Economics of Strategy for Online and Digital Markets

Topics in Economic Theory and Policy, 31C01000

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Lecture 1: Introduction

Epilogue: Phantom packages

Figure: Aliexpress.com.

Online markets: Use of data

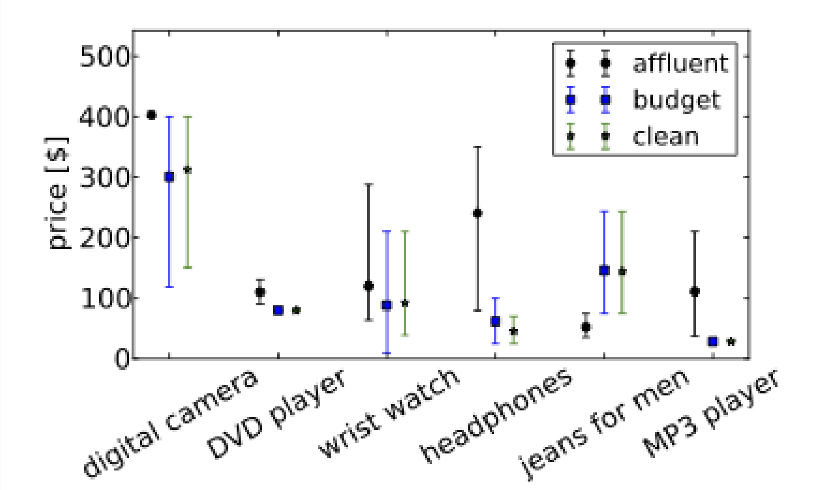


Figure: Mikians et al. 2012.

Platforms: Reduction of frictions

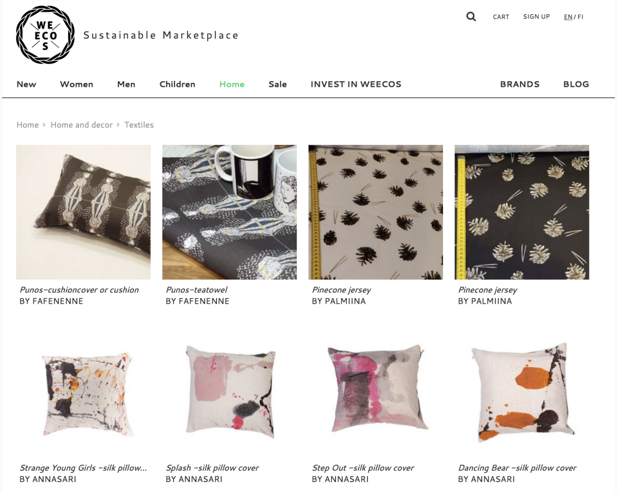


Figure: Weecos.

Why economics

- Preferences
- Efficiency

The role of preferences in a market place

- What you want to do
- How to find out what you want to do

Example: Preferences

- What you want to do
  - Buy a phone
- How to find out what you want to do... and change it
  - Design a mechanism (market place, auction, platform) to discover your preferences (in monetary terms).
  - Collect and use data to improve your design.
- We will be more precise in Lecture 2.

Example: Preferences

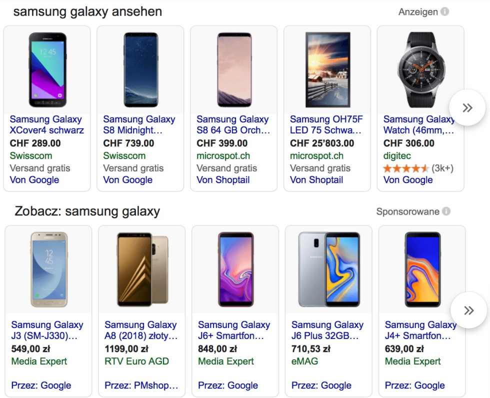


Figure. Two identical Google searches, one done in Switzerland (top) and another in Poland (bottom).

Figure: Google.

Efficiency

Why have the online and digital markets been so succesful?

- The usual suspects:
  - Economics of scale
  - Lower transaction costs
- But also need to consider
  - Search costs
  - Property rights
  - Asymmetric information
- Much of the course will be spent on these topics in detail, but we start already today.

In-class exercise: Search costs game

Write three things on a piece of paper that you are given:

1. B if you are a buyer and S if you are a seller
   - If your first name has odd number of letters you are B.
   - If your first name has even number of letters you are S.
2. Your private value for the item, i.e. the maximum price you are willing to pay or the minimum price you are willing to sell the item
   - Take the alphabet ordinal number of the first letter of your first name (A = 1, B = 2, ...), use a proxy if needed.
3. The item you want to trade:
   - Apple, if you are an Aalto econ major.
   - Orange, if you are not an Aalto econ major.

As an example, Iivo gets you S and 9 from the first two points.

In-class exercise: Search costs game

- Your task is to maximize your payoff from the trade:
  - If you want to buy an item, find someone willing to sell the same item with the lowest price you can.
  - If you want to sell an item, find someone willing to buy the same item with the highest price you can.
  - The payoff from your trade is the difference between the price you can find and your private value.
  - If you cannot buy or sell your item, you get nothing.
- As an example, if Iivo can sell his orange for 10, his payoff is 1.
- The game will continue for x minutes.

In-class exercise: Search costs game

Now let's organize differently...

And discuss the results.

Property rights

Examples:

- Buyers
  - Questions on data
- Sellers
  - From the world of IPR and standards to platforms

Data

- Many of the most valuable companies in the world collect data of their users and use it to advance their business.
- Ownership of this data may not be clearly defined or understood; nor is its value.
- People exchange data of varying value against payment in the form of service(s) that they use.

Example: Netflix

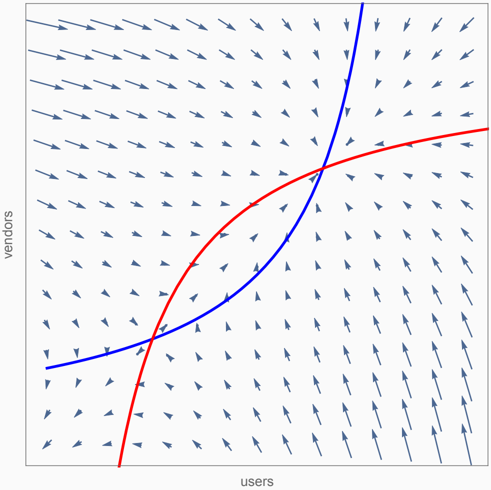
- Netflix has a 60 PB+ of data collected from all its operations, with 100+ million subscribers (around 600 MB per customer).
- Company policy is to only do data driven business decisions:
    - Recommend films
    - Choose which content to purchase
    - Create content (House of Cards)
    - Improve user experience through A/B testing
    - Give users information on which Internet provider to use
- But where should the limits on data use be?
    - Facebook was caught providing Netflix access to its user data without the consent of the users (NYT, 18 Dec 2018).

Source: Keijo Helanko / Aalto SCI.

From standards. . .

Figure: Wikimedia.

. . . to platforms



Asymmetric information

Your preferences are private information, but also the market places have information that you do not. This leads to many economic questions, such as:

- Adverse selection
- Signaling

We will discuss the role of information in many subsequent lectures.

Example: Adverse selection – Market for lemons

Market for used cars:

- Every day, 10 owners of 10 used cars consider selling.
- The cars differ in quality.
- Quality ranges from zero to 9,000 euro in equal steps.
- The average value of the cars is thus 4,500 euro.
- There are many prospective buyers and each would happily buy a car for a price equal to its true value, but not more.
- However, as the quality of the cars is not known for the buyers they are only willing to pay the average of the previous day.
- Sellers are willing to sell if they can get more than half the true value.

Akerlof, 1970.

Adverse selection robust strategies?

Figure. Earl Munz.

Figure: CBS Television.

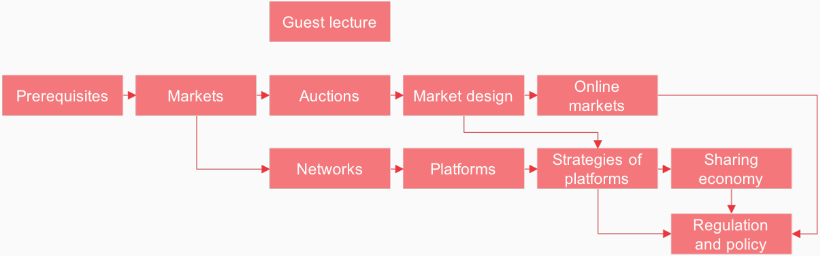
Signaling

- Instead of pretending to be crazy, try to obtain a proof of quality.
- Popular tool in online markets are reviews and ratings by previous customers.

Learning outcomes for the course

- Understand the economics of firm decisions and strategies, and competition in online and digital markets.
- Learn how the special features of such markets affect decisions.

Schedule


Guest lecture
Prerequisites
Markets
Auctions
Market design
Online markets
Networks
Platforms
Strategies of platforms
Sharing economy
Regulation and policy

Economics story that we are going to cover: Part I

Lecture 2 PREREQUISITES

- Preferences
- Basics of game theory
- Pareto efficiency

Lecture 3 MARKETS

- Institutions
- Supply and demand
- Competitive equilibrium
- Perfect competition – oligopoly – monopoly

Economics story that we are going to cover: Part I

Lecture 4 AUCTIONS

- Motivation: price discovery, competition
- Private values vs. public values
- Auction types

Lecture 5 GUEST LECTURE

- Economics of games
- Janne Peltola from Supercell

Guest lecture: Games

Figure: Supercell.

Economics story that we are going to cover: Part I

Lecture 6 MARKET DESIGN

- Setting the right incentives, implementation
- Ad-market in the internet
- Radio spectrum auctions

Lecture 7 ONLINE MARKETS

- Reduction of frictions
- Use of data
- Build trust

Economics story that we are going to cover: Part II

Lecture 8 NETWORKS

- What happens when my demand affects your demand: externality
- How does that affect the firm decisions: difference between complements and substitutes

Lecture 9 PLATFORMS

- Two (or more) distinct sides whose benefit stems from interacting through a common platform

Economics story that we are going to cover: Part II

Lecture 10 STRATEGIES OF PLATFORMS

- Design, governance, openness, pricing

Lecture 11 SHARING ECONOMY

- Peer-to-peer markets, trust, reputation

Lecture 12 REGULATION AND POLICY

- Digital rights, market power, discrimination

Grading

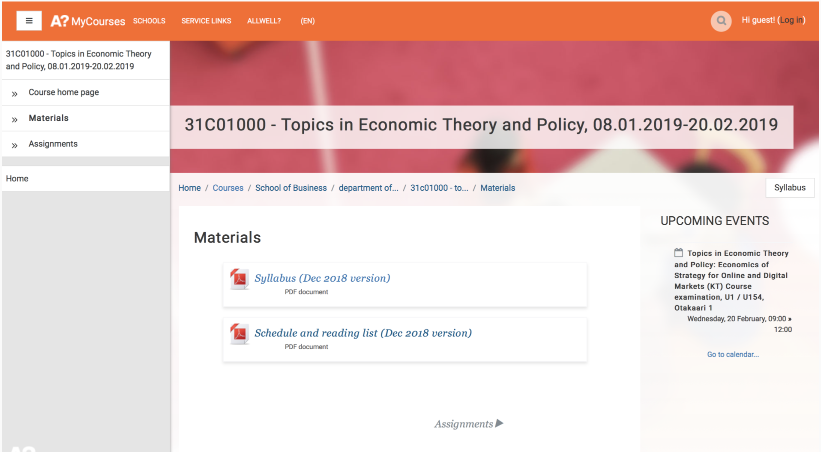
The final grade will be based on:

- 40 % exam
- 60 % assignments

There will be six graded exercise sets.

