

Economics of Strategy for Online and Digital Markets

Topics in Economic Theory and Policy, 31C01000

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Lecture 6: Market design

- Auction design
- Ad auctions
- Market design

Uses of game theory in market design

- Study existing markets
 - Identify the “rules of the game,” the incentives for the participants, and how they behave. Then try to understand why the market functions well, or not so well.
- Design new markets
 - Identify the economic problem to be solved, the players and their incentives and information. Then try to understand what sort of market rules would lead to a desired outcome.
- Economic theory provides a conceptual framework, but need to use data and experiments to test hypotheses, and identify things models may have missed.

- Game theory is helpful in describing the rational strategic interactions between agents.
- Mechanism design turns the question around:

Assuming that the agents will play a strategic interaction game, what should the rules for the game be?

This would be the theoretical setup for gaming industry as well, but real life is more messy and we need to abstract away from such detail for pedagogical clarity.

Revelation principle

- Given the vast amount of possible choices, is there hope to say something on the best possible design?
- Sometimes general results exist, esp. the *Revelation principle*:
 - Suppose that if my type is v_i then my best response to others' strategies is $\beta(v_i)$.
 - Then, if the market operator asks for my type v_i and promises to pay $\beta(v_i)$, it is optimal for me to tell the truth, given that all other tell the truth.
 - Task to design allocation and payment rules.
- We leave the theory for further classes in microeconomics and focus on some more tangible examples.

- Auction theory tells us what to expect in a Nash equilibrium:
 - In an efficient allocation the high value bidder wins.
 - Expected revenue is the same in many auction methods.
- Is there a potential to improve the expected revenue for the seller? Yes, for example by
 - Introducing reserve prices.
 - Increasing competition.

- Recall the ascending auction example with two bidder whose values are v_1 and v_2 .
- Values are assumed to follow an uniform distribution $[0, 100]$.
- So the expected revenue for the seller is $33 \frac{1}{3}$.
- What happens is the seller sets a reserve price of r ?

- Seller sets reserve price r and runs an ascending auction.
- Bidding starts from r .
- Three cases
 - Both bidder values below $r \rightarrow$ no sale.
 - One value above r , one below $r \rightarrow$ sale at r .
 - Both values above $r \rightarrow$ sale at lower value.

Effect of reserve prices to revenues

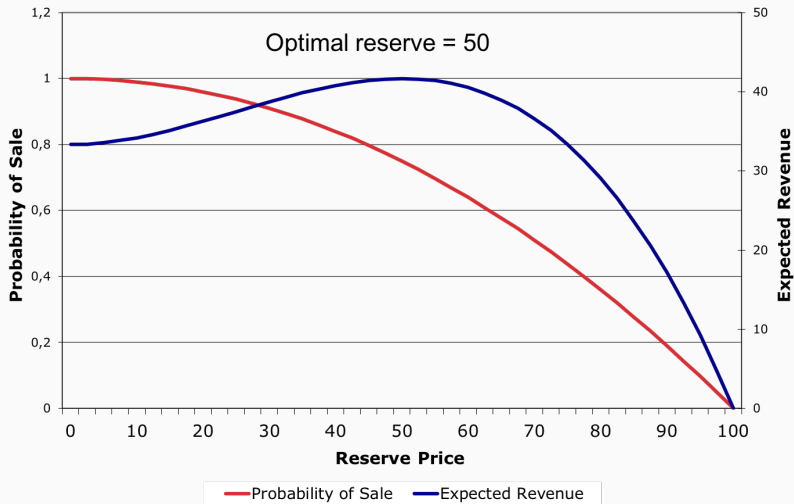


Figure: J. Levin.

Impact of competition

N	No reserve price		Optimal reserve price	
	P(sales)	E[revenue]	P(sales)	E[revenue]
1	1	0	0.5	25
2	1	33	0.75	42
3	1	50	0.88	53
4	1	60	0.95	61
5	1	67	0.97	67

Table 4: Impact of competition to sales.

Regardless of the number of bidders, the optimal reserve price in the example is always $r = 50$ (in this example).

Example from eBay auctions

[Home](#) > [Buy](#) > Search results for TAYLORMADE BURNER 09 DRIVER ...

