fixed-price auctions

Not just a theoretical concern: Swoopo displays the list of bidders active in the last 15 minutes.
Mistaken population estimates for fixed-price auctions

**TRACE dataset**
(4,328 auctions)

- Time and user of each bid
- Plus all attributes of **OUTCOMES** dataset
Mistaken population estimates for fixed-price auctions

Thought experiment: True number of players is $n$ but everyone thinks there are $n-k$ players

$$b = (v - p)(1 - \lambda) \Rightarrow \lambda = 1 - \frac{b}{v - p}$$

where $\lambda$ is the perceived probability someone places a subsequent bid

**Mistaken players**

$$\beta = 1 - (1 - \lambda)^{\frac{1}{n-k-1}}$$

$$\mu = 1 - \left( \frac{b}{v - p} \right)^{\frac{n-1}{n-k-1}}$$

**Omniscient players**

$$\beta = 1 - (1 - \mu)^{\frac{1}{n-1}}$$

$$\mu = 1 - \frac{b}{v - p}$$

Reminder: $\beta$ pr. one player bids, $\mu$ pr. some player bids
Mistaken population estimates for fixed-price auctions

Overestimation

Underestimation

\[ n = 50, \ v = 100, \ b = 1 \]
Mistaken population estimates for fixed-price auctions

Over and underestimation in equal measures: **Swoopo still profits**

\[ n = 50, \ v = 100, \ b = 1 \]
Mistaken population estimates for fixed-price auctions

• Underestimates of the number of players increase Swoopo's profit.

• Overestimates of the number of players decrease Swoopo's profit.

• But not symmetrically!

• Mixtures of over/underestimates with the right mean will increase Swoopo's profit!
Modeling general asymmetries

Two groups of players, A & B

**Group A**
- size $k$
- bid $b^A$
- value $v^A$
- population estimate $n^A$
- aware of B

**Group B**
- size $n-k$
- bid $b^B$
- value $v^B$
- population estimate $n^B$
- unaware of A
A Markov chain for modeling general asymmetries

\[ P_A(q + 1) = P_A(q)p_{AA}(q) + P_B(q)p_{BA}(q) \]

\[ P_{WA}(q + 1) = P_A(q)p_{AWA}(q) + P_{WA}(q) \]
Mistaken population estimates for ascending-price auctions

Trivial upper bound: \((Q + 1)(b + s)\)
Asymmetries in bid fees
Asymmetries in bid fees

65% winners’ discount

55% winners’ discount accounting for previously lost auctions
Asymmetries in bid fees for fixed-price auctions

- Group A of size $k$ has a discounted bid and they know it.
- Group B of size $n-k$ think everyone is paying $b$.  

$n = 50$, $v = 100$, $b^B = 1$
Asymmetries in bid fees for ascending-price auctions

- Group A of size $k$ has a discounted bid and they know it.
- Group B of size $n-k$ think everyone is paying $b$.

$n = 50, \ v = 100, \ b^B = 1, \ s = 0.25$
Varying object valuations

Sony Bravia KDL-40XBR9 40" 1080p 240Hz LCD TV

Experience powerful performance and superior design with the premium Sony BRAVIA XBR9 HDTV

Auction Price: $33.03
Bidder: Udonator

Statistics
Bidders in the last 15 minutes: 15

Bidding History
- $33.03 by Udonator
- $33.02 by Prince1108
- $33.01 by Kranman052
- $33.00 by Mr17
- $32.99 by Caferco
- $32.98 by Mr17
- $32.97 by Caferco
- $32.96 by Mr17
- $32.95 by Caferco

"Can you say excited? I told a couple of close friends immediately..."
- Marvin W., Wake, NC

Recently sold for $32.23

Worth up to: $1,599.00
Auction Price: $33.03
Savings: $1,565.97

Buy this product now:
Worth up to: $1,599.00
Bid Rebate: $0.00
Purchase price: $1,599.00

Swoop it Now
Now you can buy this item at the discounted price. Bid to win. Bid to save.

Notice that you get a discount equal to the amount of bids you’ve placed.