To pass the course a passing grade in the exam is required.

MyCourses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Syllabus
Materials
Syllabus (Dec 2018 version)
PDF document
Schedule and reading list (Dec 2018 version)
PDF document
Assignments
UPCOMING EVENTS
Topics in Economic Theory and Policy: Economics of Strategy for Online and Digital Markets (KT) Course examination, U1 / U154, Otakaari 1
Wednesday, 20 February, 09:00 » 12:00
Go to calendar...

Reading material

- Especially at the start of the course *The Economy* (www.core-econ.org) should be helpful for anyone in need to update their basic economics.
- Later, we will use mostly academic journal articles as reading material for each lecture.
- See details in the schedule which can be found in the course page at MyCourses.
- When needed, I'll give more detailed reading instructions, some of the material can get overly technical for the purposes of this course.

Exercises

There will be 6 sets of exercises initially as follows:

- Lectures 1–2
- Lecture 3–4
- Lecture 5
- Lectures 6–7
- Lectures 8–9
- Lectures 10–12

i.e. the exercise deadlines are grouped as above in MyCourses.

Learnings today

- Economics tools used extensively in online and digital markets.
- Relationship between preferences and data.
- Sources for efficiency improvements: search costs, frictions.

Exercises for Lecture 1

1. Come up with at least one example of both
   (a) an online market place
   (b) a digital platform

   that you would be interested to hear about later during the course.
2. List the top 5 reasons why you think Amazon has been so successful.

Readings for this lecture

- Athey, S. and M. Luca. 2018. Economists (and Economics) in Tech Companies. Harvard Business School Working Paper, Working Paper 19-027.

Next time

Prerequisites

- Preferences
- Game theory
- Pareto efficiency

Lecture 2: Prerequisites

Outline

- Preferences
- Game theory
- Pareto efficiency

Preferences

Several approached for preferences, but somewhat standard is *revealed preference theory* by Samuelson which we will follow:

- When given a choice, it is *assumed* that people behave consistently
- This consistency can arise from, for example:
  - Preference of one item over another
  - Limits on the choice, by budget, but also by e.g. conviction, laws and regulation, or social norms
  - Habits, for example sleep during the night, curioisity, laziness
- It can then be shown that people then behave as though they are maximizing something which economists call *utility*.

Utility

- An utility function assigns a numeric value for each choice.
- In economic theory, we often start with a specific functional form for the utility function.
- An example is the popular Cobb-Douglas utility function:

$$u(x, y) = x^a y^{1-a},$$

  which was crafted to explain how productivity depends on labor and capital inputs.
- The validity of such mapping of choices to numeric values will depend on the task at hand, and is an empirical question.

Substitution and indifference

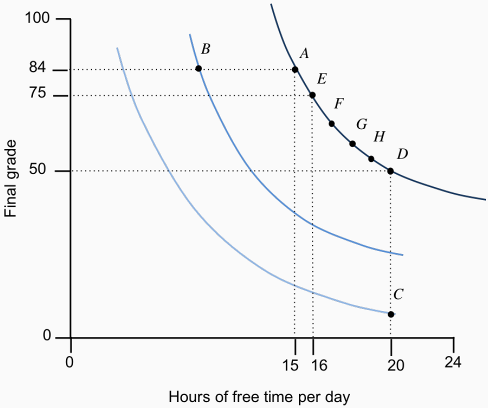
- One cannot have everything: need to make trade-offs
- Trade-offs are made between the choices that affect utility.
- Same utility can be achieved with different choices:
  - E.g. in the Cobb-Douglas utility capital input to automatization can be a substitute to labor input.
  - Or sometimes quality can be substituted with quantity, time with money etc.
- We say that one is indifferent between two choices if the utility of choosing either of them is the same.

Substitution and indifference

The (fictitious!) student here assigns some utility to both the amount of free time and the grade from a course.
In the illustration the student:

- is indifferent between choices A to D.
- prefers A over B.
- prefers D over C.

	A	E	F	G	H	D
Hours of free time	15	16	17	18	19	20
Final Grade	84	75	67	60	54	50

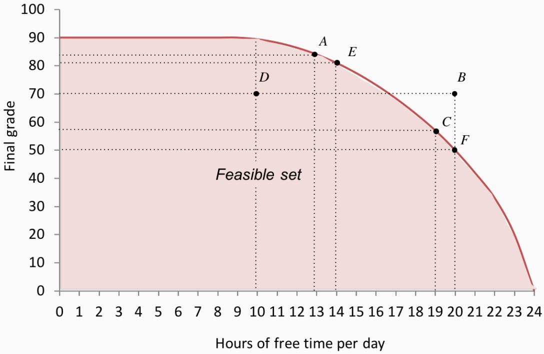


Source: CORE.

Opportunity cost

- Maximum grade is constrained e.g. by your talent and the amount of time you choose to study.
- Spending less time for study gives more free time but incurs an *opportunity cost* in lower grade.

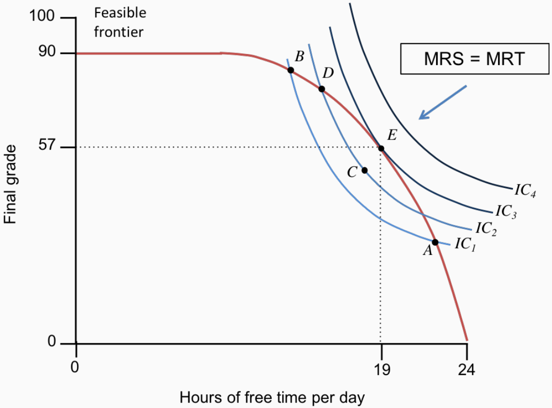
	A	E	C	F
Free time	13	14	19	20
Grade	84	81	57	50
Opportunity cost		3		7



Source: CORE.

Optimal utility

Utility is maximized when marginal rate of substitution (MRS) is equal to the marginal rate of transformation (MRT) set by the constraints.



Source: CORE.

From preferences to demand

- In every-day life people do not knowingly optimize their utility.
- The preference model is still a useful approximation:
  - Over time people adopt some consumption patterns.
  - The model is used successfully in microeconomics to explain many observed market phenomena.
  - Sometimes the simplifications in the basic model can become restrictive and other tools, such as behavioral economics, can be useful.
- Of particular interest in this course are the private preferences that determine your utility of consumption, and the aggregated market demand of all consumers.

Example: Preferences, substitutes, and demand

Table 1

Reduced Form Estimates

Bandwidth	p128	p96	p64	p32	p16
128	*−2.0*	+0.80	+0.25	−0.02	−0.16
96	*+1.7*	*−3.1*	*+43*	+0.19	+0.18
64	+0.77	*+1.8*	*−2.9*	+0.59	+0.21
32	+0.81	−1.0	*+1.0*	*−1.4*	+0.15
16	+0.2	−0.29	+0.04	*+1.2*	*−1.3*

Notes. Italics indicate significance at the 5% level. All own-price effects are significantly negative; the cross-price effects for one-step lower bandwidths are positive.

Figure. Demand elasticities by bandwidth.

Source: Varian, 2012.

Recovering preferences

- There are two key motivations to find out your preferences:
  1. Understand the drivers behind your choices.
  2. Predict how you will behave in a given situation.
- The first part, causal interference, is a traditional field of economics (microeconometrics).
- The second part, prediction, has become popular in data science with the availability of big data.

Estimation and prediction

- Let's consider a model

$$Y_i = f(X_i) + \epsilon_i$$

- Here X_i and Y_i are observed values.
- Function f maps values of X to Y and ϵ_i are the random noise (in measurement, unobserved variables, etc.).

Estimation and prediction

The goals in estimation and prediction are different:

1. The goal of regression estimation is unbiasedness:

$$E[\hat{f}] = f.$$

2. The goal of prediction is to minimize prediction error:

$$\hat{f} = \min_{f \in \mathcal{F}} L(f) = \min_{f \in \mathcal{F}} E[\ell(f(x), y)],$$

where e.g. $\ell(f(x), y) = (y - f(x))^2$.

Estimation and prediction

The expected prediction error is:

$$\begin{aligned} \text{error} &= E[(y-\hat{f}(x))^2] \\ &= E[(y-f(x))^2] + (E[\hat{f}(x)] - f(x))^2 \\ &\quad + E[(\hat{f}(x) - E[\hat{f}(x)])^2] \end{aligned}$$

Which can be written as

$$\text{error} = Var(y) + Bias^2 + Var(\hat{f}(x))$$

i.e. a combination of variance in data ($Var(y)$), bias in estimation, and variance from the fact that a sample is used to estimate $\hat{f}$ ($Var(\hat{f}(x))$).

Example: Predicting student numbers

	code	group	class
1	363651	11	2015
2	608436	11	2016
3	431779	11	2015
4	489072	8	2018
5	280478	3	2011
6	369920	4	2018
7	444360	7	2018
8	536385	11	2015
9	601187	12	2016
10	555559	11	2016

Table 1: Sample of data (code here randomized).