Refine search
 In Golf Clubs
Flex
 Regular (12)
 Stiff (19)
[Choose more...](#)
Condition
 New
 Used
 Not Specified
[Choose more...](#)
Price
 \$ to \$ [Go](#)
Club Type
Brand
Dexterity
Seller
Categories
Sporting Goods (31)
 Golf (31)
Preferences
Buying formats
 Auction
 Buy It Now
[Choose more...](#)

All items Auctions only Buy It Now only Products & reviews [Help](#)

31 results found for TAYLORMADE BURNER 09 DRIVER 2009 GOLF CLUB NEW 10... [Save this search and alert me later](#)

View as: [Grid](#) [List](#) [Compare](#) [Customize view](#)

Sort by: Time: ending soonest

				Price + Shipping to \$4.995	Time Left
	TAYLORMADE BURNER 09 DRIVER 2009 GOLF CLUB NEW 10.5 RH		7 bids	\$104.83 + \$7.99 shipping	3h 21m
	TAYLORMADE BURNER 09 DRIVER 2009 GOLF CLUB NEW 10.5 RH		9 bids	\$81.00 + \$9.99 shipping	3h 22m
	TAYLORMADE BURNER 09 DRIVER 2009 GOLF CLUB NEW 10.5 RH		Buy It Now	\$124.99 + \$9.99 shipping	6h 9m
	TAYLORMADE BURNER 09 DRIVER 2009 GOLF CLUB NEW 10.5 RH		Buy It Now	\$124.99 + \$7.99 shipping	6h 9m
	TAYLORMADE BURNER 09 DRIVER 2009 GOLF CLUB NEW 10.5 RH		7 bids	\$70.01 + \$9.99 shipping	8h 59m
	TAYLORMADE BURNER 09 DRIVER 2009 GOLF CLUB NEW 10.5 RH		Buy It Now	\$124.99 + \$9.99 shipping	9h 41m
	TAYLORMADE BURNER 09 DRIVER 2009 GOLF CLUB NEW 10.5 RH		Buy It Now	\$124.99 + \$7.99 shipping	9h 41m
	TAYLORMADE BURNER 09 DRIVER 2009 GOLF CLUB NEW 10.5 RH		12 bids	\$91.00 + \$7.99 shipping	11h 7m

RIVER-2009-GOLF-CLUB-NEW-10-5-RH/290471001772?pt=Golf_Clubs&hash=item43a16bbeac

Figure: Einav et al. 2012.

Example from eBay auctions

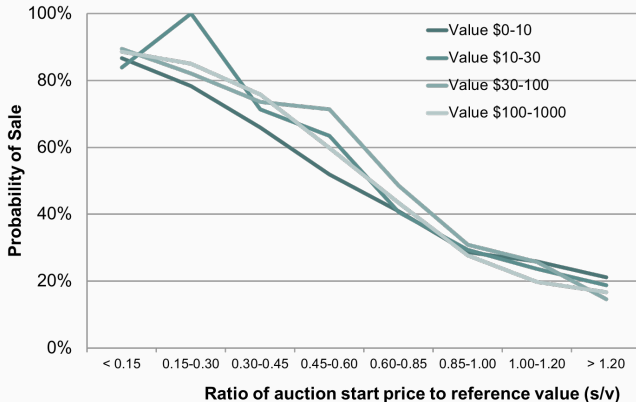


Figure. Impact of reference price to sales probability.

Figure: Einav et al. 2012.

Example from eBay auctions

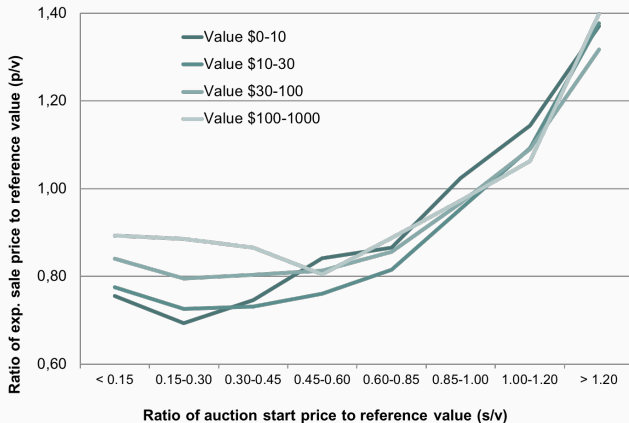


Figure. Impact of reference price to revenues.