>> Product details

>> more info
Varying object valuations
Same auction id...
Different currency!
Same players...
Different value!
Varying object valuations for fixed-price auctions

- Revenue is naturally bounded by maximum valuation
- The more players overestimate the item the better for Swoopo

\[ n = 50, \ v = 100, \ b^B = 1 \]
Collusion & shill bidding: The role of hidden information
Collusion

**Many players model**
A group of players form a coalition and they secretly agree not to outbid each other.

**Single player model**
A single player secretly controls many identities and never bids when leading the auction.

Difference between two models is the tie-breaking rule.
Collusion:
Ascending-price auctions, many-players model

- A coalition of size $k$ is playing against $n-k$ players

- Swoopo’s revenues shrink as the coalition size grows

- The coalition gains an advantage exponential to its size in winning the auction

$n = 50, \ v = 100, \ b = 1, \ s = 0.25$
Shill bidding: Ascending-price auctions, many-players model

- A \((\rho, L)\)-shill enters the auction with probability \(\rho\) and bids until \(L\) bids have been made.
- A shill produces no revenue for the auctioneer.
- If the shill wins all revenue is profit (no item is shipped).

\[ n = 50, \; v = 100, \; b = 1, \; s = 0.25 \]
Swoop it Now

Buy the item at a discount equal to your bid fees

Committed player: someone who is willing to bid up to a certain price and then exercise the Swoop it Now option
In the presence of many committed players the resulting game is a **game of chicken**.

Assuming a common valuation of $v$ and a retail price of $r$ the **maximum loss is bounded** by $v-r$.

<table>
<thead>
<tr>
<th></th>
<th>Quit</th>
<th>Play Till End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quit</td>
<td>Both lose bidding fees</td>
<td>Lose bidding fees/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Get discount</td>
</tr>
<tr>
<td>Play Till End</td>
<td>Get discount/</td>
<td>Both lose $v-r$</td>
</tr>
<tr>
<td></td>
<td>Lose bidding fees</td>
<td></td>
</tr>
</tbody>
</table>
Is there evidence of chicken?

Look for **duels** - auctions culminating in long bidding sequences by two players
Evidence of chicken
The Duel
Evidence of chicken

The Duel

201 bid long duel
Evidence of chicken

This is Thedduel

This is cikcik

201 bid long duel
Evidence of chicken

<table>
<thead>
<tr>
<th>% of auctions</th>
<th>Duel length</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>$\geq 10$</td>
</tr>
<tr>
<td>5%</td>
<td>$\geq 20$</td>
</tr>
<tr>
<td>1%</td>
<td>$\geq 50$</td>
</tr>
</tbody>
</table>
Players willing to playing chicken need a way to announce it

A natural way is to be aggressive by placing many bids in rapid succession

\[ \text{Aggression} = \frac{\text{Number of bids}}{\text{Average response time}} \quad \text{(bids}^2 \text{ / sec)} \]

<table>
<thead>
<tr>
<th>Aggressive bidders</th>
<th>Number of auctions</th>
<th>Auction revenue (as % of retail price)</th>
<th>Mean winner profit margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1,699</td>
<td>62%</td>
<td>77%</td>
</tr>
<tr>
<td>1</td>
<td>493</td>
<td>135%</td>
<td>51%</td>
</tr>
<tr>
<td>≥ 2</td>
<td>834</td>
<td>246%</td>
<td>26%</td>
</tr>
</tbody>
</table>
Signaling intention: Aggressive bidding

- Highly skewed aggression distribution
- Winners most aggressive, but profitable winners less so
- Those who lost demonstrate about average aggression
- Successful strategies are mostly concentrated at aggression ranks lower than average
- The highly aggressive players are responsible for most of Swoopo’s profits
Conclusions and Remarks

- Information asymmetry can have **powerful effects** in pay-per-bid and similar auctions.

- Is this understanding useful? What is the **value of the missing information** in this setting?

- Swoopo operates in the grey area between **gambling** and “**entertainment shopping.**”

- Is this a **fad** or the **future**?
Thank you.
Any questions?