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

John W. Byers
Computer Science Dept.
Boston University

Michael Mitzenmacher
School of Eng.& Appl. Sci.
Harvard University

Georgios Zervas
Computer Science Dept.
Boston University

Bid now - these auctions are about to end

Avatar The Game (Nintendo DS)

00:00:18

$1.20

Bigvictor74

BID

Sharp AQUOS LC46LE700UN 46-Inch LED HDTV

00:00:11

$21.58

Joneyke

BID

Kindle DX 9.7" (Latest Generation)

00:00:18

$29.88

Badboyutsch

BID

Toshiba Satellite 16.0-Inch Laptop

00:00:29

$94.28

Kraylic666

BID

Apple iPhone 3GS 32GB (Black)

00:01:22

$3.41

2deep

BID

Auction ID: 313644

Add auction to watchlist

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

Recently sold for $48.94


NO IMAGE AVAILABLE
NO IMAGE AVAILABLE
NO IMAGE AVAILABLE

Click on an image to enlarge it

Price: **$50.85**

All prices are in US Dollars

Bidder: **Cg1234**

1 BidButler + $0.01 + 00:00:03

10 **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

Savings:

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

BIDDING HISTORY | Statistics

Bidders in the last 15 minutes: 25

$50.85	**Cg1234**	**BidButler**
$50.84	MI1234	Single bid
$50.83	05116040855	Single bid
$50.82	Cg1234	BidButler
$50.81	schawnarc	Single bid
$50.80	MI1234	Single bid
$50.79	schawnarc	Single bid
$50.78	Cg1234	BidButler
$50.77	MI1234	Single bid

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 [?] * 60 cents = **$** [?] 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

REGISTER

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

Ken C. - Canyon, ID

REGISTER

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

Geoffrey M. - Summit, OH

REGISTER

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

Marvin W. - Wake, NC

REGISTER

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

Julio G. - Alameda, CA

REGISTER

The New York Times

"...a scary website that seems to be exploiting the low-price allure of all-pay auctions."

The New York Times

"...a scary website that seems to be exploiting the low-price allure of all-pay auctions."

The New York Times

"...devilish..."

The New York Times

"...a scary website that seems to be exploiting the low-price allure of all-pay auctions."

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]

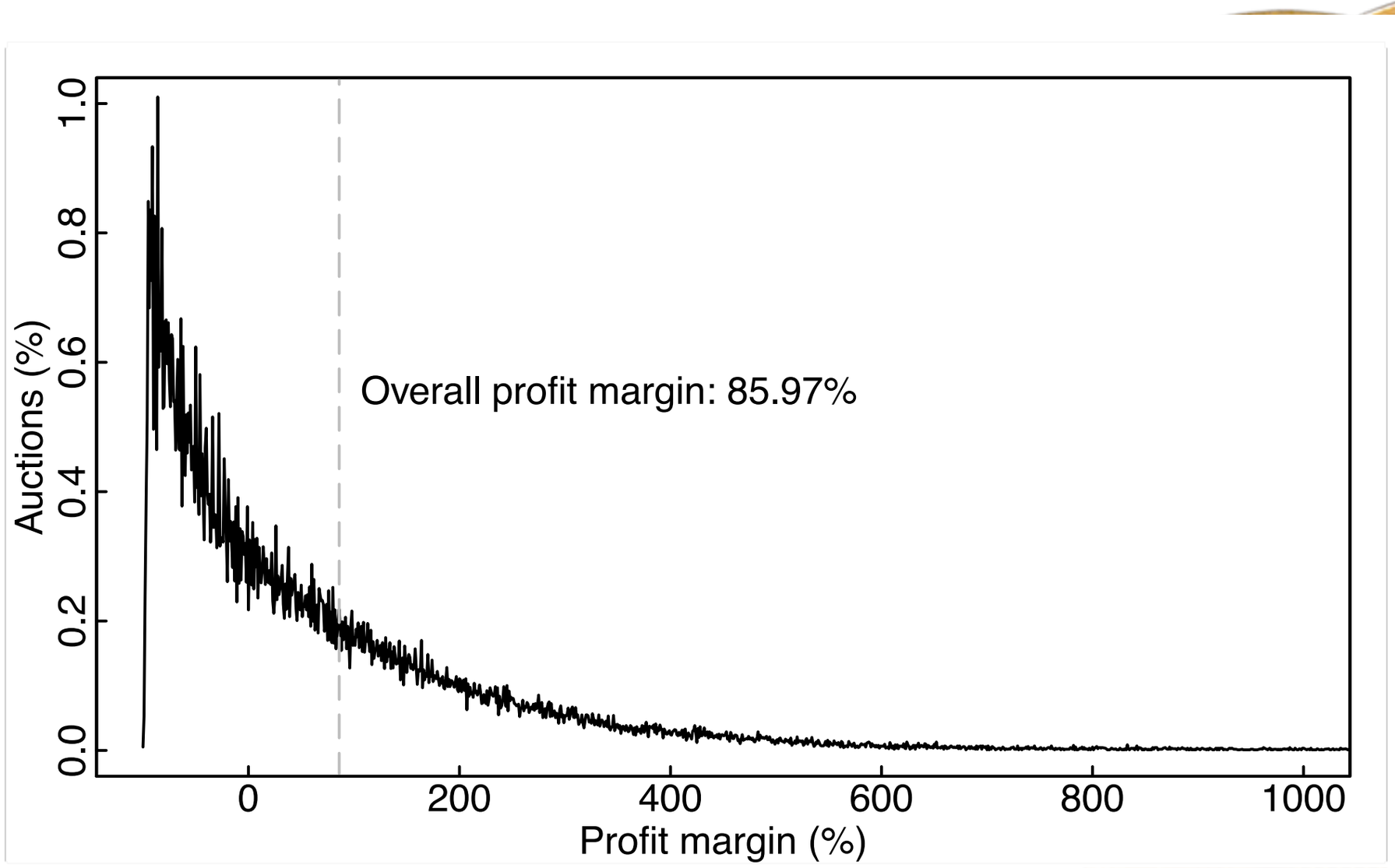
OUTCOMES dataset

(121,419 auctions)

- Total number of bids
- Bid fee
- Price increment
- Retail price
- Winner

Previous work predicts *profit-free* equilibria

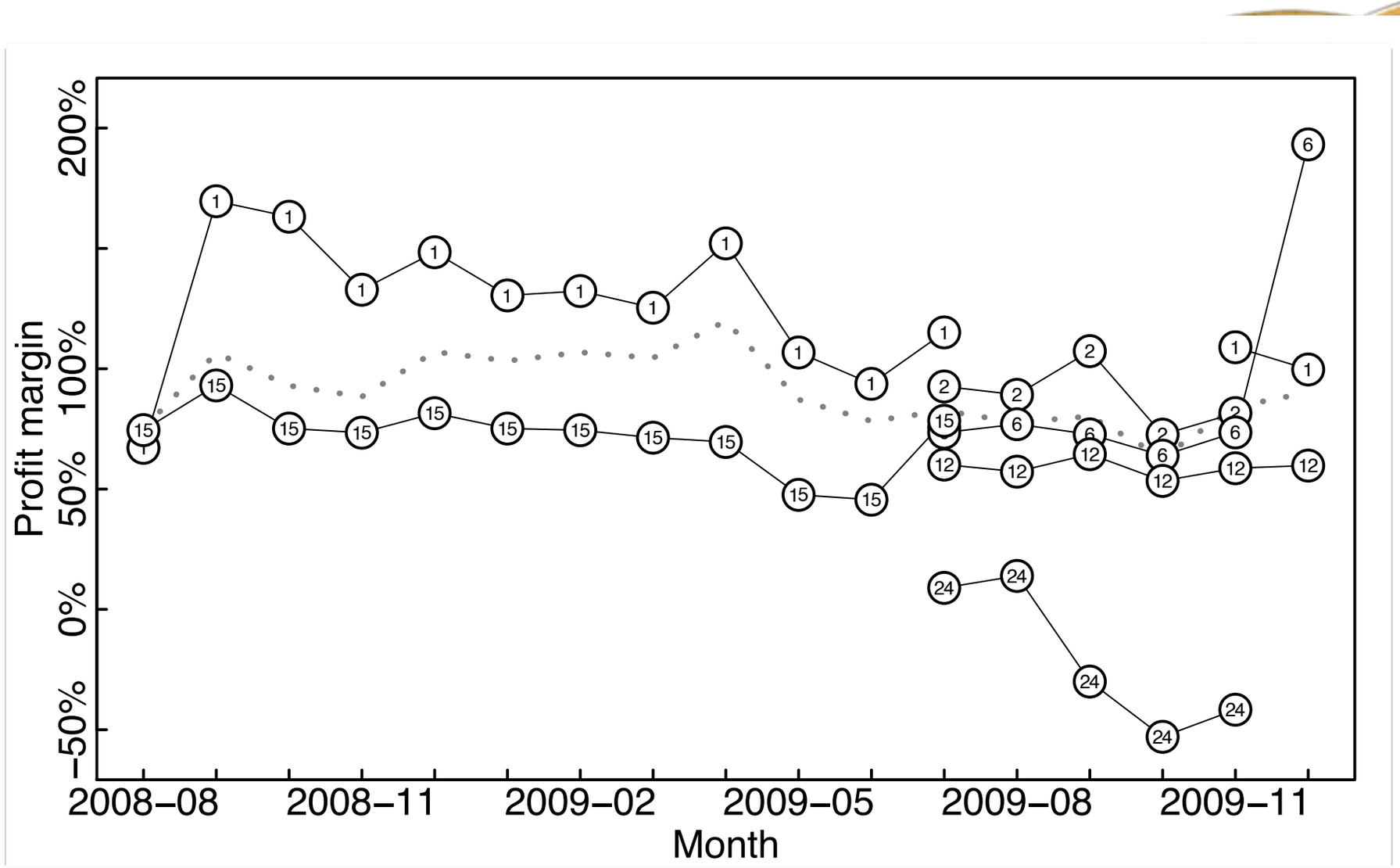
[Augenblick '09, Platt et al. '09, Hinnosaar '09]