Example: Predicting student numbers

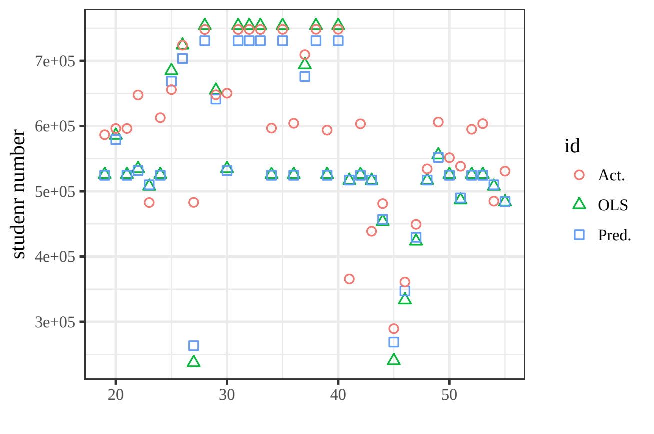
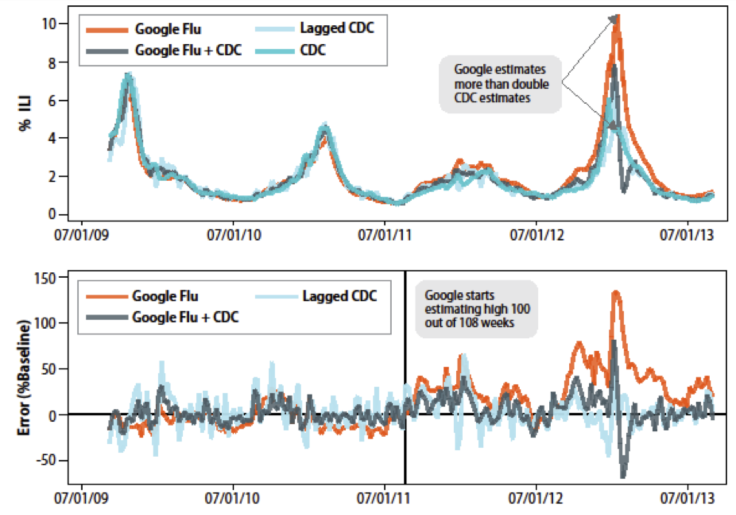


Figure. Average prediction error in OLS 5 % higher than with prediction.

Experiments and A/B testing

- Almost all large consumer websites carry out A/B tests.
- The idea is to take a random sample of users who are shown a version B of the website while the the rest use version A.
- Comparing results (e.g. clicks, purchases) between A and B can *predict* which version is better.
- These are very similar to controlled experiments used in economics, medicine etc., just the objective is different.
- For a website it may be enough to see which version works better (for now), but for other decisions it can be crucial to understand what are the reasons for the differences.

Example: Prediction gone wrong



Source: Lazer et al. 2014.

Game theory

- So far discussion on the behavior of an individual.
- In a market place the interactions of agents (firms) often important in practice: How will the actions of the others affect my decisions?
- Game theory has been hugely successful in explaining these interactions.

Game theory

- We make a difference between:
  - the behavior that does not take into account the actions of the others (non-strategic, sometimes price taker) and
  - the behavior where the other actions are accounted for (strategic, price setting).
- Game theory considers the modeling of the strategic interactions.
- Typically, in a market setting, the focus is on the behavior of firms that wield strategic influence over the market.

Illustration: War of attrition

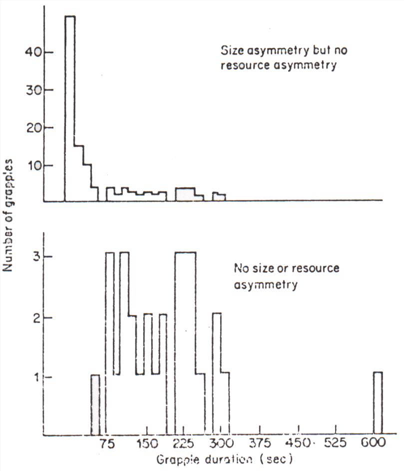


Figure. Length of grapple between spiders.

Source: Austad, 1982.

Illustration: War of attrition

- Two firms, i and j, own plants K and k, $K > k$.
- Demand is defined by an inverse demand function $p(Q)$.
- Marginal cost of production for both plants is c.
- Payoffs defined with:

$$\pi^i = \pi(K, k) = [p(K + k) - c]K$$
$$\pi^j = \pi(k, K) = [p(K + k) - c]k$$

Source: Liski & Vehviläinen, 2018.

Illustration: War of attrition

- Assume that the payoffs of the firms are defined as

(π^i, π^j)	$k = 0$	$k = 1$
$K = 2$	(45, 0)	(20, 10)
$K = 0$	(0, 0)	(0, 90)

Source: Liski & Vehviläinen, 2018.

Illustration: War of attrition

- In a *Nash equilibrium* both firms keep their plants running.

(π^i, π^j)	$k = 0$	$k = 1$
$K = 2$	(45, 0)	(20, 10)
$K = 0$	(0, 0)	(0, 90)

- If the firms could coordinate their actions, there would be more money on the table to be shared $(90 > 20 + 10)$.

Source: Liski & Vehviläinen, 2018.

Game theory

- In a strategic interaction game, n players who take action a_i.
- This will give the players a payoff that depends on their own action and the actions of the others: $u_i(a_1, \ldots, a_i, \ldots, a_n)$.
- An action a_i is a *dominant strategy* for player i if .

$$u_i(a_1, \ldots, a_i, \ldots, a_n) \geq u_i(a_1, \ldots, \tilde{a}_i, \ldots, a_n), \forall \tilde{a}_i \neq a_i$$

- Dominant strategy optimal for i regardless of what others do.
- A *Nash equilibrium* means that each player i's action is optimal given the actions of the other players.

In-class exercise: Game theory

Set-up:

- Prof. Quackenbush has graded a midterm exam for his class.
- Before handing back the exam, he calculated the average, 80, but forgot to record the students' individual grades.
- He now has no choice but to ask the students their scores.
- Class has 3 students whose actual grades are 60, 80, and 100.

Your job is to construct a "payoff mechanism" that should encourage each student to tell the truth regarding their grade on the exam, under the assumption that the other students are reporting their grades truthfully.

In-class exercise: Game theory

Let s_i be actual grade for student i and r_i the reported grade.
Take payoff functions $u_i(r_1, \ldots, r_n, \bar{s})$, where $\bar{s}$ is the average of s_i.
To reach a Nash equilibrium with truthful reporting, you need a function:

$$u_i(s_1, \ldots, s_i, \ldots, s_n, \bar{s}) \geq u_i(s_1, \ldots, r_i, \ldots, s_n, \bar{s}), \forall r_i \neq s_i$$

For example

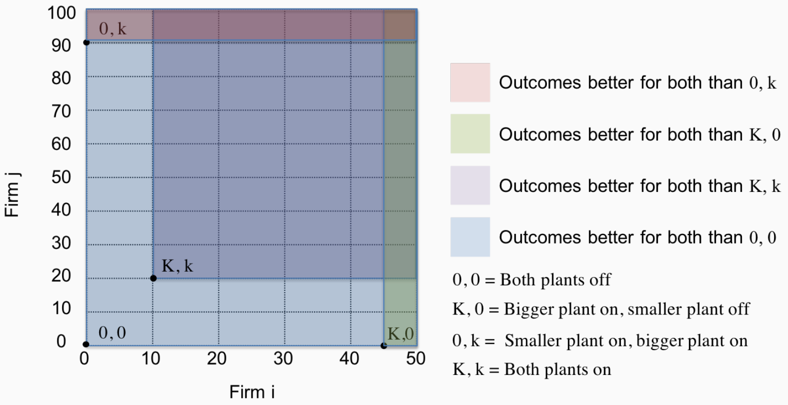
$$u_i = r_i - \begin{cases} 0, & \text{if } \bar{r} \leq \bar{s}, \\ k(\bar{r} - \bar{s}), & \text{if } \bar{r} > \bar{s}, \end{cases}$$

where $\bar{r}$ is the average of r_i, and $k > n$.

Pareto efficiency

- When dust settles in the market each agent is takes some action that results in the *allocation* of resources between the agents.
- An allocation is Pareto efficient if nobody can be better off without making somebody worse off.
- In general, little more can be said about how “good” an allocation is compared to other possibilities.

Exit game example of Pareto efficiency



0, 0 = Both plants off

K, 0 = Bigger plant on, smaller plant off

0, k = Smaller plant on, bigger plant on

K, k = Both plants on

Learnings today

- Revealed preferences model is a tool to explain observed market behavior of individuals.
- Game theory models the strategic interactions of firms.
- A Nash equilibrium is a state where all players in a game make the best possible decisions for them while taking the actions of others in to account.
- Pareto efficiency can be used as a criteria to describe if everyone is as happy as possible in the current market state given the utility of others.

Readings for this lecture

Following units from *The Economy* (www.core-econ.org) should be helpful:

- Preferences (CORE 3.2-3.5)
- Game theory (CORE 4.1-4.3)
- Pareto efficiency (CORE 5.2)

Note that these units from CORE may not necessarily be self-sufficient. If you are unfamiliar with the topics covered you may want to familiarize yourself with the earlier CORE units. Do not be overwhelmed by the amount of material: it is extensive but for the purposes of this course should make a quick read.

Exercises for Lecture 1

1. Come up with at least one example of both
   (a) an online market place
   (b) a digital platform

   that you would be interested to hear about later during the course.
2. List the top 5 reasons why you think Amazon has been so successful.

3. Suppose that you are in a supermarket buying ice cream. A package costs 2.66 €, but there is a bundle of two offered at 4.00 €. If you are indifferent between the two choices:
   (a) What does that tell you about your preferences?
   (b) Can you tell at what price you would be indifferent with three packages of ice cream? Why?
4. You are going to a concert with a friend, and tickets are about to come online any minute. A single ticket costs 40 € and there is a fixed delivery fee of 10 € per purchase (i.e. not per ticket). You forgot to communicate beforehand and need to make decisions on who buys and how many tickets on the spot. You share the total bill. If you miss the online sale, you must go to the black market at a cost of 100 € per ticket.
   (a) Model the costs for one player as in a strategic interaction game.
   (b) How many tickets you end up buying in a Nash equilibrium of the game? (Hint: Use (a) and the symmetry of the problem.)
   (c) Can you improve the outcome? If yes, then how?

Submit your answers through MyCourses by noon Thu 17 Jan.

Exercise for Lecture 5

1. Think of a question (about economics of games) to Janne Peltola / Supercell. You get an extra point if we use the question for in-class discussion.

Submit your question through MyCourses by noon Thu 17 Jan.

Next time

Markets

- Institutions
- Supply and demand
- Competitive equilibrium
- Perfect competition, monopoly, oligopoly

Lecture 3: Markets

Outline

- Supply and demand
- Competitive equilibrium
- Perfect competition, monopoly, oligopoly
- Institutions

Markets

- We now turn to see in detail how markets operate.
- In a market place we have a number of buyers that set the demand and a number of sellers that set the supply.
- Buyers have some willingness to pay for a good, set e.g. by their budget constraints and preferences.
- Similarly, sellers have some reservation price set e.g. by production costs and preferences.
- Markets balance the aggregated demand and supply.