Example: Online auction for an apartment – revisited

Fredrikinkatu 58, Etu-Töölö, Helsinki

40 m² | KT, Th, avok, kph, vh



Annettu	Asiakasnumero	Tyyppi	Summa
01.01.2019	1493587	Kirjallinen tarjous	337 000,00 €
30.12.2018	1500570	Kirjallinen tarjous	336 000,00 €
29.12.2018	1493587	Kirjallinen tarjous	335 000,00 €
27.12.2018	1500570	Kirjallinen tarjous	332 000,00 €
25.12.2018	1493587	Kirjallinen tarjous	331 000,00 €
25.12.2018	1500570	Kirjallinen tarjous	329 000,00 €
23.12.2018	1493587	Kirjallinen tarjous	328 000,00 €
22.12.2018	1500570	Kirjallinen tarjous	326 000,00 €
21.12.2018	1493587	Kirjallinen tarjous	324 000,00 €
20.12.2018	1499837	Kirjallinen tarjous	319 000,00 €
20.12.2018	1493587	Kirjallinen tarjous	318 000,00 €
19.12.2018	1500570	Kirjallinen tarjous	315 000,00 €
19.12.2018	1500082	Kirjallinen tarjous	307 000,00 €
19.12.2018	1493587	Kirjallinen tarjous	306 000,00 €

Source: Kiinteistömaailma.

Example: Online auction for an apartment

- Maybe the seller's (secret) reserve price was just not met.
- Empirical evidence suggests that keeping the reserve price hidden might be an efficient strategy, if there is a possibility to bargain afterwards:

Table 2: Probability of trade

	Used-car dealers (168,745 observations)		Fleet/lease sellers (182,843 observations)	
	% of Sample	% Trade	% of Sample	% Trade
High bid \geq Reserve	15.77%	100.00%	36.85%	100.00%
<i>High bid < Reserve cases</i>				
A) Immediate agreement/ disagreement	61.45%	76.15%	44.16%	68.30%
B) Phone bargaining	22.78%	39.47%	18.99%	55.52%
Overall trade volume	71.55%		77.55%	

Notes: For each sample, the first column reports the proportion of the sample with the game ending at the auction, immediately after the auction, or in alternating-offer bargaining over the phone. The second column reports the percentage of time that trade occurs in each case.

Example: Online auction for an apartment

- Also possible that the seller did not have a fixed reserve price, but was trying to learn from the market with the auction.
- Each higher bid gives a more positive expectations, both for the seller and all bidders.
- Somewhat similar to a case when some bidders are uncertain (uninformed) on their valuations. Then:
 - Can be shown that a secret reserve price leads to higher expected revenues than a public reserve price.

“ “ Google and Facebook attracted one-fifth of global advertising spending last year, nearly double the figure of five years ago
–*The Guardian*, 2 May 2017.

” ”

- Google ad auctions were introduced in 2002. Auctions are now widely used for selling advertisement space online.
- Advertisers send their money bids by search term:
 - E.g. loans, vodka, head ache.
 - Offer a payment per click.
- Google arranges separate ad auctions for *every query*.
 - Conditional on sufficient number of bidders.

Example: Google search

2019 Best Personal Loans | Get \$1,000 - \$50,000 in 24 hrs

[Ad](#) www.lendingtree.com/personal ▼

Fast, Free Personal Loan Offers in Minutes. Compare Now & Find Your Best Offer! One Form, Multiple Offers. Fixed Rates. Low Interest Rates. Get The Money You Need. up to \$50,000 in 24 hrs.

[Need A Personal Loan?](#) · [Personal Loan Calculator](#) · [Start Your Loan Request](#)

[\\$1,000 Loan](#) - from \$30.00/mo - 36 Mos Term. 5.46% APR · [More](#) ▼

Best Personal Loans | Get \$1,000 - \$50,000 Fast

[Ad](#) www.magnifymoney.com/Loan ▼

Comparing Loan Offers Can Save You Money. Fill Out A Quick Form & Find Your Best Rate! Low Fixed Rates. Debt Consolidation. Secure the Money You Need. Easy Online Form. Connect With Top Lenders. Up to \$50,000 in 24 hrs. Services: Compare Multiple Offers, Apply in Minutes.

10 Best Loans Online 2019 | Low APR Rates | Easy Approval

[Ad](#) www.top10personalloans.com/ ▼

Top Online Loans | Reliable Reviews & Comparison | Best Rates | No Hidden Fee. Reliable Service.

[Best Loan For Bad Credit](#) · [Do You Need A Loan?](#) · [Best Peer To Peer Lenders](#) · [Ask the Loan Expert](#)

[36 months Loan](#) - from \$478.00/mo - \$16,000 Loan · [More](#) ▼

10 Best Personal Loans | Get \$1,000 - \$100,000 in 24hr

[Ad](#) www.consumersadvocate.org/Personal-Loan/Comparison ▼

Read Trusted Personal Loan Company Reviews. Comparisons Trusted by 20,000,000+. Always Free.