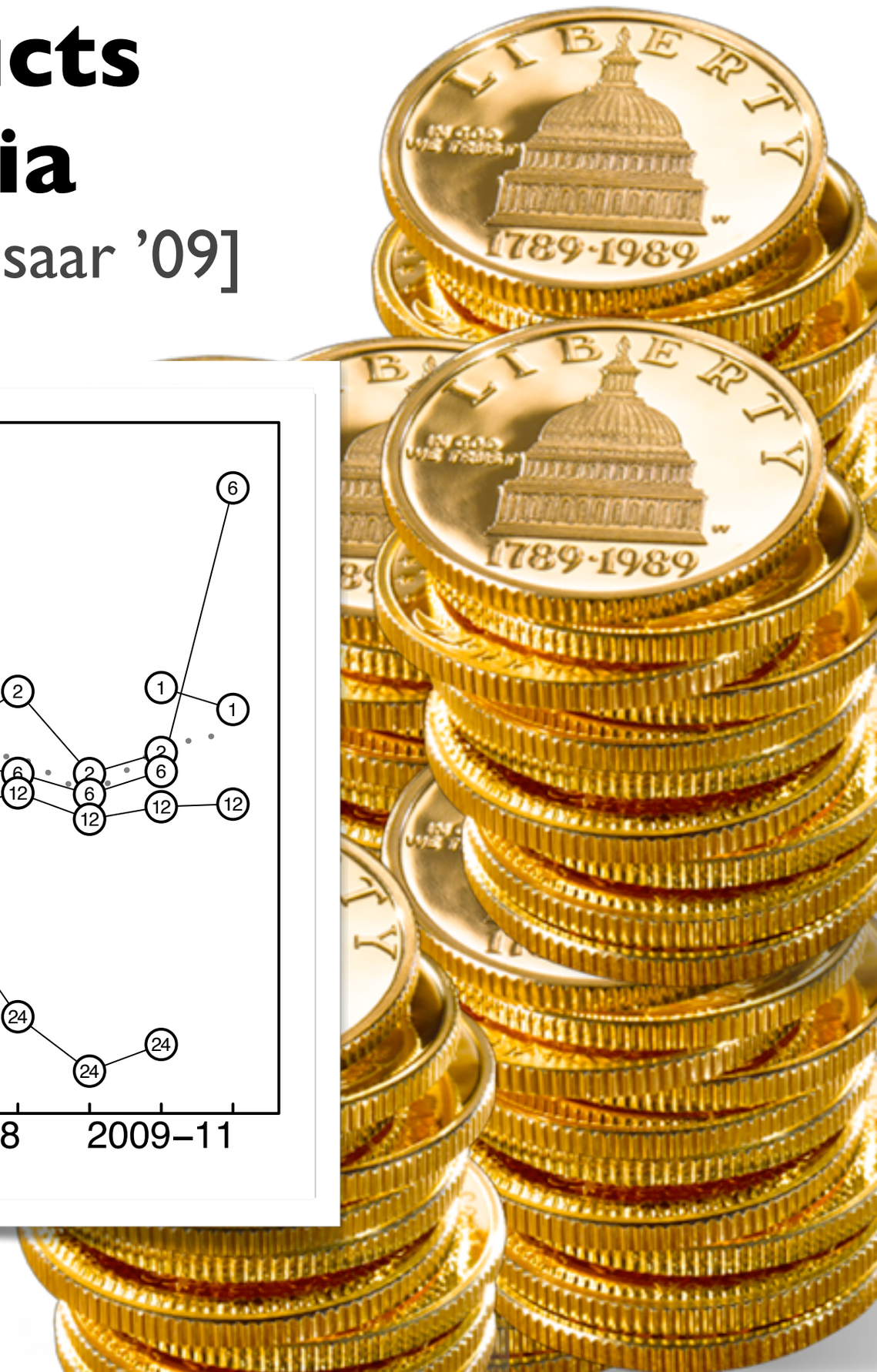


From OUTCOMES dataset

Previous work predicts *profit-free* equilibria

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





From OUTCOMES dataset

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.

μ, probability that somebody places a subsequent bid

$$b = (v - p)(1 - \mu) \quad \rightarrow \quad \mu = 1 - \frac{b}{v - p}$$

β, probability that an individual player places a subsequent bid

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

Symmetric equilibrium for ascending-price auctions

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

μ_{q+1}, probability that somebody places the $(q+1)$st bid

$$b = (v - sq)(1 - \mu_{q+1}) \quad \rightarrow \quad \mu_{q+1} = 1 - \frac{b}{v - sq}$$

β_{q+1}, probability that a player bids after q bids have been placed

$$1 - \mu_{q+1} = (1 - \beta_{q+1})^{n-1} \quad \rightarrow \quad \beta_{q+1} = 1 - \left(\frac{b}{v - sq} \right)^{\frac{1}{n-1}}$$

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

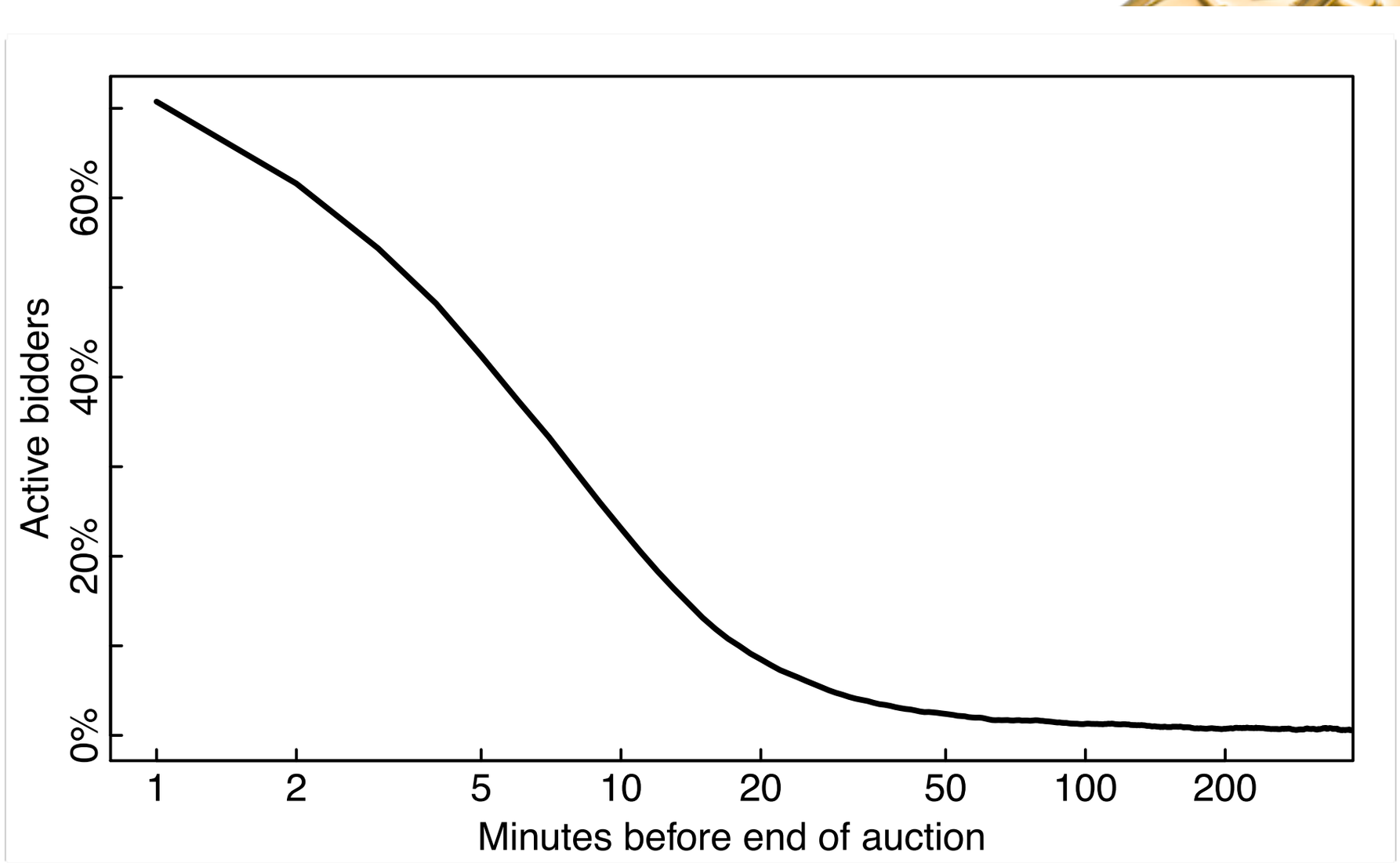
- population estimate, ***n***
- bid fee, ***b***
- item valuation, ***v***

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 λ is the **perceived probability** someone places a subsequent bid