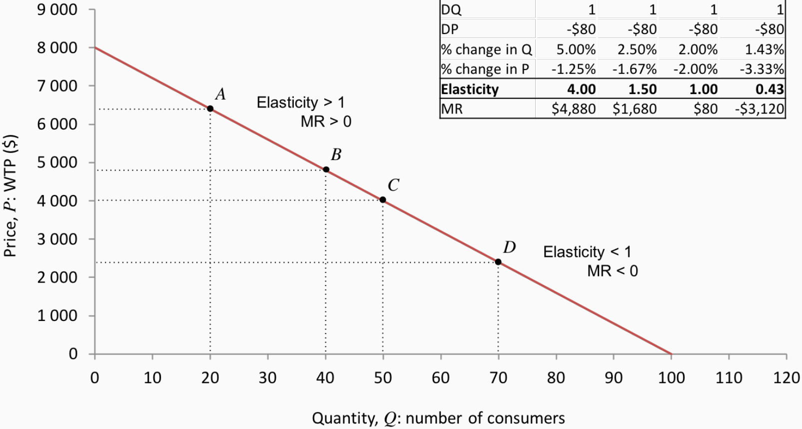
Example: Demand

bid.id	date.time	type	P	Q
1	2015-01-15 11:00:00	D	0.011	144.215
2	2015-01-15 11:00:00	D	0.029	79.928
3	2015-01-15 11:00:00	D	0.042	63.523
...	...	...	...	...
79	2015-01-15 11:00:00	D	25	0.035
80	2015-01-15 11:00:00	D	25.010	0.464
81	2015-01-15 11:00:00	D	25.145	0.881
...	...	...	...	...
165	2015-01-15 11:00:00	D	120.900	30
166	2015-01-15 11:00:00	D	123.203	25.400
167	2015-01-15 11:00:00	D	126.257	45

Table 2: Demand bids in the Nordic electricity market.

Aggregated demand and demand elasticity

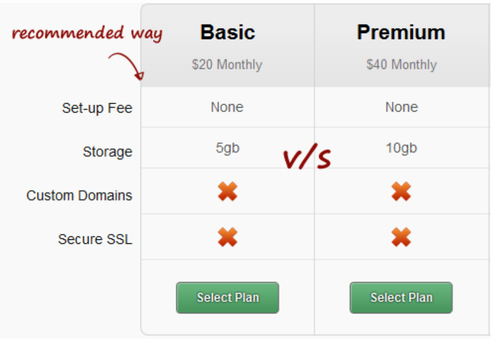
Elasticity = - % Change in Q/ % Change in P				
	A	B	C	D
Q	20	40	50	70
P	\$6,400	\$4,800	\$4,000	\$2,400
DQ	1	1	1	1
DP	-\$80	-\$80	-\$80	-\$80
% change in Q	5.00%	2.50%	2.00%	1.43%
% change in P	-1.25%	-1.67%	-2.00%	-3.33%
Elasticity	**4.00**	**1.50**	**1.00**	**0.43**
MR	\$4,880	\$1,680	\$80	-\$3,120



Source: CORE.

Strategies to estimate demand

- Change of price leads to changes in demand.
- Online market places differ from traditional sales in the speed and reach of testing.
- A/B testing can provide an understanding on how demand changes when prices change, i.e. on the price elasticity of demand.



Source: VWO.

Example from a test in a game environment

	Arden A (Control)	Arden B (Experiment)
Subjects	22	21
Price of Cure Light Wounds Potion	15 gold	30 gold
Potions Purchased	597	324
Potions Per Subject	27.14	15.43

Figure. Demand for Cure Light Wounds Potion with different prices.

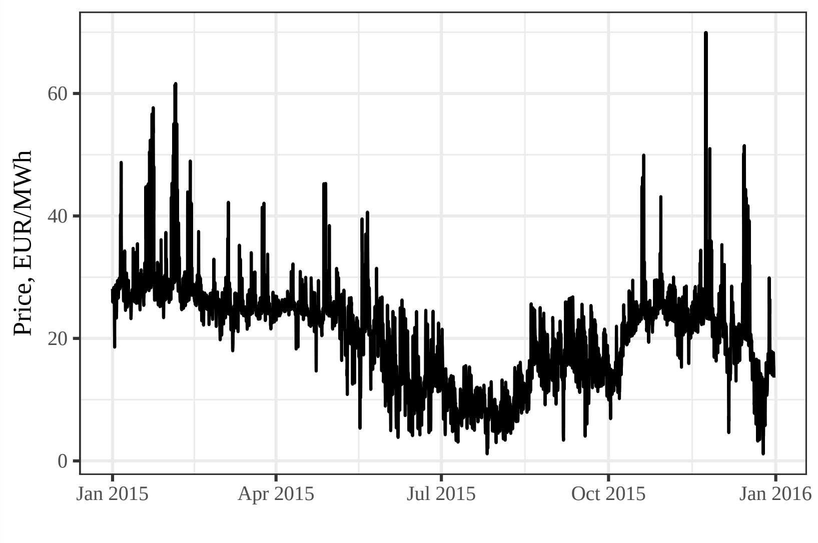
Source: Castronova, 2008.

Example: Supply

bid.id	date.time	type	P	Q
1	2015-01-15 11:00:00	S	0.011	146.371
2	2015-01-15 11:00:00	S	0.029	272.917
3	2015-01-15 11:00:00	S	0.042	205.597
...	...	...	...	...
116	2015-01-15 11:00:00	S	20.007	4.999
117	2015-01-15 11:00:00	S	20.100	64.486
118	2015-01-15 11:00:00	S	20.200	32.611
...	...	...	...	...
583	2015-01-15 11:00:00	S	100.100	5.107
584	2015-01-15 11:00:00	S	108	0.569
585	2015-01-15 11:00:00	S	110	4.689

Table 3: Supply bids in the Nordic electricity market.

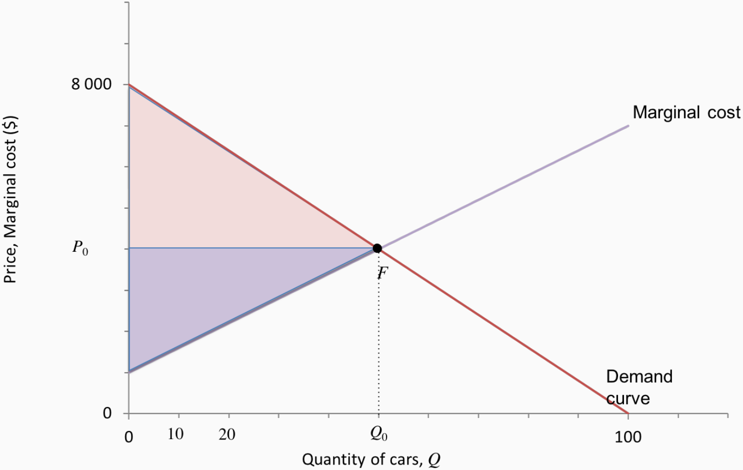
Example: Nordic electricity market



Example: Nordic electricity market

Video of market bid curves in the Nordic electricity market.

Competitive equilibrium



Source: CORE.

Perfect competition

- Equilibrium allocation in the perfect competition model is Pareto efficient:
  - All buyers whose valuation is higher than the market price purchase the good. All buyers whose valuation is lower than the market price do not.
  - All sellers whose cost is lower than the market price sell the good. All sellers whose cost is higher do not.
- The allocation also maximizes welfare, i.e. the sum of
  - *Consumer surplus*: Gain to buyers who pay less than they would have been willing to.
  - *Producer surplus*: Gain to sellers who sell for a higher price than their cost.

Perfect competition

- Several conditions required, including:
  - Well-defined property rights.
  - Perfect information available to all players.
  - Participants act as price takers.
- Efficiency of the allocation requires also that there are no transaction costs, taxes or other distortions that prevent a trade from happening.
- In practice: frictions always present.

Characterization of the competitiveness of the markets

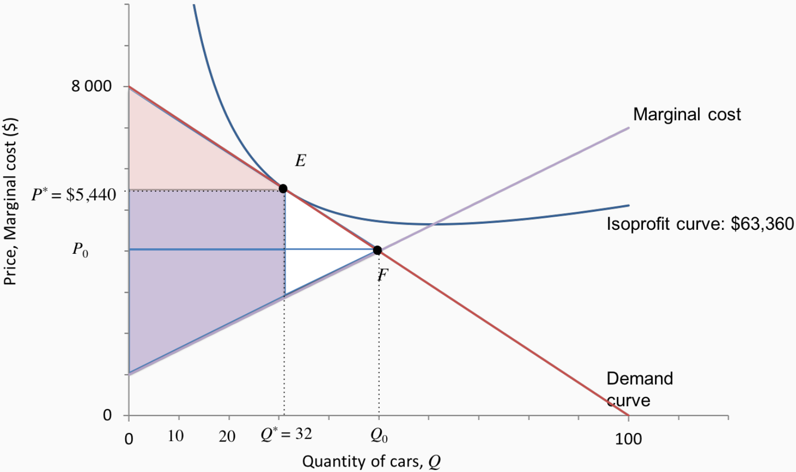
Ignoring other frictions and distortions, the main types of competition can be characterized as:

- Perfect competition
  - All participants act as price takers.
- Monopoly
  - Only a single supplier that can set prices to maximize its profit.
- Oligopoly
  - Limited number of market participants who engage in strategic behavior to maximize their profits.

Monopoly

- Use of monopoly power increases the profits of the monopoly firm compared to the competitive equilibrium.
- In practice, monopoly can raise its selling price or withhold supply compared to what it would do in a competitive market situation.
- This leads to:
    1. Change in distribution of surplus: higher profit to the monopoly firm, higher cost to consumers.
    2. Efficiency loss: the reduction of consumption and the associated surplus.
- There is a tendency to regulate monopolies to reduce harmful effects of market power.

Deadweight loss caused by monopoly pricing



Source: CORE.

Oligopoly

When there is a limited number of firms engaging in strategic behavior, several possibilities emerge:

- Bertrand competition
  - Firms can be thought to compete by setting prices.
  - Paradoxically, pure price competition reduces to efficient allocation even with only two firms.
- Cournot competition
  - Firms can be thought to compete by setting quantities.
  - Effect to market equilibrium depends on the number of firms (or their market share): from monopoly to perfect competition.
- Collusion
  - Instead of competing, firms can co-operate, collude, to achieve monopolistic control over the market.

Illustration: Exit game – Collustion

- Going back to example in Lecture 2.
- In a collusive solution the firms maximize the total profit by closing the larger plant:

(π^i, π^j)	$k = 0$	$k = 1$
$K = 2$	(45, 0)	(20, 10)
$K = 0$	(0, 0)	(0, 90)

- This leads to an additional gain of $90 - (20 + 10) = 60$ compared to the competitive solution.
- Division of the cake will depend on the bargaining powers of the firms.

Source: Liski & Vehviläinen, 2018.

Institutions

- Institutional arrangements set the rules for “games” in marketplaces.
- Market places can have their own rules, e.g. stock exchanges.
- Setting these rules is a question of market design, which we will return to in lectures 6 and 7.
- Even with no market specific rules, we have rules and regulation in place to set some boundary conditions
    - For example, environmental regulation, competition law, consumer protection law, copyright law, health and safety laws, labor laws etc.

Learnings today

- Competitive markets are an efficient tool to allocate resources.
- Monopolies may need regulation and oligopolies antitrust controls to prevent efficiency losses.
- Markets are always formed or designed within the legislative and institutional boundaries.