[SoFi](#) - from \$191.00/mo - \$10,000 - 5.49% - 5 yrs · [More](#) ▼

Figure. Search for “loans” in Google (U.S.).

- Possibly several positions for sale.
- Auction mechanism is a “generalized second price” auction.
 - Positions are assigned in the order of bid.
 - Advertisers submit a single bid.
 - Advertisers pay the bid of the advertiser in the position below.
- If only one position, reduces to a second price auction.

Assumptions:

- Positions $k = 1, \dots, K$ and bidders $n = 1, \dots, N$.
- Each position gets x_k clicks per day: $x_1 > x_2 > \dots > x_K$.
- Each bidder has value v_n per click: $v_1 > v_2 > \dots > v_N$.

This leads to:

- For bidder n , the value of position k is $v_n * x_k$.
- For bidder n , the profit from buying k is $(v_n - p_k) * x_k$.

Example: Ad auctions

- Two positions: receive 200 and 100 clicks per day.
- Three bidders with values of 10, 5, 2 cents.

Bidder	Value in €	
	1st position	2nd position
1	20	10
2	10	5
3	4	2

Table. Value of positions in € for each bidder.

- In an efficient allocation, the first position goes to the highest bidder and the second position to the second highest bidder.

Example: Ad auctions

- Three bidders with values of 10, 5, 2 cents.
- Market clearing prices are determined by the value (in cents) of the bidder below the winner.

Bidder	Value in €		Price in cents
	1st position	2nd position	
1	20	10	5
2	10	5	2
3	4	2	-

Table. Market clearing prices (if bidders bid their true value).

Generalized second price auctions

- Truthful bidding not a dominant strategy. Consider two positions with 200 and 100 clicks, and a bidder with valuation 10. If competing bids are 4 and 8.
 - Bidding 10 wins 1st slot, pay 8, profit $200 * 2 = 400$.
 - Bidding 5 wins 2nd slot, pay 4, profit $100 * 6 = 600$.

But if competing bids are 6 and 8, it is better to bid 10.

- In general several Nash equilibria, including some that are inefficient.

- In addition to the auction method above, Google uses a measure for “ad quality”:
 - The quality of ad affects to clicks, in addition to the position.
 - Google uses its data to predict the quality of an auction, i.e. how many clicks it will receive.
- Bids are made in terms of cost per click.
- Outcome of the auction is determined by ad rank that is calculated as the cost per click (bid) times the ad quality score (Google).
- The allocation is no longer efficient when comparing the money bids.

- Always a balance between what tasks are left to the competition/game in the marketplace to decide and what is decided by the rules.
- Choice of implementation detail will depend on the desired outcomes.
- There needs to be sufficient enforcement mechanisms in place to ensure that the actual outcomes meet desired outcomes.

Properties of good market design

1. Provide *thickness*
 - Attract a sufficient proportion of potential market participants to come together ready to transact with one another.
2. Overcome the *congestion* that thickness can bring
 - Ensure that market participants can consider enough alternative possible transactions to arrive at satisfactory ones.
3. Make it *safe* to participate in the market as simply as possible
 - As opposed to trading outside of the marketplace or engaging in strategic behavior.
4. Some markets can be *repugnant*: they should not exist.
5. *Experimentation* to diagnose and understand market failures and successes, and to communicate results to policy makers.

Exercises for Lecture 6

1. Use the market design criteria of Alvin Roth from 2008 (*thickness, congestion, safe, repugnant, experimentation*, see slides from lecture 6) and analyze, concisely, how they apply to the ad market run by Facebook.
2. Take an ad auction with two positions. Assume that the number of clicks the ad receives is given by a position multiplier times the quality of the ad. The position multipliers are $x_1 = 40$ and $x_2 = 20$. There are three bidders with ad qualities of $a_1 = 3$, $a_2 = 7$, $a_3 = 5$. Their bid values are $b_1 = 10$, $b_2 = 5$, $b_3 = 2$ cents per click (bidders bid their true value). Calculate the ad ranks and report the values of each position in euro (see slides from lecture 6 for an example without the ad quality).

- Varian, H. (2012) “Revealed Preferences and its Applications”, Economic Journal.
 - Section 1: Discussed in Lecture 7, you can skip it for now.
 - Section 2: Example from here was used in Lecture 2, this provides more detail, but is not essential reading.
 - Section 3: This is what I expect you to read.