Mistaken players

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

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

≫

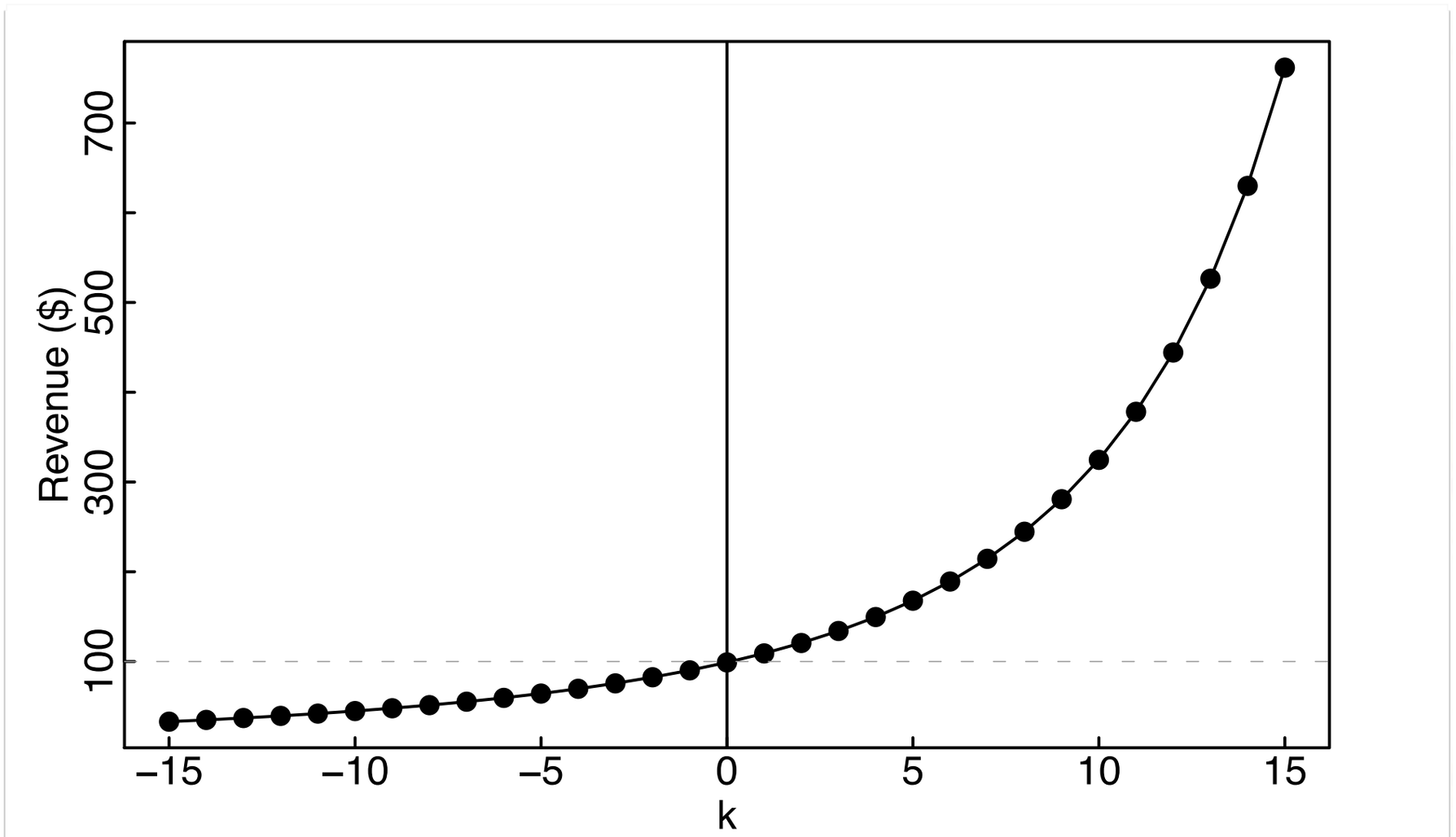
Omniscient players

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

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

Reminder: β pr. one player bids, μ pr. some player bids

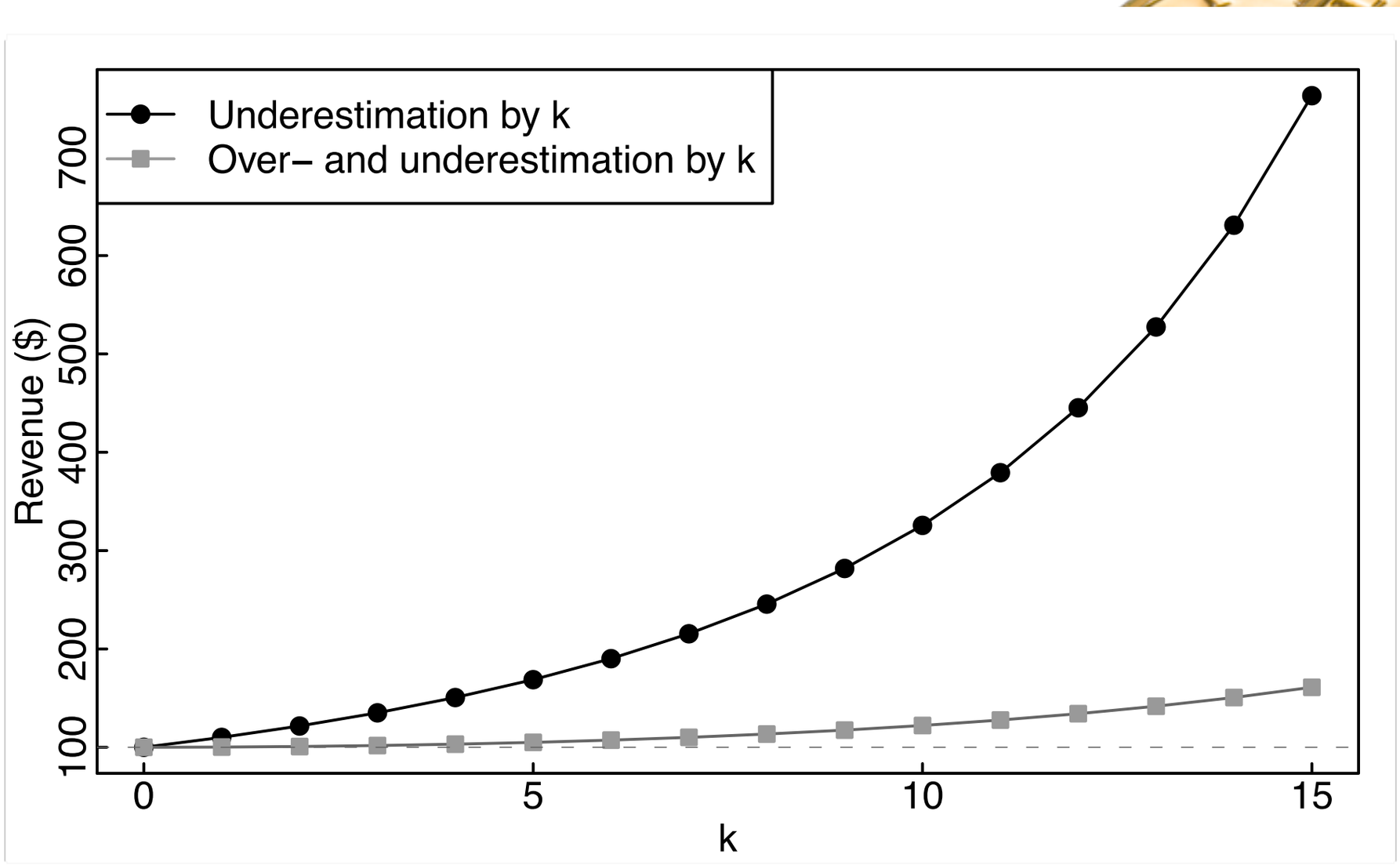
Mistaken population estimates for fixed-price auctions



$n = 50,\ v = 100,\ b = 1$

Mistaken population estimates for fixed-price auctions

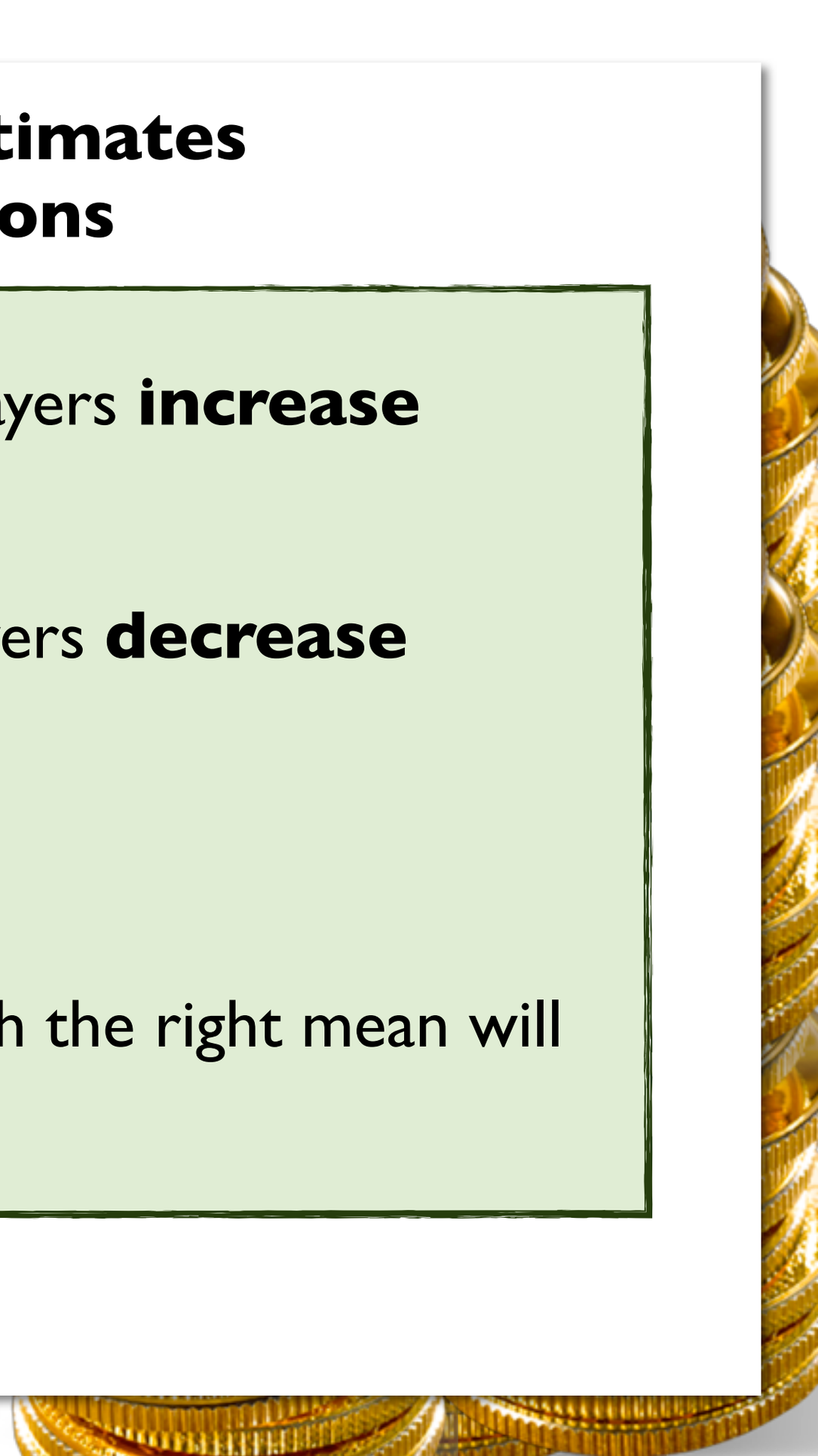
Over and underestimation in equal measures: **Swoopo still profits**