Readings for this lecture

Following units from *The Economy* (www.core-econ.org) should be helpful:

- Institutions, supply and demand (CORE 8.1, 8.2)
- Competitive equilibrium (CORE 8.5)
- Perfect competition (CORE 8.8)

Note that these units from CORE may not necessarily be self-sufficient. If you are unfamiliar with the topics covered you may want to familiarize yourself with the earlier CORE units. Do not be overwhelmed by the amount of material: it is extensive but for the purposes of this course should make a quick read.

Exercises for Lecture 3

1. Assume that firms may collect data on users' purchase behavior, but compete otherwise in a frictionless and distortion-free marketplace. Describe how competition can work in the following cases:
   (a) If there are many firms who all know the users' purchase history fully?
   (b) If there is a single firm who knows the users' purchase history fully and other firms know nothing of it?
2. Consider a market for a single homogenous good. Assume that there are n buyers with bid for buyer i given as (p_i, Q_i) and m sellers with bid for seller j given as (p_j, Q_j). Write down (maths or verbally) the perfect competition equilibrium conditions.

Exercise for Lecture 5

1. Think of a question (about economics of games) to Janne Peltola / Supercell. You get an extra point if we use the question for in-class discussion.

Submit your question through MyCourses by noon Thu 17 Jan.

Next time

Auction theory

- Why auctions (price discovery, competition)
- Private vs. common value auctions
- Auction types

Lecture 4: Auction theory

Outline

- Why auctions (price discovery, competition)
- Auction methods
- Private vs. common value auctions

Auctions as a tool for selling stuff

- We consider a situation where a seller has a single item for sale and there a number of potential buyers.
- What is the right price to ask?
  - It will depend on how much buyers are willing to pay.
  - Buyers are not going to tell you their true value.
  - Auction is a mechanism for price discovery.
- Auctions also create a competition between buyers.

Ascending auction

- Seller asks for bids from potential buyers.
- Several rounds of bidding are possible.
- Price starts low. Price is increased until only one bidder is left.
- Variation: Price starts high, is lowered until someone buys.
- Remaining bidder pays their bid.
- Common applications
    - Traditional auction houses selling all sorts of fancy stuff.
    - eBay, huuto.net (Finnish eBay) and the like.

Simple model

- Seller looking to sell one item.
- There are n buyers
  - Buyers have their own valuations for the item $v_1, v_2, \ldots, v_n$.
  - These valuations are private information.
- We assume that the valuations are drawn from an uniform distribution $[0, 100]$.
- Seller sets the rules for the auction.

Ascending auction

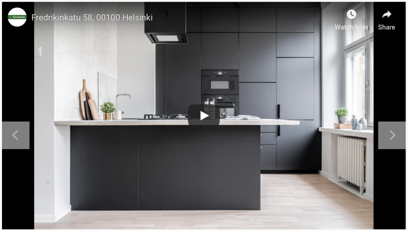
- Prices start at zero, and rises slowly.
- Buyers can bid at the current price or exit.
- Auction ends when just one bidder remains.
- Final bidder wins, and pays the price at which the second remaining bidder dropped out.

How should you bid?

Online auction for an apartment

Fredrikinkatu 58, Etu-Töölö, Helsinki

40 m² | KT, 1h, avok, kph, vh



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19.12.2018	1493587	Kirjallinen tarjous	306 000,00 €

Source: Kiinteistömaailma.

Ascending auction

- In this auction it is optimal for you to bid until the price is higher than your private value:
  - If you continue bidding above your value and win, you need to pay a price that is higher than your private value.
  - If you stop bidding below your value, you lose the potential gain from buying the item below your value.
- Bidder with the highest valuation will win and pay the second highest value.
- Example with three bidders
  - Assume that the valuations are 25, 33, 75.
  - First exit at 25, second at 33 and the auction ends.

Expected revenue from the ascending auction

- Assume two bidders with random values.
- Expected revenue from the auction is equal to the expected value of the second highest bid.
- Expected values for the bids
  - Highest value is 66 ⅔.
  - Second highest value is 33 ⅓.
- So the expected revenue for the seller is 33 ⅓.

Role of competition

More competition increases the bids and the expected value for the seller:

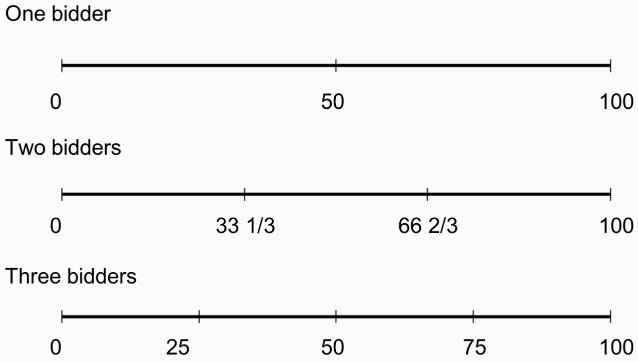


Figure. Expected bid values drawn from uniform $[0, 100]$ distribution as the number of bidders increases.

Why auctions have been popular online

- Arranging an auction is a trade-off between the benefit of price discovery vs. the cost of arranging an auction.
  - For example, think of a traditional auction selling arts.
- Online both the advantage and disadvantage change:
  - Many more participants possible online vs. physically.
  - Lower costs of arranging.
  - Emergence of popular sites has made it easier for people to know where to find the auction action.

Online example

Watching DealDash website.

Sealed bidding

- Seller asks for bids from potential buyers.
- There is only one round of bidding.
- Buyers deliver their bids so that the other buyers do not observe their bids.
- Highest bidder wins and pays their bid.
- Or a variation: Winning bidder pays the second highest bid.
- Common applications
  - Procurement contracts for commodities and services.
  - Private M&A ownership transactions between firms.

Sealed bidding – Second price auction

- Buyers submit their bids.
- Seller opens the bids.
- Bidder who submitted the highest bid wins.
- Winner pays the second highest bid.

How should you bid?

Second price auction – Optimal bidding

- Again, it is optimal for you to bid your private value.
  - Proof is left to the exercises.
- In equilibrium, everyone bids their value.
- Bidder with the highest valuation will win and pay the second highest value, exactly as in the ascending auction.
- Example with three bidders
  - Assume that the valuations are 25, 33, 75.
  - Winner has value 75, pays 33, as in ascending auction.

Sealed bidding – First price auction

- Buyers submit their bids.
- Seller opens the bids.
- Bidder who submitted the highest bid wins.
- Winner pays her/his bid.

How does the optimal bidding change?

In-class exercise: Auction

First stage:

- Guess how long the line on the blackboard is in centimeters.
- Write down your guess on the piece of paper in front of you.

In-class exercise: Auction

Second stage:

- Now you will bid for a money prize that is worth 1 € times the true answer in centimeters.
    - E.g. if the line is 90 cm, the prize is worth 90 €.
- The highest bidder will win the prize.
- The winner will be be paid as follows:

$$\text{payment} = (1\,€ \times \text{the true answer}) - \text{winning bid}$$

- Write down your bid on the piece of paper in front of you.

In-class exercise:

Return the papers. Discussion on the results.

First price auction – Optimal bidding

- Optimal bid is less than your true value.
- A higher bid (but still below your value)
  - Increases your chances to win.
  - Decreases your profit if you do win.
- Optimal bid depends on what you think the others will bid.
- We need to consider an equilibrium analysis.

First price auction – Equilibrium

- Recall the concept of Nash equilibrium: the strategic interaction now takes place through bidding strategies.
- A set of bidding strategies is a Nash equilibrium if each bidder's strategy maximizes his expected payoff given the strategies of the others.
- Bidders do not know their opponent's values: this is called incomplete information.
- In equilibrium, all bidding strategies maximize the expected payoff of the bidder taking in to account the uncertainty about opponent values.

First price auction – Equilibrium

- In the above first price sealed bid auction example, there is an equilibrium in which both bidders bid half their value.
- Bidder with the highest value wins.
- In expectation, highest value is 66 ⅔, so the expected revenue is 33 ⅓. Which is the same as in the second price auction.
- Turns out this is a quite general result.

Auction efficiency

- Auction outcome is efficient if the high value bidder wins.
- The Nash equilibrium outcome is the same in several auction mechanisms:
  - The high value bidder wins.
  - The expected auction price equals the expected value of the second highest bidder.
- This is the essence of the revenue equivalence theorem:
  - Every auction that allocates the goods efficiently has the same expected profits for every bidder valuation and the same expected revenue for the seller.

How does the theory work in practice?

- Outcomes of the auction will depend on the implementation.
- Sellers can modify the basic auction forms and try to increase their revenue.
  - Attracting bidders to participate in the auction.
  - Setting minimum bid prices, i.e. reserve prices.
  - Subsidizing bidders to create competition.
- Sometimes the assumptions, rational behavior and rational expectations, may be too restrictive.
- In many settings, such as procurement, there is also the challenge of making sure bidders compete, i.e. avoid collusion.

Common values

- Previously we have assumed that the buyers have some *private* valuation for the item.
- Reverse is also possible, it may be that the value of the item once acquired is the same for all buyers, but the value during the auction is uncertain.
- These are named *common* value auctions.

Winner's curse

- In a common value auction the bidder with the highest valuation on the value of the item, i.e. the most optimistic bidder, wins.
- A bidder who fails to take this into account pays, on average, more than the item is worth.

Other Auction methods

- Second price auctions can be generalized to auctions when many identical items are sold simultaneously, so-called Vickrey auctions.
- All-pay auctions where bidders submit bids, highest bidder wins, and everyone has to pay their own bid.
  - Winner pays less in expectation, because everyone pays.
  - Not often seen in monetary auctions, but can be used to model e.g. R&D competition or lobbying

Learnings today

- Auctions are a method for price discovery and to induce competition, works well online.
- Several auction methods, but in theory often same expected revenues when an efficient method is employed.
- Details of the auction design matter in practice.

Readings for this lecture

- Milgrom, P. (1989) "Auctions and Bidding: A Primer", Journal of Economic Perspectives.
  - The proofs of the theorems are not required reading.
  - Also section "Correlated Bidder Information" and beyond may get too involved and is not essential for this course.
- Reiley, D. (2000) "Auctions on the Internet: What's Being Auctioned, and How?", Journal of Industrial Economics.
  - A lot of the detail is outdated and not essential. Focus on how the economic theory has been applied in real life cases.
  - Feel free to skip sections III, IV, VIII and IX.
- Ockenfels, A., Reiley, D. and Sadrieh, A. (2006) "Online auctions", NBER Working Paper 12785.
  - Another survey with some outdated links.
  - Sections 1, 2.1, 2.2 and 8 are the key parts for this course.

Exercises for Lecture 4

1. Find an example of an online auction (other than the examples in the lecture slides: Kiinteistömaailma, eBay, huuto.net, DealDash). Describe the auction mechanism that they are using.
2. Prove that in the second price sealed bid auction for a single indivisible good it is optimal for you to bid your private value v.