$n = 50,\ v = 100,\ b = 1$

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

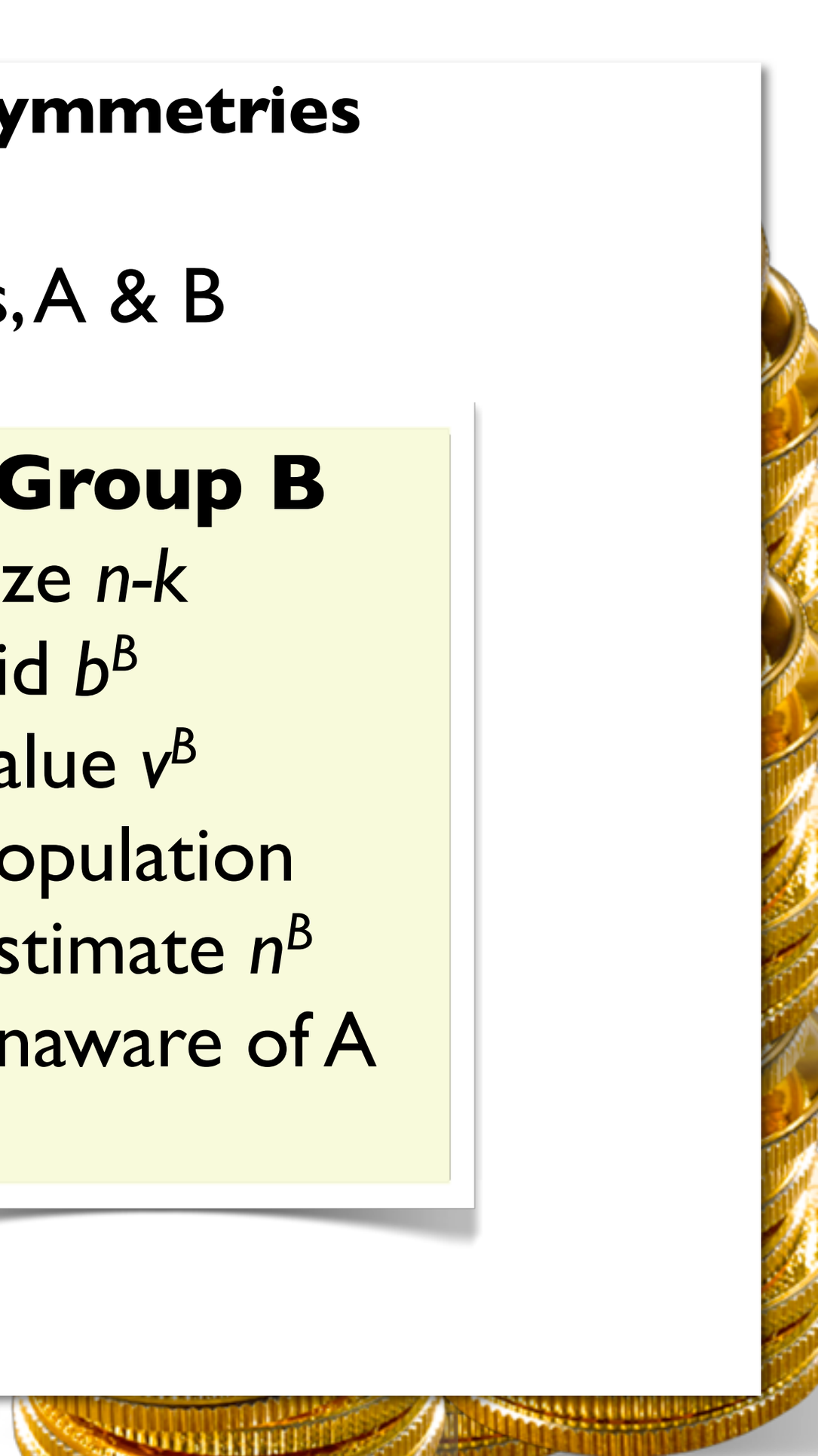
Two groups of players, A & B

Group A

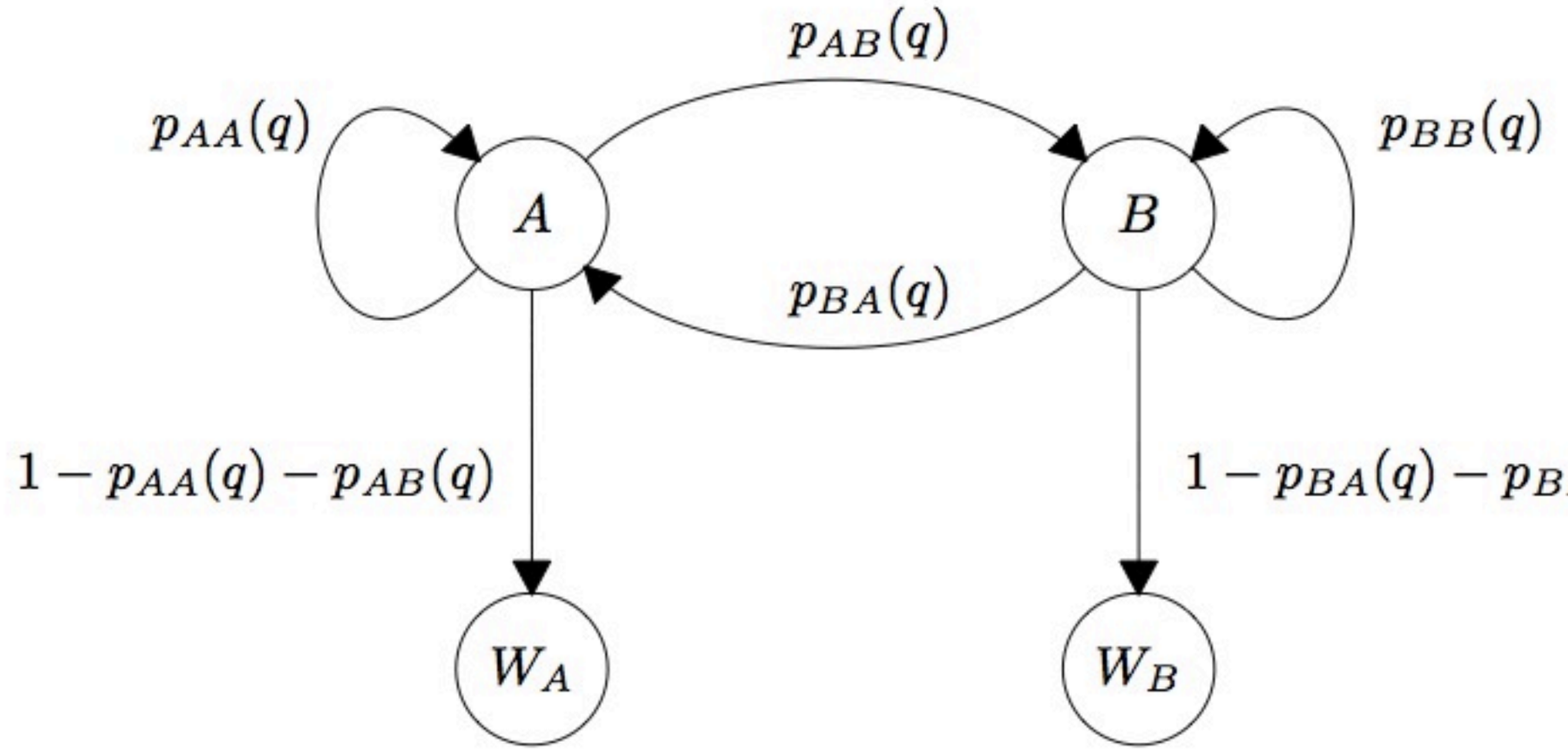
- size k
- bid b^A
- value v^A
- population estimate n^A
- aware of B

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

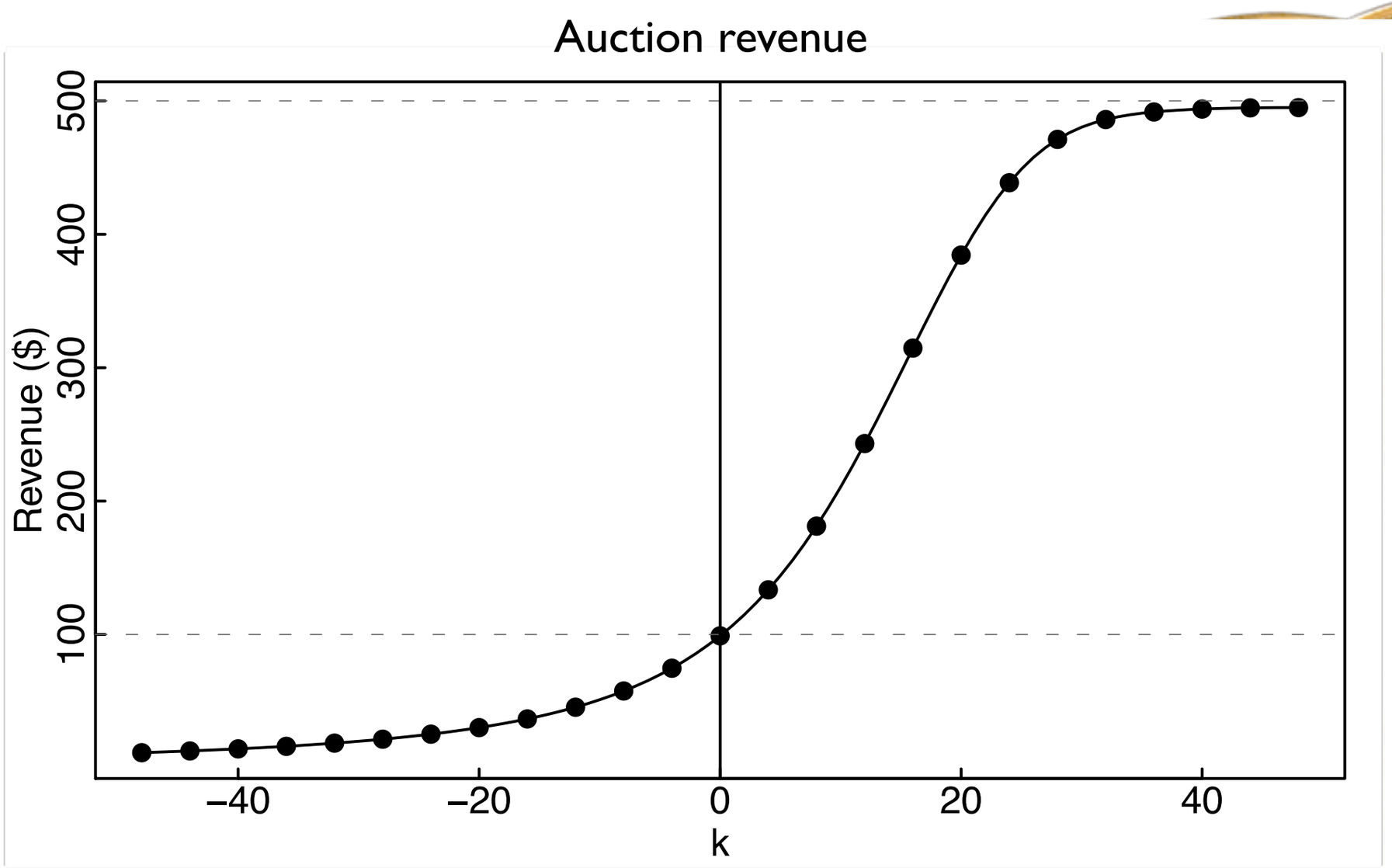


$$P_A(q+1) = P_A(q)p_{AA}(q) + P_B(q)p_{BA}(q)$$

$$P_{WA}(q+1) = P_A(q)p_{AW_A}(q) + P_{W_A}(q)$$

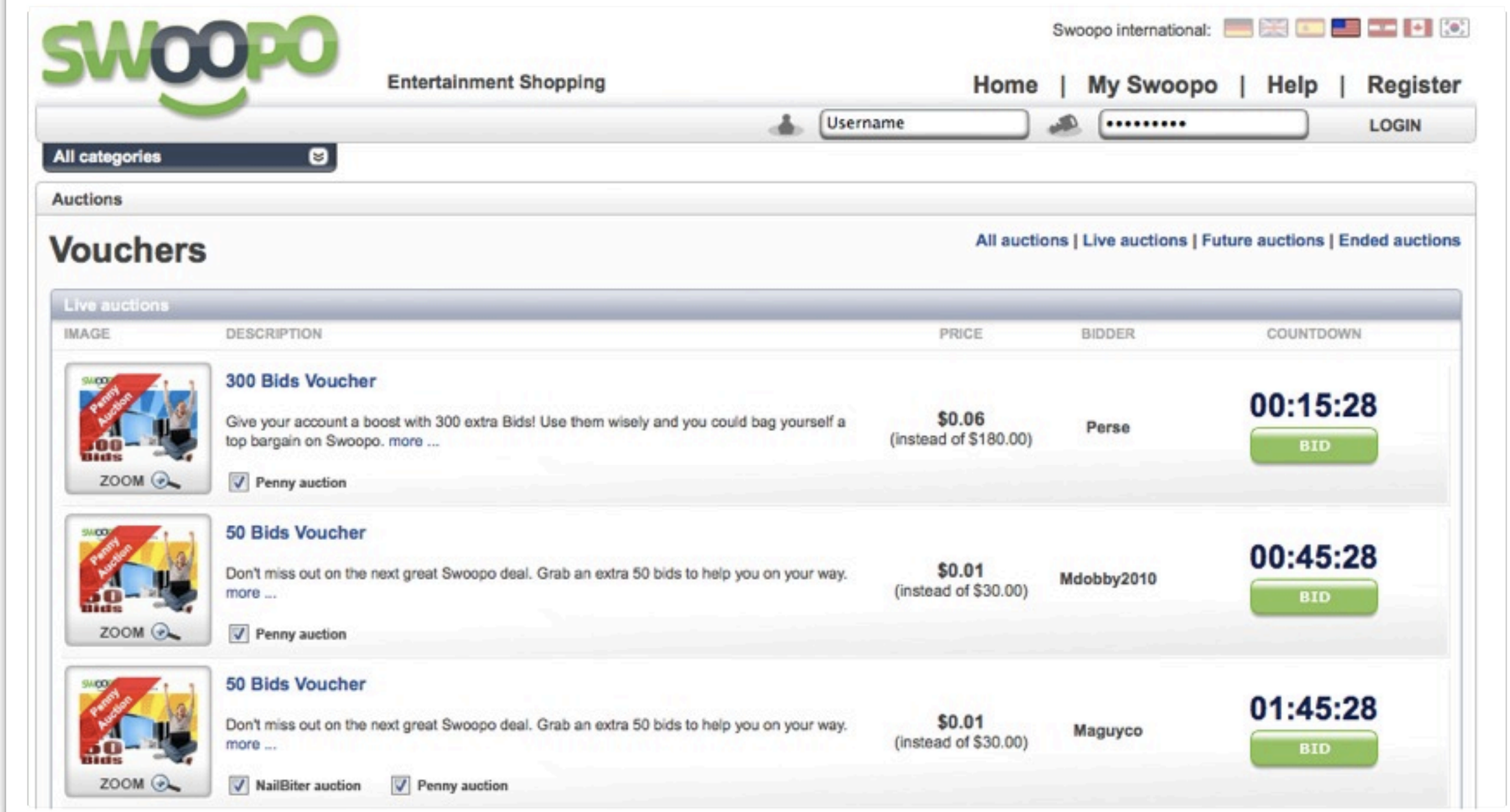
Mistaken population estimates for ascending-price auctions

Trivial upper bound: $(Q+1)(b+s)$



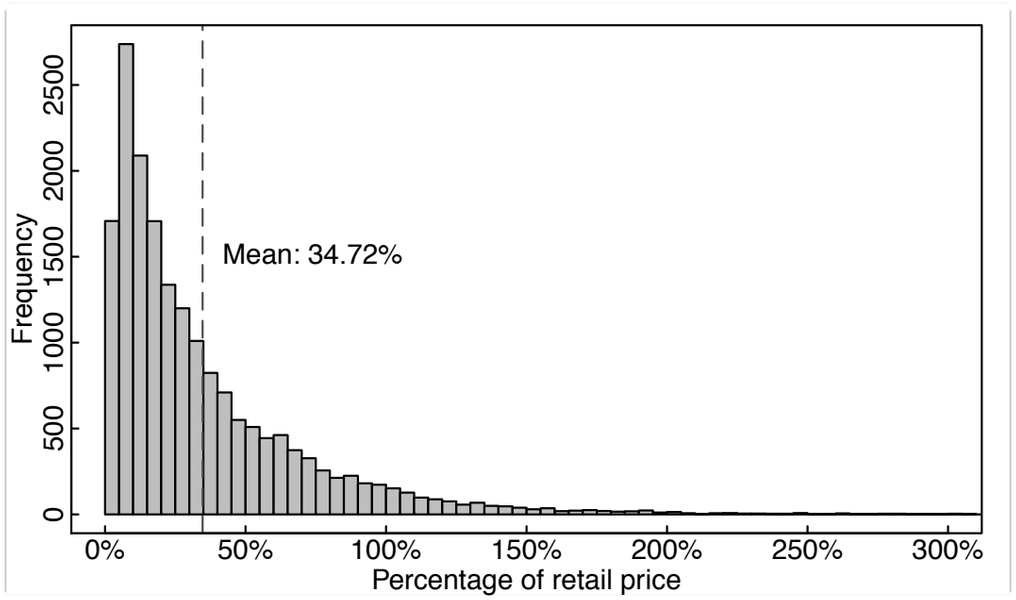
$n = 50,\ v = 100,\ b = 1,\ s = 0.25$

Asymmetries in bid fees



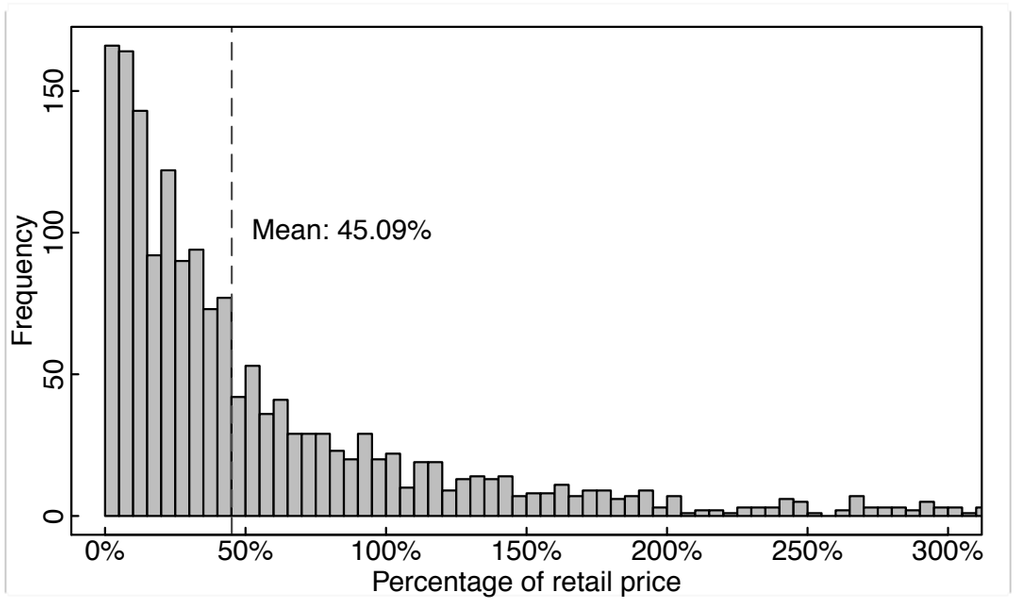
Asymmetries in bid fees

Asymmetries in bid fees



65%

winners' discount

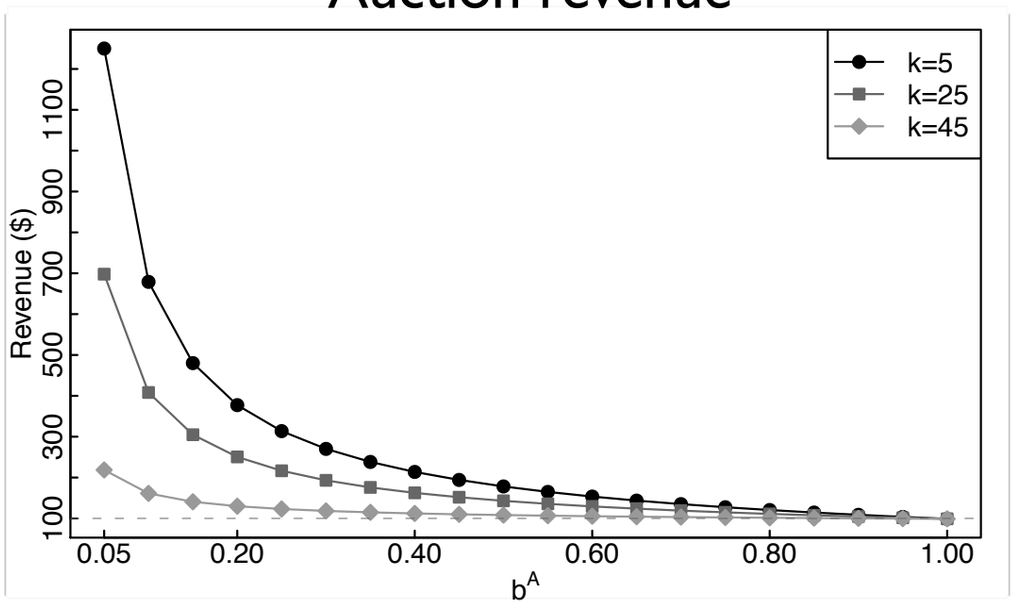


55%

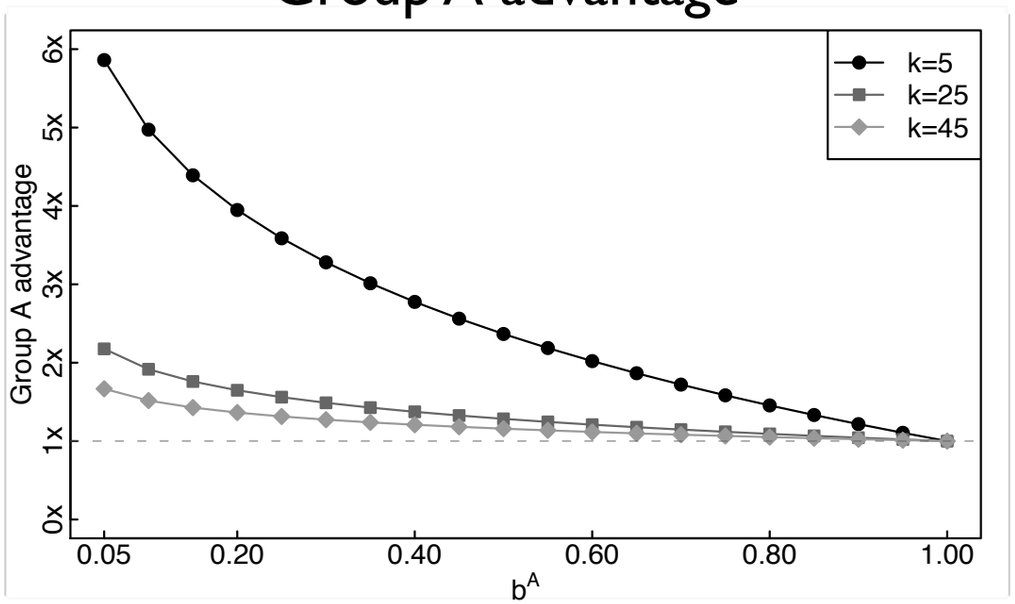
winners' discount accounting for previously lost auctions

Asymmetries in bid fees for fixed-price auctions

Auction revenue



Group A advantage



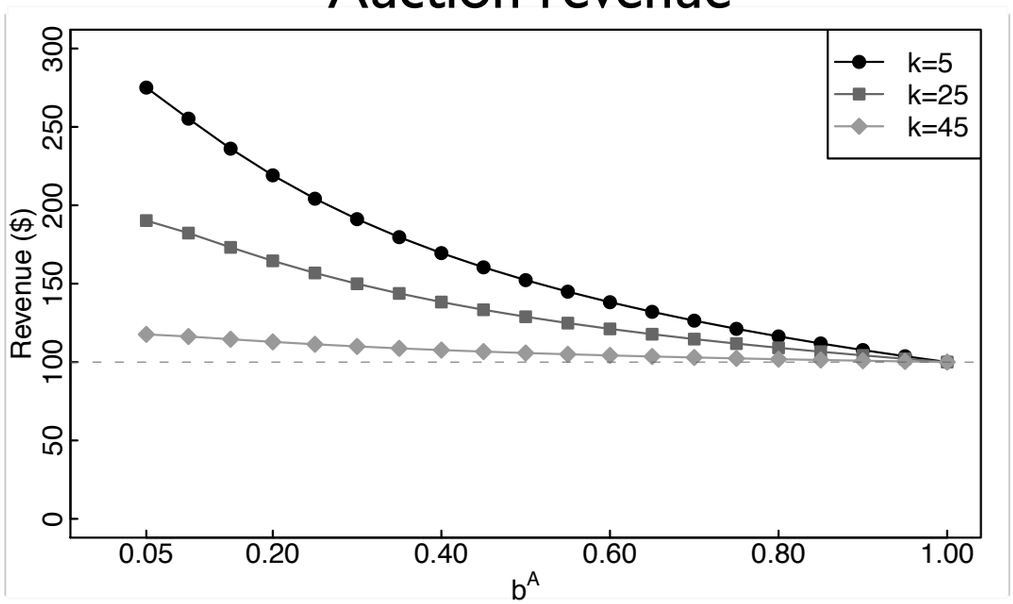
$$n = 50,\ v = 100,\ b^B = 1$$

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

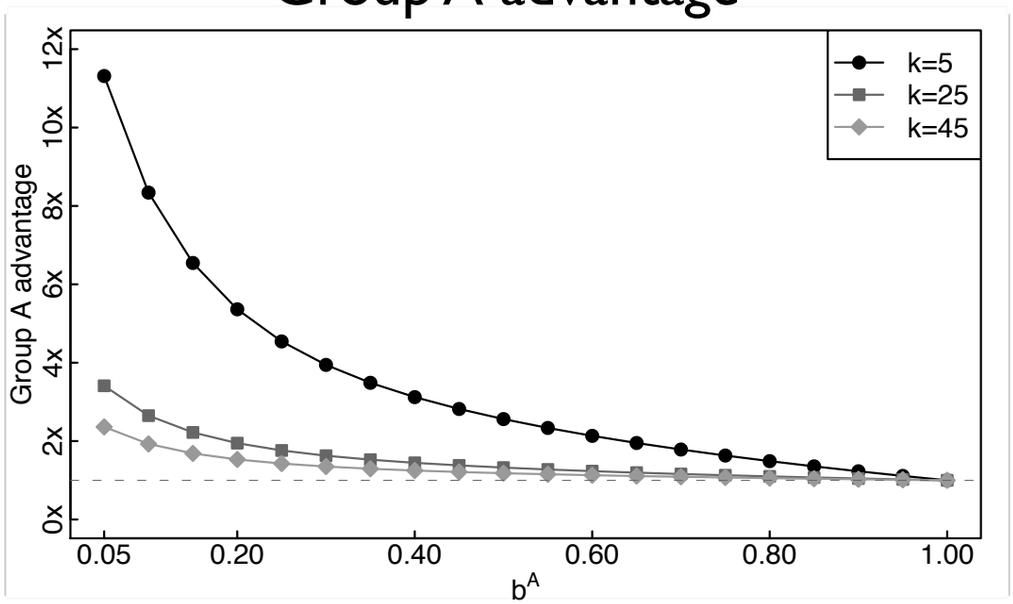
Synergy!

Asymmetries in bid fees for ascending-price auctions

Auction revenue



Group A advantage



- 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

Auction ID: 261695 — Add auction to watchlist

Sony Bravia KDL-40XBR9 40" 1080p 240Hz LCD TV *NEW ON SWOOPO*

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

Recently sold for $32.23

Click on an image to enlarge it

>> Product details

Auction Price: $33.03
All prices are in US Dollars

Bidder: **Udonator**

00:05:39

BID

Each bid raises the auction price by $0.01.