Next time

Guest lecture

- Economics of games
- Janne Peltola from Supercell

Lecture 5: Guest lecture

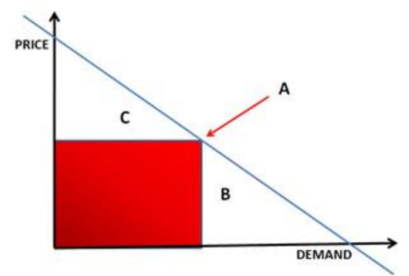
Outline: Janne Peltola from Supercell

Supercell's Clash Royale Revenue Has Surpassed $2 Billion, and It's Still Going Strong

In just over two years, Clash Royale has managed two incredible feats. Feat one: It has now, according to Sensor Tower Store Intelligence estimates, exceeded $2 billion in global player spending. Feat two: In doing so, it has cemented Supercell as the first mobile publisher to have more than one multi-billion-dollar title on the App Store and Google Play, the other being its 2012 hit Clash of Clans, which itself has grossed in excess of $6 billion.

Source: Sensor Tower.

Free-to-play games: Tool for price discrimination



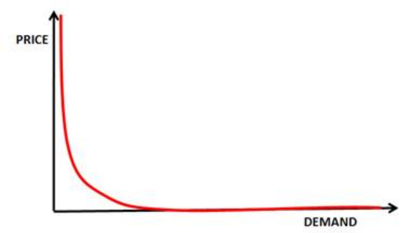


Figure. Linear demand (left). Model for demand in a free-to-play game (right).

- Setting one fixed price at A leads to buyers that could have paid more (C) and buyers that do not pay anything (B).
- Empirically, it seems that few people are willing to pay huge sums of money within the games (like in the demand curve on the right). Free access and in-game purchases provide a way for price discrimination and monopoly rents.
- High-paying customers or *whales* are similar to high-rollers in casinos.

Figure: Lovell, 2011.

Regulatory angle

- Discussion on public or private regulation for other popular services (e.g. Google, Facebook).
  - Privacy concerns, discrimination and other misuses (of data) create regulatory pressures.
- Is the gaming industry insulated against such concerns?
- Other possible social concerns:
  - Some video games associated with concerns on repugnant content (e.g. violence).
  - The very mechanisms that make games popular can also lead to overuse (loss of study time!) or even addiction.

Next time

Market design

- Auction design
- Ad auctions
- Market design

Lecture 6: Market design

Outline

- 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.

Mechanism design

- 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.

Designing auctions – Auction mechanisms

- 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.

Reserve prices

- 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 ⅓.
- What happens is the seller sets a reserve price of r?

Reserve prices

- 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

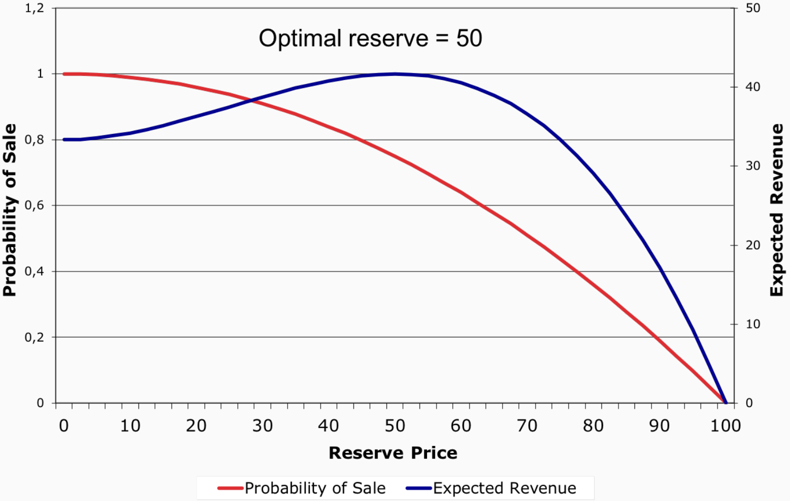


Figure: J. Levin.

Impact of competition

	No reserve price		Optimal reserve price	
N	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

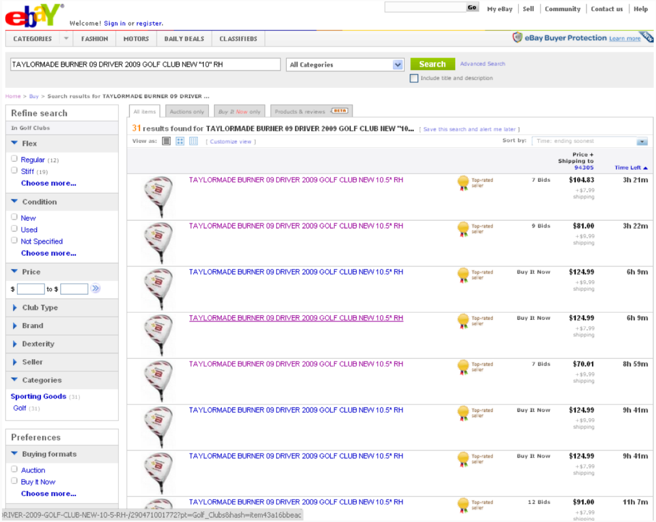


Figure: Einav et al. 2012.

Example from eBay auctions

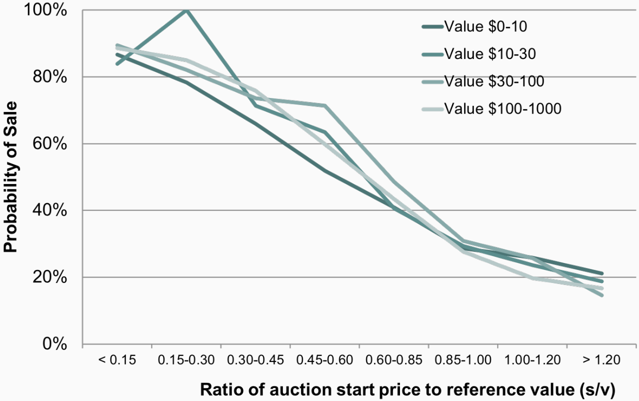


Figure. Impact of reference price to sales probability.

Figure: Einav et al. 2012.

Example from eBay auctions

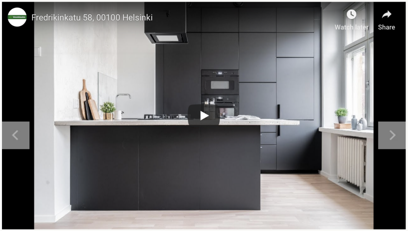
Figure. Impact of reference price to revenues.

Figure: Einav et al. 2012.

Example: Online auction for an apartment – revisted

Fredrikinkatu 58, Etu-Töölö, Helsinki

40 m² | KT, 1h, avok, kph, vh



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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 ≥ Reserve	15.77%	100.00%	36.85%	100.00%
High bid < Reserve cases				
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.

Source: Larsen 2014.

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.

Source: Hossain, 2008.

Ad auctions

> 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.*

Ad auctions

- 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.).

Figure: Google.

Ad auctions

- 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.

Ad auctions

Assumptions:

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

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.

	Value in €	
Bidder	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.

	Value in €		Price
Bidder	1st position	2nd position	in cents
1	20	10	$\boxed{5}$
2	10	5	$\boxed{2}$
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.

Goolge ad auctions

- 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.

Market design in general

- 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.

Source: Roth 2008.

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).

Readings

- 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.

Lecture 7: Online markets

> Like a burnished cloak of crystals the giant Amazon, its current gently churns overtaking the grass on the banks and then, away off, the clouds that the sun imbues with its dimming remains in a flighty whim steep the celestial sphere in scarlet. *–Manuel Pasion Zegarra*

Outline

- Reduce frictions between buyers and sellers
- Establishing trust
- Managing information

Online marketplace: Conflicting incentives?

Low prices for buyers:

- Transparent and low prices attract buyers.
- E-commerce marketplaces or internet platforms have a need to limit search frictions and induce competition.

High prices for sellers:

- Sellers are attracted by higher prices.
- Those with cost advantage win if prices are low.
- Others may want to differentiate or make it harder for consumers to understand their pricing.

Online marketplace: Effect of market design on search

Online search design affects consumer search and seller incentives at the same time. The search can be used to:

1. Predict consumers' demand, and to guide them toward their most desired product:
   - Can be in response to a user query.
   - Or through advertising or product recommendations.
2. Help consumers to find a retailer who offers an attractive price for the product:
   - This increases the effective price elasticity faced by sellers, and increases competition.

Online marketplace: Effect of market design on search

Different online marketplaces take very different approaches:

- How many items and from how many sellers the user can see.
- The order of the items / sellers.
- Present different sequences of choices:
  - Choose exact product first, the present price alternatives.
  - Present alternative products and prices directly.

Some examples from the U.S. and Finland below.

Example: Search in Amazon.com (U.S.)

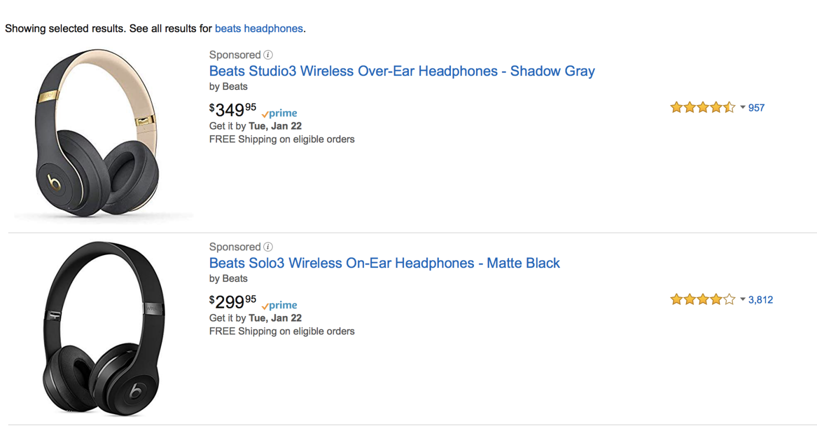


Figure: Amazon.

Example: Search in Verkkokauppa (Finland)

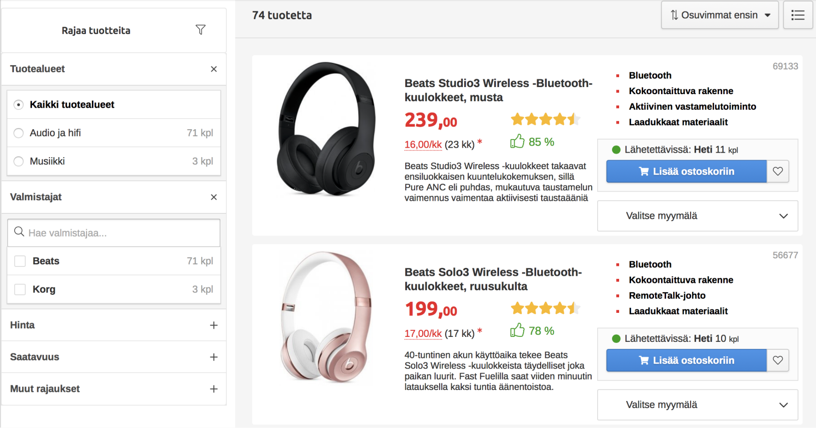


Figure: Verkkokauppa.