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

BIDDING HISTORY | Statistics

Bidders in the last 15 minutes: 15

$33.03	**Udonator**	**Single bid**
$33.02	Prince1109	Single bid
$33.01	Kranman052	Single bid
$33.00	Mrr17	BidButler
$32.99	Caferico	BidButler
$32.98	Mrr17	BidButler
$32.97	Caferico	BidButler
$32.96	Mrr17	BidButler
$32.95	Caferico	BidButler

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

Marvin W. - Wake, NC

REGISTER

Buy this product now:

Worth up to:	**$1,599.00**
Bid Rebate:	**-$0.00**
Purchase price:	**$1,599.00**

All prices are in US Dollars

BUY

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.

>> more info

Varying object valuations

Auktionsnummer: 261695 — Auktion in Mein Swoopo beobachten

Sony KDL-40Z5500 *NEU BEI SWOOPO*

Scharfe Bilder, fließende Bewegungen und ein attraktives Design. Sony LCD-TV KDL-40Z5500 mit 40 Zoll (102cm) Bilddiagonale, Motionflow 200Hz, 1920 x 1080 Pixel FUll HD Auflösung, 4x HDMI, 2x SCART, DLNA Ethernet, USB 2.0 und DVB-T/-C-Tuner.



KEIN BILD VERFÜGBAR
KEIN BILD VERFÜGBAR

Klicken Sie auf das jeweilige Bild für eine Großdarstellung

>> Produktbeschreibung

Auktionspreis: **33,03 €**
inkl. MwSt, zzgl. Versandkosten

Bieter: **Udonator**

10 **00:05:29**

BIETEN

Jedes Bid erhöht den Auktionspreis um 0,01 €.

Vergleichspreis*:	1.348,95 €
Auktionspreis:	33,03 €
Ersparnis:	**1.315,92 €**

GEBOTS-HISTORIE | Statistik

Bieter in den letzten 15 Minuten: 14

33,03 €	**Udonator**	**Einzelgebot**
33,02 €	Prince1109	Einzelgebot
33,01 €	Kranman052	Einzelgebot
33,00 €	Mrr17	BietButler
32,99 €	Caferico	BietButler
32,98 €	Mrr17	BietButler
32,97 €	Caferico	BietButler
32,96 €	Mrr17	BietButler
32,95 €	Caferico	BietButler

"... zum richtigen Zeitpunkt geklickt und schon war es meins."

Magdalene M. - Dortmund

ANMELDEN

Produkt direkt kaufen:

Vergleichspreis*:	**1.348,95 €**
Bid Rabatt:	**-0,00 €**
Kaufpreis:	**1.348,95 €**

inkl. MwSt, zzgl. Versandkosten

KAUFEN

Direktkauf
Jedes eigene Bid reduziert Ihren persönlichen Kaufpreis.

Der Direktkauf beendet die Auktion nicht!

>> Mehr zum Direktkauf

Same auction id...

Same players...

Different currency!

Different value!

Auktionsnummer: 261695

Auktion in Mein Swoopo beobachten

Sony KDL-40Z5500 *NEU BEI SWOOPO*

Scharfe Bilder, fließende Bewegungen und ein attraktives Design. Sony LCD-TV KDL-40Z5500 mit 40 Zoll (102cm) Bilddiagona FUll HD Auflösung, 4x HDMI, 2x SCART, DLNA Ethernet, USB 2.0 und DVB-T/-C-Tuner.



KEIN BILD VERFÜGBAR

KEIN BILD VERFÜGBAR

Klicken Sie auf das jeweilige Bild für eine Großdarstellung

>> Produktbeschreibung

33,03 €

inkl. MwSt, zzgl. Versandkosten

Bieter: **Udonator**

10 **00:05:29**

BIETEN

Jedes Bid erhöht den Auktionspreis um 0,01 €.

Vergleichspreis*:	1.348,95 €
Auktionspreis:	33,03 €
Ersparnis:	**1.315,92 €**

GEBOTS-HISTORIE	Statistik	
Bieter in den letzten 15 Minuten:		**14**
33,03 €	**Udonator**	**Einzelgebot**
33,02 €	Prince1109	Einzelgebot
33,01 €	Kranman052	Einzelgebot
33,00 €	Mrr17	BietButler
32,99 €	Caferico	BietButler
32,98 €	Mrr17	BietButler
32,97 €	Caferico	BietButler
32,96 €	Mrr17	BietButler
32,95 €	Caferico	BietButler

"... zum richtigen Zeitpunkt geklickt und schon war es meins."

Magdalene M. - Dortmund

ANMELDEN

Kaufpreis: **1.348,95 €**

inkl. MwSt, zzgl. Versandkosten

KAUFEN

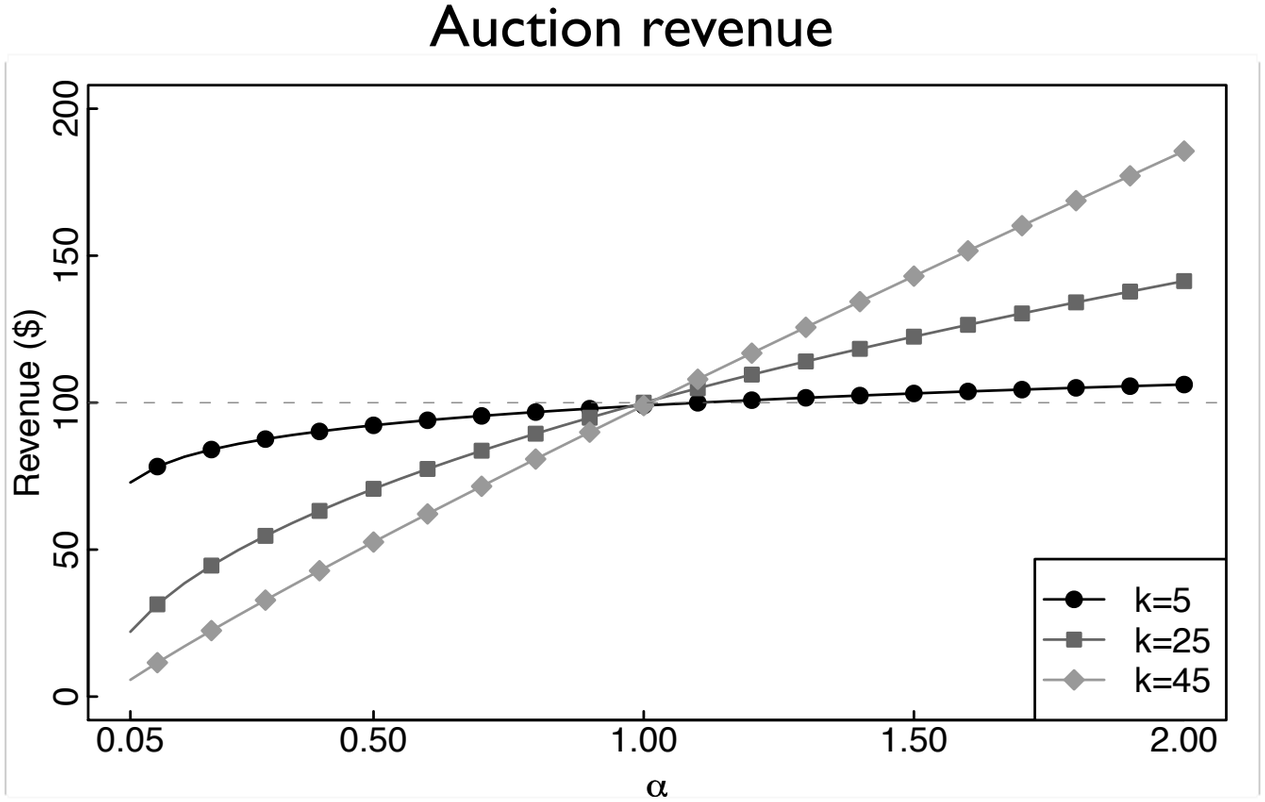
Direktkauf

Jedes eigene Bid reduziert Ihren persönlichen Kaufpreis.

Der Direktkauf beendet die Auktion nicht!

>> Mehr zum Direktkauf

Varying object valuations for fixed-price auctions



$$n = 50,\ v = 100,\ b^B = 1$$

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

Collusion & shill bidding:
The role of hidden information

Collusion

Many players model

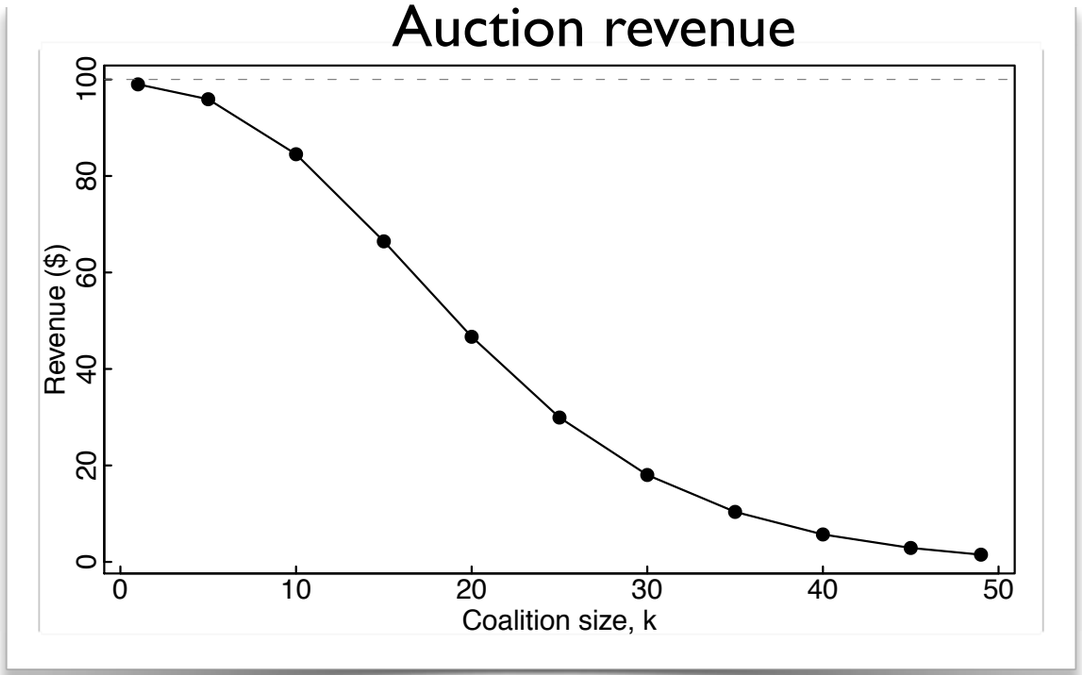
A group of players form a coalition and they secretly agree not to outbid each other