Example: Search in eBay (U.S.)

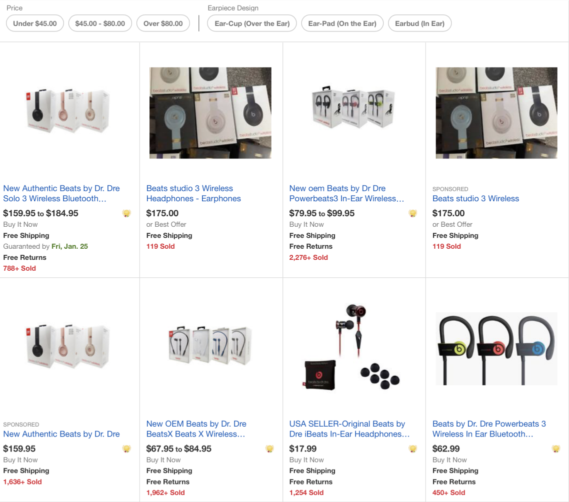


Figure: eBay.

Example: Search in Tori.fi (Finland)

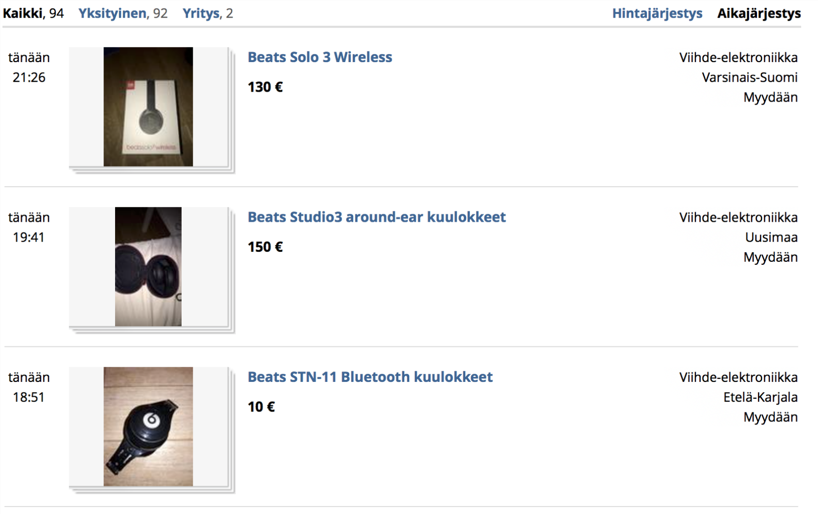


Figure: Tori.fi.

Example: Search in Huuto.net (Finland)

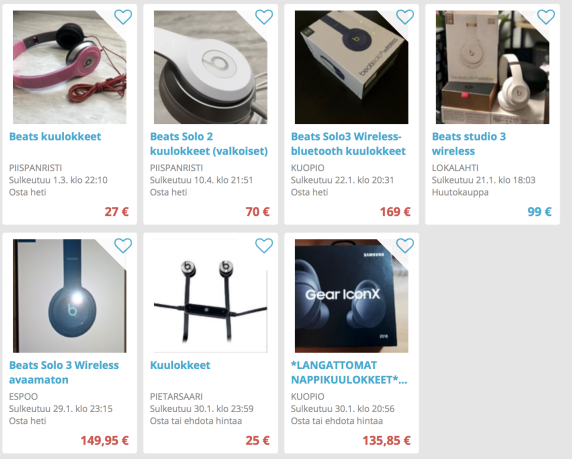


Figure: Huuto.net.

Do these things matter?

At least three channels seem evident:

- The amount of competition among the sellers is determined on the basis of how many items the user can see. This will affect which choices the customer can make.
- The order of the items / sellers will affect who gets most sales. May be based on other criteria than price, gives control to the marketplace.
- The available customer choices will start to affect the pricing (and other) decisions by the sellers.

Experiment with eBay market design

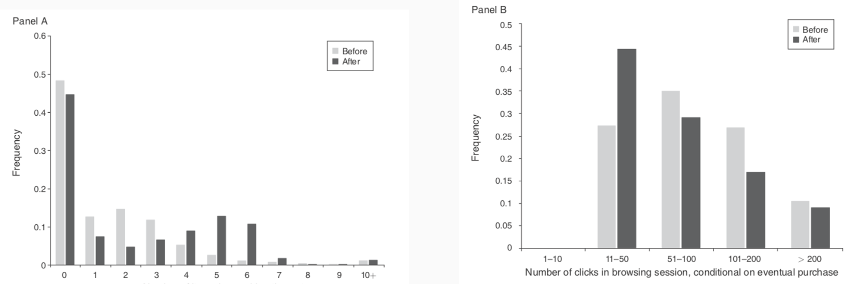


Figure 5. Change in Size of Consideration Set

Figure. Impact of the design change to choices people see (left) and number of clicks they need to make (right).

Source: Dinerstein et al. 2018.

Experiment with eBay market design

- In May 2011, eBay introduced a new search result page:
  - Prominent “Buy Box” that displayed the lowest posted price among the sellers classified as “top rated” by eBay.
  - As a result customers could both see more choices and resort to the default choice with fewer clicks.
  - This reduced prices of trades, both because customers could more easily choose the lower price and because the prices offered by the sellers were lower.
- Apparently also quantities sold were slightly reduced. In any case, eBay reverted back to a search that was close to their original search page in 2012.

Source: Dinerstein et al. 2018.

Establishing trust

- Problem in online markets is how to trust your trading partner
  - Is the trade fulfilled at all? (fraudulent behavior)
  - What is the true quality? (remember the lemons)
- Is this problem worse online than offline?
  - Offline it can often be easier to inspect goods, and trade might be more likely to be face-to-face.
  - Online trade can happen by mail (goods) or online (e.g. coding service) delivery, be initially anonymous (Craigslist, dating sites), and often payment needs to occur before delivery.
- How to make the marketplace safe to both buyers and sellers?

Establishing trust

- Third party verification or participation:
  - Amazon will pick, pack, ship and provide customer services for non-Amazon sellers.
  - Taobao (part of Alibaba) escrow service: pay after delivery.
  - eBay/Paypal buyer money-back guarantee.
- Online reputation mechanisms:
  - Allow buyers (and sellers) to give feedback.
  - Report the feedback to subsequent participants.
  - We will return to the related issues later.
- Indirect measures also possible, e.g. use AI to follow messaging between the buyers and sellers post-trade (Milgrom and Tadelis, 2018).

Managing information

- Online transactions create data for the companies.
- We'll explore the evidence on some of the (known) ways by which the companies can use these data to advance their business:
    - Dynamic pricing.
    - Product steering.
    - Price discrimination.

Dynamic pricing

- One of the fundamentals in economic theory is the the law of one price:

  The price of an identical good traded should be the same across all buyers and sellers.

- If this is not true, then some assumptions on perfect competition are not met, for example:
  - Information is not perfect.
  - Transaction costs (e.g. fixed fees, taxes) distort the outcomes.
- If a good were sold at different prices in different places, a trader could maker arbitrage profits until prices are even.

Example: Dynamic pricing

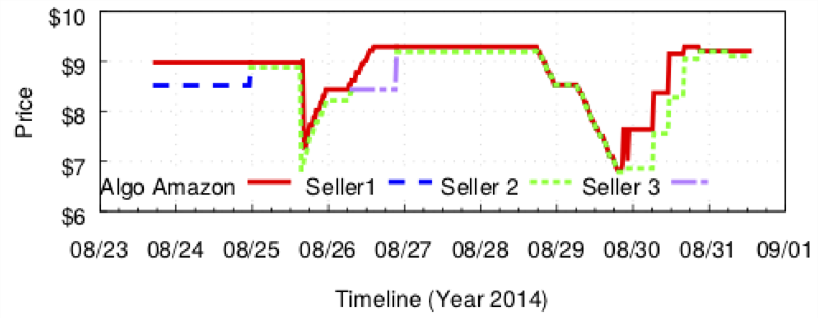


Figure. Example of Amazon matching the lowest seller.

Source: Chen et al. 2016.

Example: Dynamic pricing

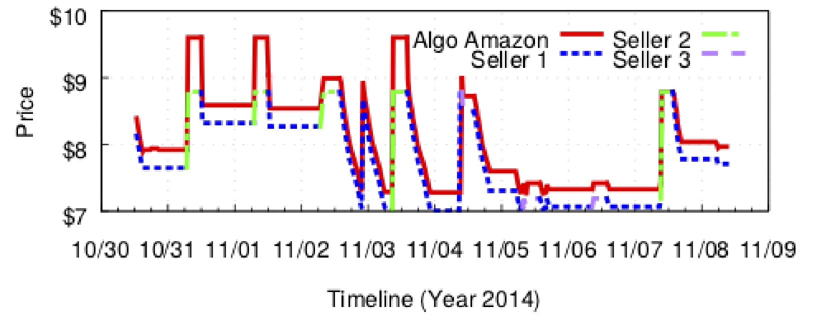


Figure. Example of Amazon keeping a premium over other sellers.

Source: Chen et al. 2016.

Dynamic pricing

- Online information on the bids of competitors makes it easy to match prices.
- If and when consumers are inattentive, Amazon has the advantage of deciding when it wants to sell the product and at what price.
- This also works the other way around: Other companies can start to match Amazon prices.
    - There is evidence that also offline retail prices start to match Amazon's online prices (e.g. Cavallo 2017).
    - As the share of online markets grow, this will start to have wider economics implications, e.g. to inflation.

Product steering

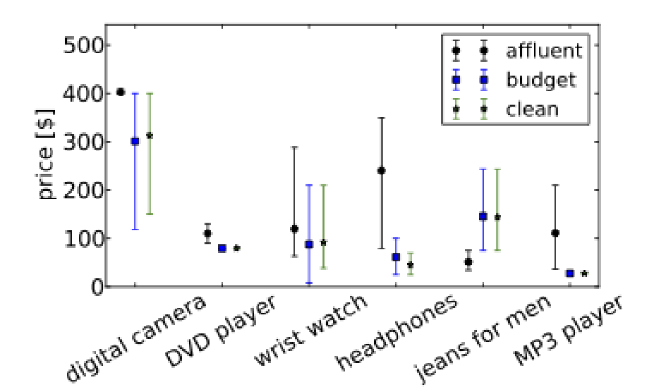


Figure. Example of the use of data to steer product selection, see e.g. the prices offered in headphones or MP3 players.