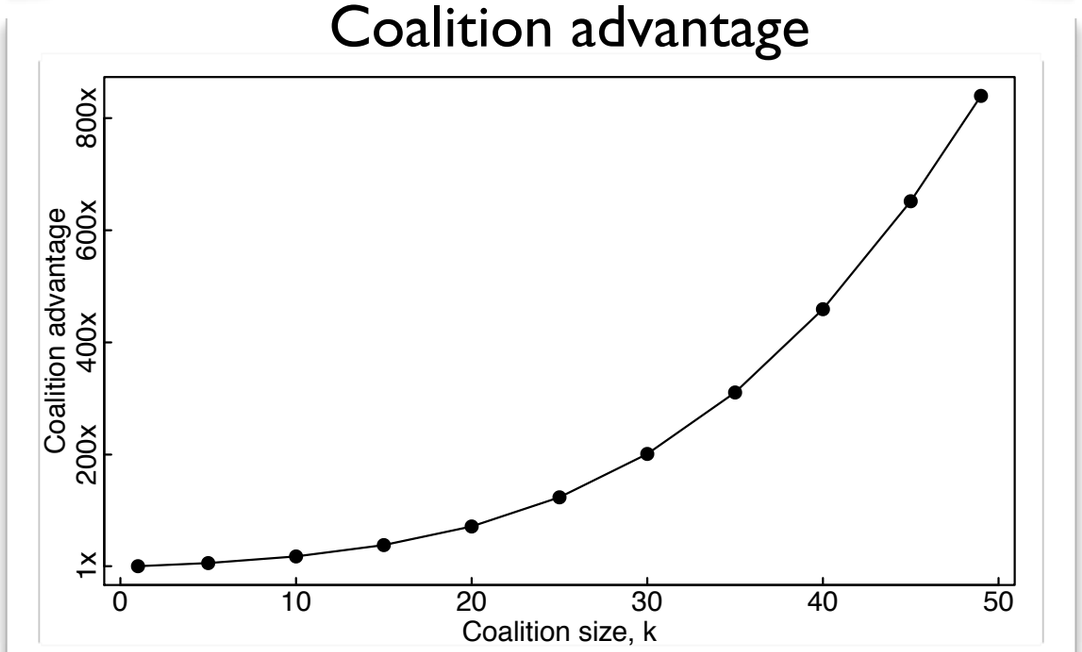
Single player model

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



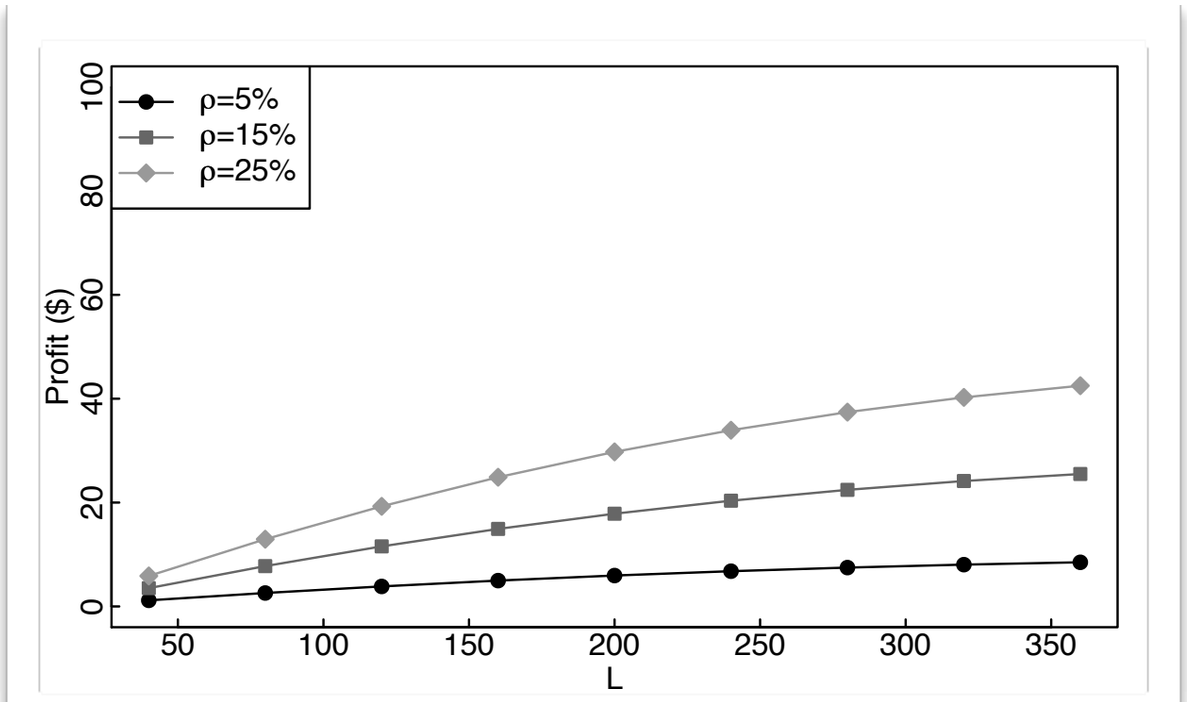


$n = 50,\ v = 100,\ b = 1,\ s = 0.25$

- 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

Shill bidding:
Ascending-price auctions, many-players model

Auction profit

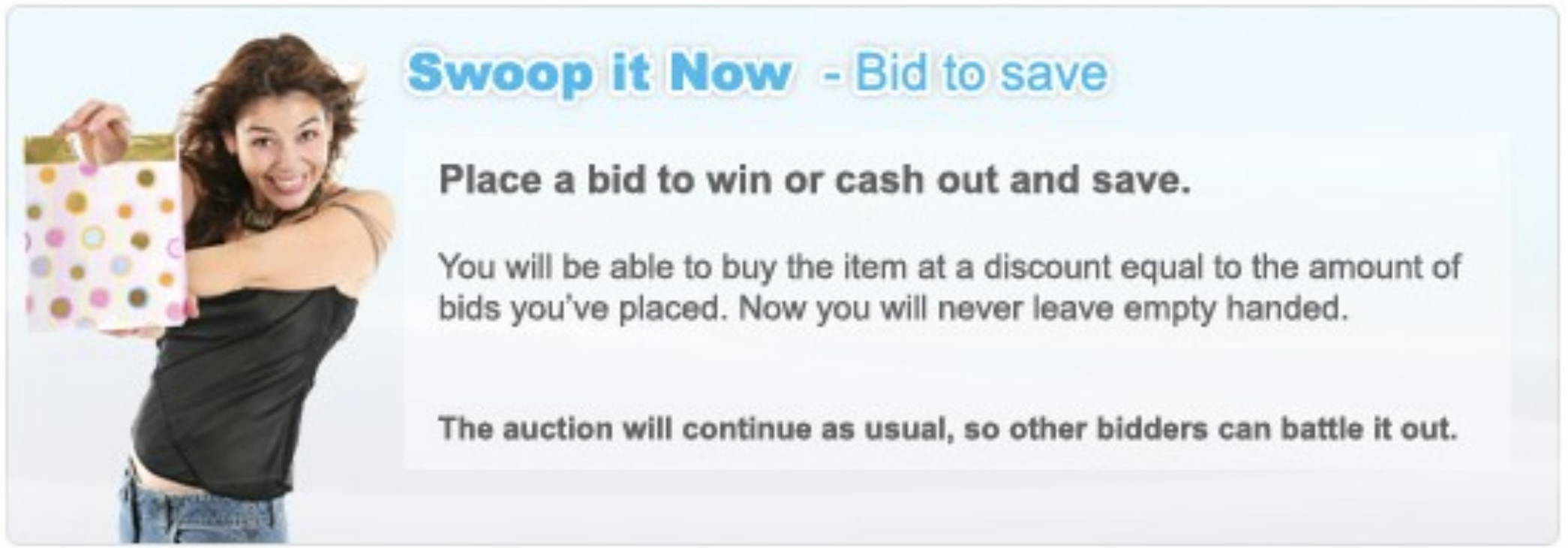


$n = 50,\ v = 100,\ b = 1,\ s = 0.25$

- A *(ρ,L)*-shill enters the auction with probability ρ 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)

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

Swoop it Now

- In the presence of many committed players the resulting game is a **game of chicken**.

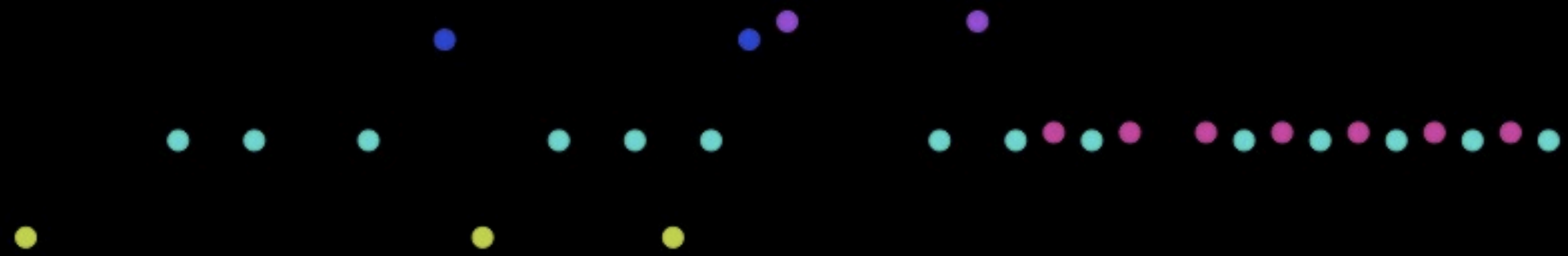
- Assuming a common valuation of ***v*** and a retail price of ***r*** the **maximum loss is bounded** by ***v-r***.

	Quit	Play Till End
Quit	Both lose bidding fees	Lose bidding fees/ Get discount
Play Till End	Get discount/ Lose bidding fees	Both lose ***v-r***

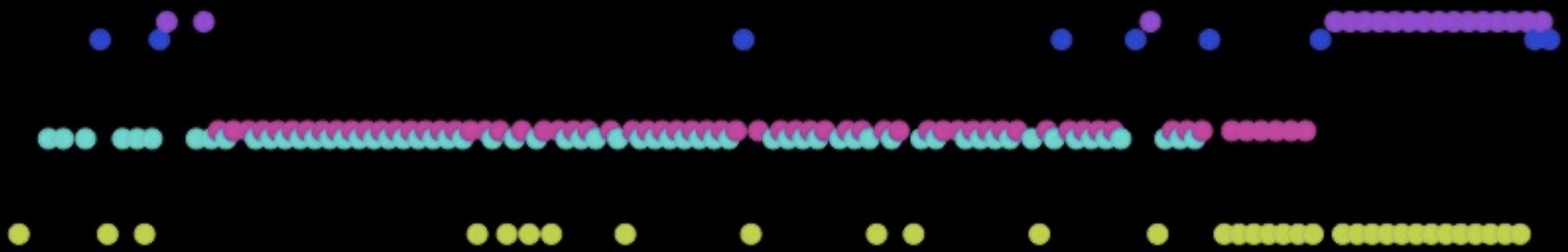
Is there evidence of chicken?

Look for **duels** - auctions culminating is long bidding sequences by two players

The Scrum

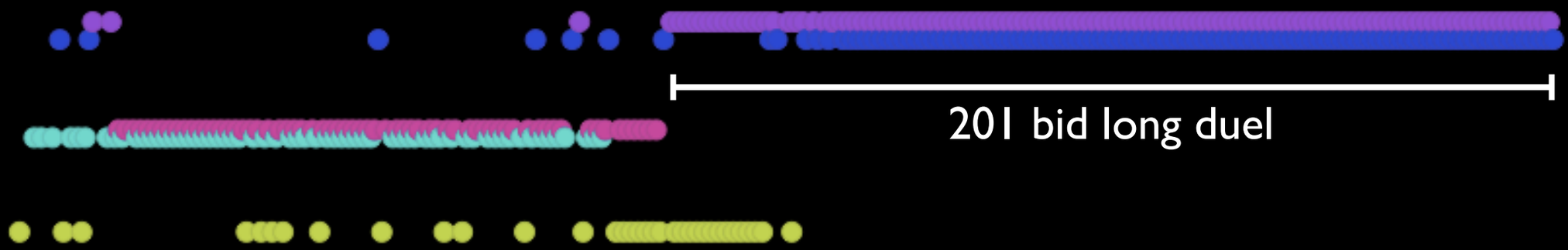


The Mêlée

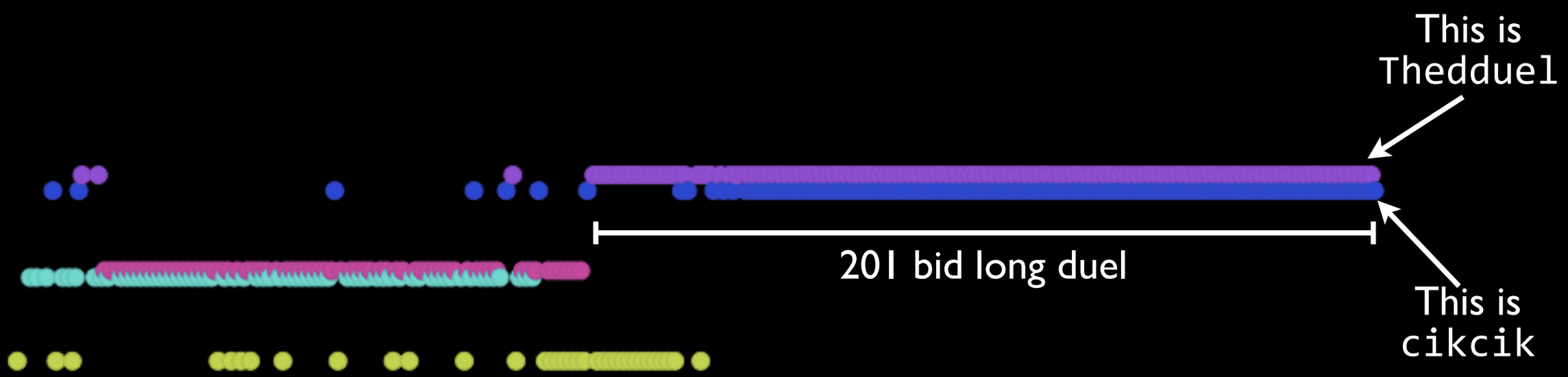


The Duel

The Duel

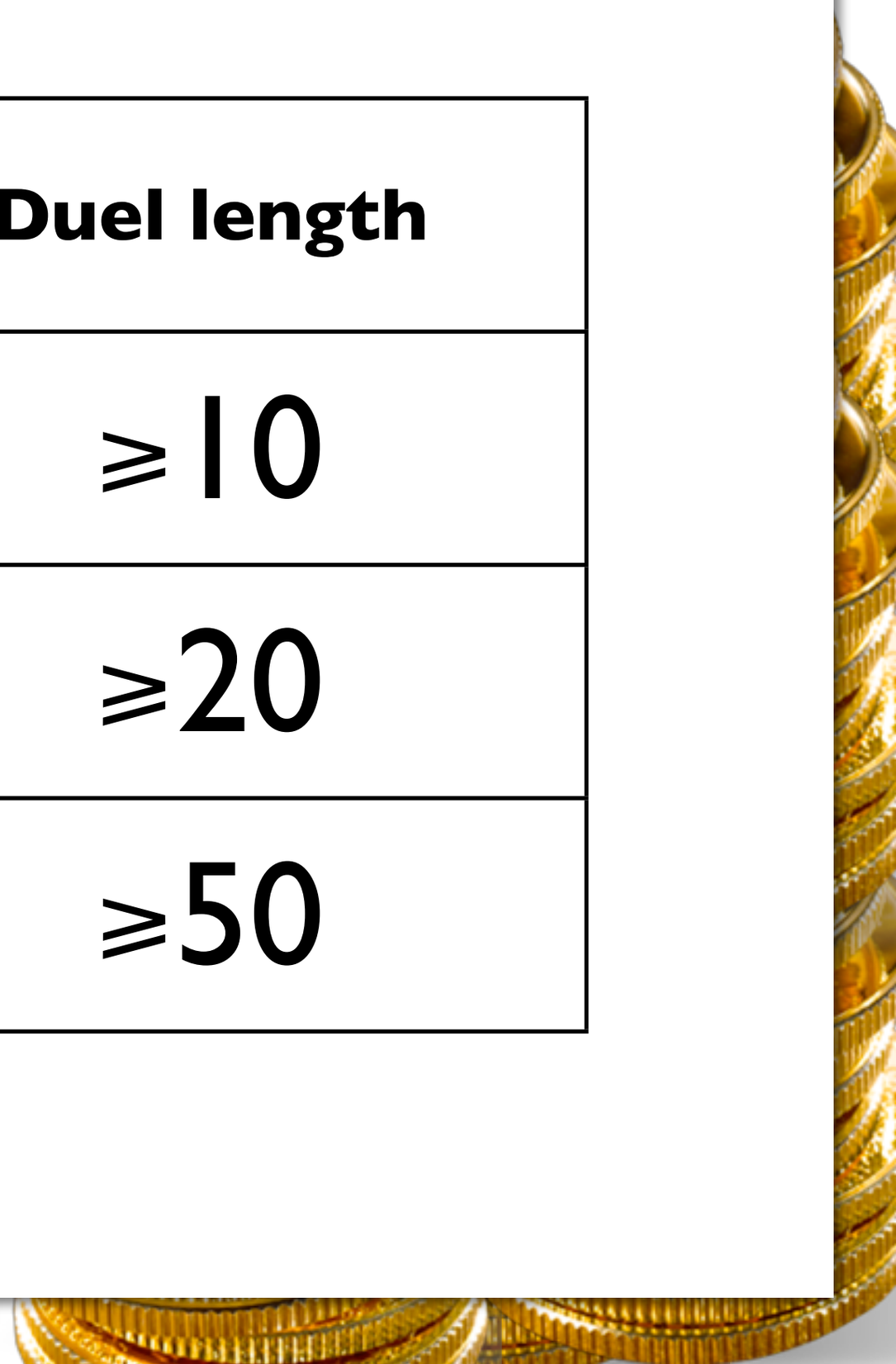


The Duel



Evidence of chicken

% of **auctions**	**Duel length**
9%	⩾10
5%	⩾20
1%	⩾50



Signaling intention: Aggressive bidding

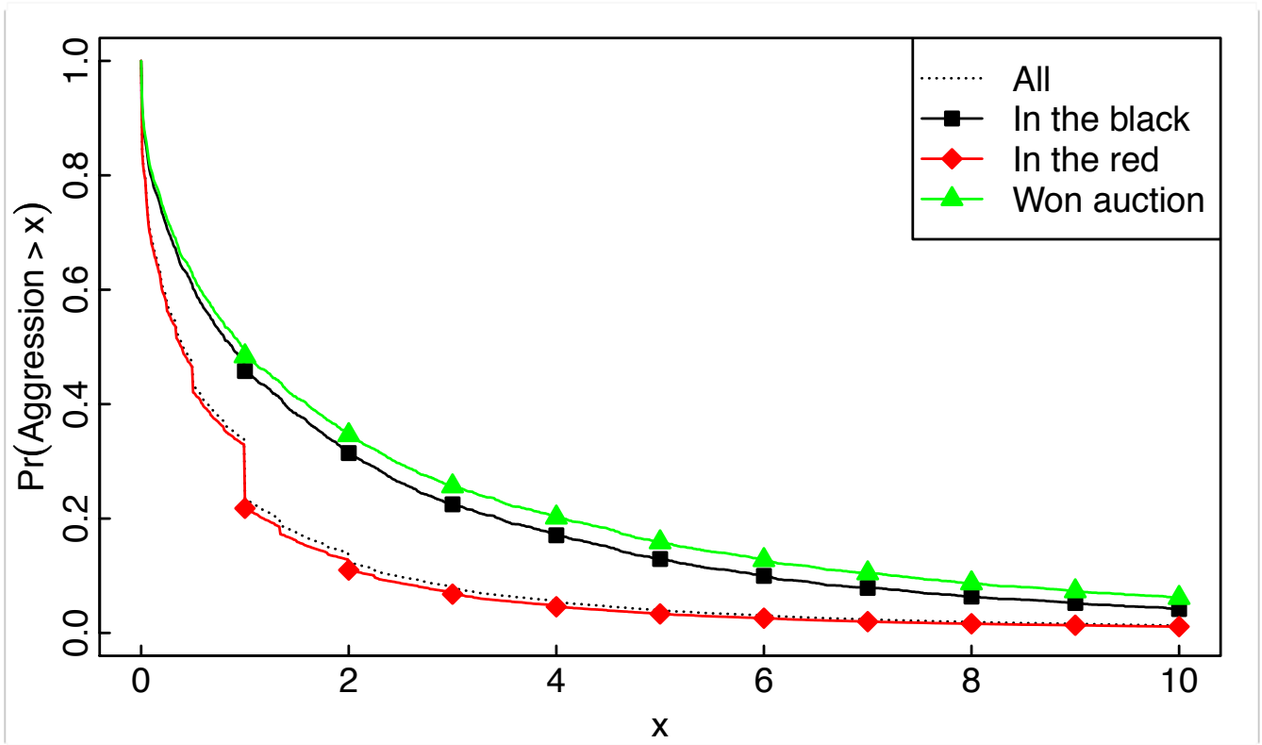
Players willing to playing chicken need a way to announce it

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

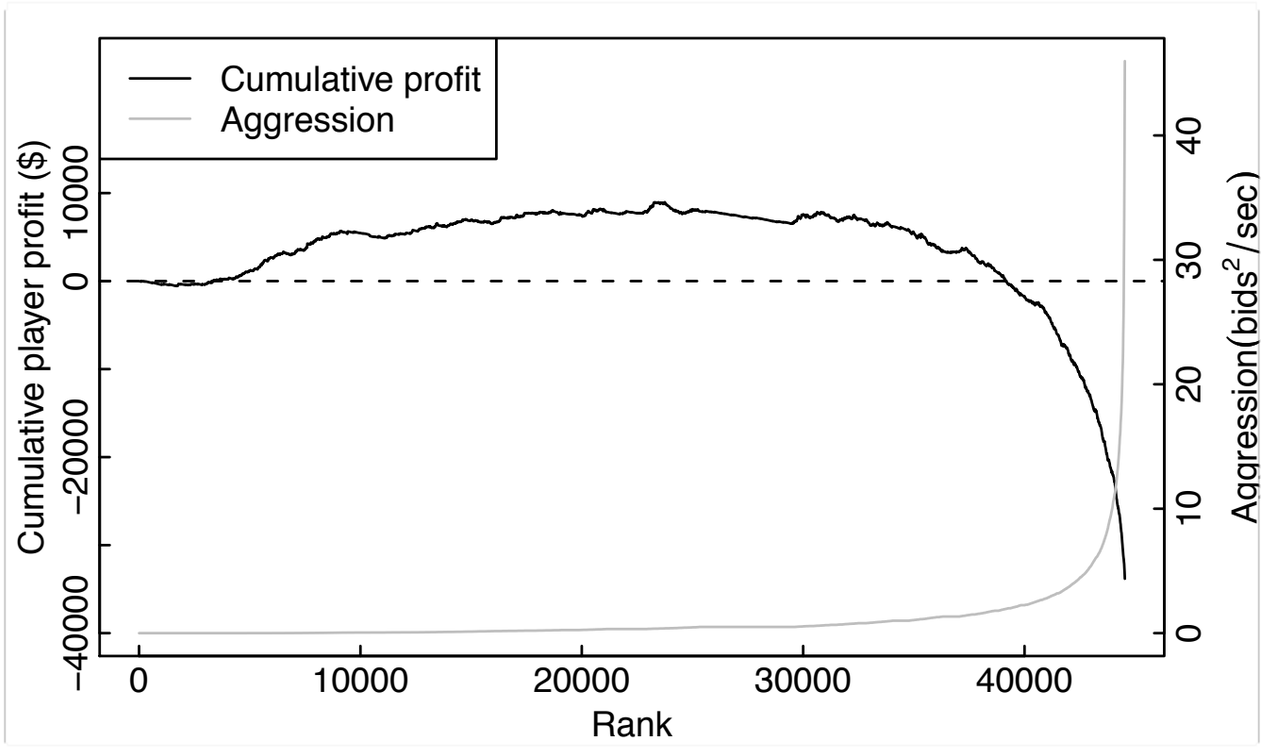
$$\text{Aggresion} = \frac{\text{Number of bids}}{\text{Average response time}} \quad (\text{bids}^2 / \text{sec})$$

Aggressive bidders	Number of auctions	Auction revenue (as % of retail price)	Mean winner profit margin
0	1,699	62%	77%
1	493	135%	51%
≥ 2	834	246%	26%

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?