Figure: Mikians et al. 2012.

Price discrimination

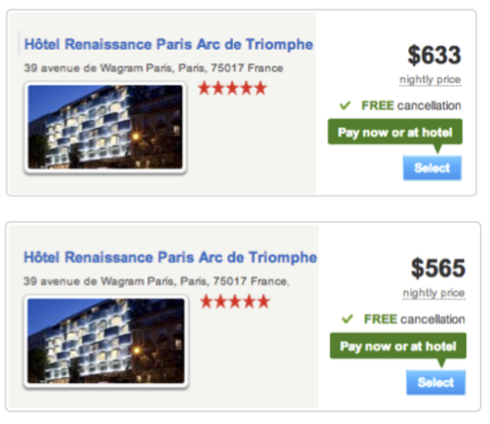


Figure. Example of price discrimination. Two identical searches with different online fingerprint.

Figure: Hannak et al. 2014.

Price discrimination

- Product steering and price discrimination are ways by which the firm tries to extract the maximum amount you are willing to pay.
- If the firm has market power and is only able to offer *uniform pricing*, the price for everyone, then it will still maximize its profit but some trade will not happen.
- Remember, that in perfect competition all sellers would be willing to sell at their cost (if they would try sell at a higher price, someone else would sell at cost level).

Deadweight loss caused by monopoly pricing

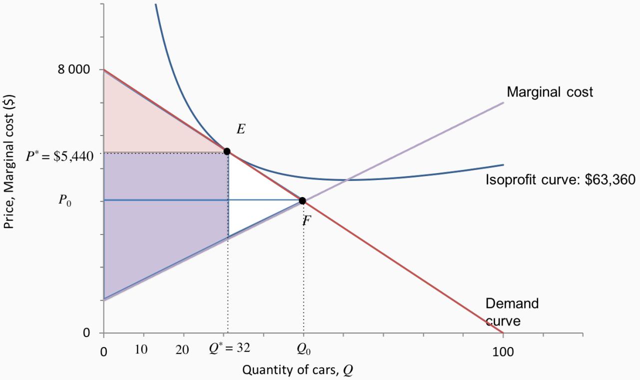


Figure. If a monopoly can charge only one price (at E here), then the allocation is not efficient.

Source: CORE.

Price discrimination

- If the firm has monopoly position, can set prices freely and knows all data, then:
  - The firm will set a different price for each customer.
  - The price will be exactly set to customers valuation.
  - All customers with valuation higher than cost will get the item.
  - Consumer surplus will be zero, monopoly extracts all the rents.
- But the allocation will be efficient: total welfare increases!
  - In a monopolistic market situation price discrimination may restore market efficiency compared to uniform pricing.
  - But the all the benefits from efficiency will be pocketed by the monopoly; this typically is seen to be problematic.

Price discrimination

- Consider x_i goods sold to markets $(1, \ldots, n)$.
- Let c be the equal marginal cost of production.
- Compare change in welfare ΔW in cases
  - Goods are sold for a uniform price p_0.
  - Price discrimination: goods sold for prices $(p_1, \ldots, p_n)$.
- The following inequalities hold:

$$(p_0 - c) \sum_{i=1}^{n} \Delta x_i \geq \Delta W \geq \sum_{i=1}^{n} (p_i - c) \Delta x_i$$

- First inequality tells that with uniform prices output must increase for the total welfare to increase.
- Second inequality tells that if price discrimination is profitable, total welfare must increase.

Source: See Varian, 2012, Section 1.

Price discrimination

- Despite the potential, evidence suggests that price discrimination is not that wide-spread:
  - In 2015, the U.S. Council of Economic Advisers: price discrimination is used in a "limited and experimental fashion".
  - Geographical price discrimination rare among the top online retailers in the U.S. (Cavallo 2018).
- Arguments against price discrimination:
  - Transparency of online prices.
  - The fear of antagonizing customers.
- In 2000, Amazon was caught selling same DVD with different prices. This lead to the following statement by their CEO:
  - "We've never tested and we never will test prices based on customer demographics."

Use of data in price discrimination

In the case of duopoly competition, the following result holds:

- If firms are equally able to profile consumers or if only one firm is able to profile consumers, then profiling does not allow firms to escape from the Bertrand paradox and make positive profits.
- If both firms can profile customers and price discriminate, but there is uncertainty (did one firm recognize the consumer or did they both?), then the firms can earn positive profits.

Source: Belleflamme et al., 2017.

Learnings today

- Reduction of search frictions is key to how much competition there really is on a marketplace.
- Companies can collect and use data to their advantage in at least three way: dynamic pricing, price discrimination, and product steering.
- Marketplaces need to balance their design to remain viable.

Readings for this lecture

- Milgrom, P. and S. Tadelis (2018) "How artificial intelligence and machine learning can impact market design", NBER Working Paper 24282.
    - Section II., though entertaining reading and relevant for anyone interested in auctions, is not in the core of this course and can be skipped.

3. Assume that you are a social planner (i.e. trying to maximize total welfare) that is set to design an online marketplace. The market place has producers trying to sell and consumers interested in buying. Sellers submit their offerings, products and prices, to the marketplace. The marketplace is build around a search engine where buyers can try to find a product that they are interested in. If the price is lower than the willingness to pay of the user, then they will make the purchase.
   (a) First assume that you can ban all other marketplaces (you are the planner!). How would you try to organize the search to maximize welfare? (No need to worry about other frictions or distortions.)
   (b) How does the design problem change if there are alternative venues of trade for the producers to sell their products?
   (c) How and why would you collect and use data on buyers?

   Note that your job is not to present a website design or anything like that, but to describe the key economic principles that would direct how to setup the market place. I'm after a simple theory answer for (a); (b) and (c) are more open ended and will be graded on the merits of thinking (not the same things as length!).

Next time

Networks

- Networks
- Direct network effects

Lecture 8: Networks

Outline

- Networks
- Network effects
- Model of fulfilled expectations

Figure. Photo of Wynn Wagner III.

Figure: Religion Wiki.

Example of a listing: `Compost, 914-720 497, V.21, 24H`.

Figure: infostory.com.

Mark Davis was walking east on Wilshire Boulevard — smiling. He had a few minutes to kill between lunch and launching a quarter-million-dollar electronic parts deal with a Singapore distributor.

He'd been talking about how he managed to pull off the "deal of a lifetime." A corporate coup. His self-proclaimed "corporate guerilla army" fought off several bids from multinational companies. But he had an ace in the hole: a PC-based bulletin board system (BBS).

Davis recalled the part his company's BBS played: "We had an in-house Fidonet BBS set up for communications between our L.A. office and our two-man advance team in New York. We'd used it for about a year to overcome the bicoastal time zone hassle. No telephone tag.

"When we moved the New York team to Singapore, the first thing they did was set up a similar Fidonet BBS. The Singapore BBS and the one here automatically exchanged messages each night."

Source: InfoWorld 22 Aug 1988.

Network business – it's the 1990s

- American Online (AOL) is an example of a network business:
  - The roots of the company are in the 1980s when it was providing online services via a modem link.
  - In 1995, the company had roughly 5 million subscribers.
  - The following year AOL opened dial-up internet connection, and went on to reach 20+ million customers by 2000.
  - America Online agrees to purchase Time Warner for $165 billion in what would be the biggest merger in history.
- A quote from an analyst:
  "*The dot-com guys have sort of won*" (NYT, 11 Jan 2000).

Network business – it's the 1990s

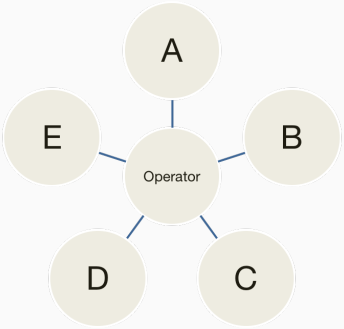
- The basic idea was simple and powerful:
  - In some cases a service is more valuable if more customers are using it because customers want to interact with each other.
  - If a firm moves fast and gets some customers, those customers will attract more customers, which will attract even more.
  - As a result, growth will be explosive and result in a single firm owning the market forever.
  - The winner would take all.
- These interrelated customers are called a network, and the feedbacks between customers are called network effects.

Network business – it's the 1990s

- The first dotcom boom crashed in 2000, wiping out much of the expected valuations of internet companies.
- AOL's growth stopped around the same time, its dial-up subscription service lost to broadband internet.
- Clearly, the network model was not working in all cases.
- We still need to understand it to be able to discuss what went wrong; and the basic logic is still valid in many examples.

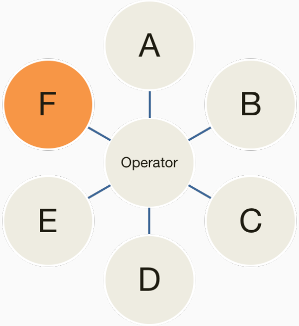
Traditional networks

In a traditional network, network externalities arise because a typical subscriber can reach more subscribers in a larger network.



Traditional networks

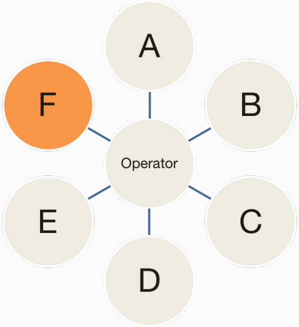
- The number of potential transactions increases with network size.
- If every new transaction has positive value, a larger network gives higher value to a subscriber.



Complementarities

Links from subscribers to the operator are used as complements:

- Enabling connection F–A through the operator enables also connections F–B, . . . , F–E.



Traditional goods: The law of demand

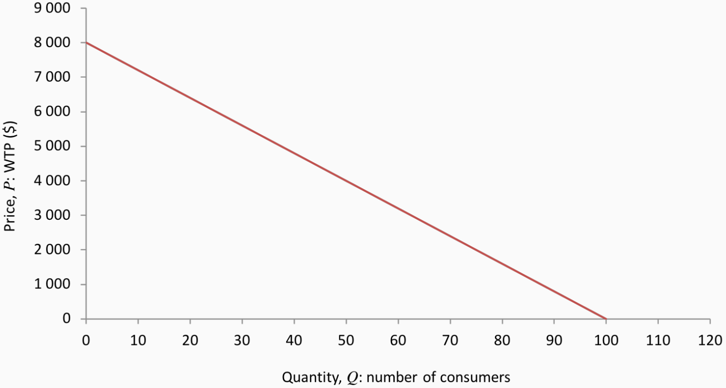


Figure. In traditional non-network industries, the willingness to pay for the last unit of a good decreases with the number of units sold.

Source: CORE.

Network effects

- The existence of positive network effects implies that, as sales expand, people are willing to pay more for the last unit.
- The key reason for the appearance of network effects is the complementarity between network components.
- Depending on the network, the network effect may be direct or indirect.

Direct network effects

- When customers are identified with components, the network effect is direct.
- Consider for example a typical two-way network, such as the local telephone network, with n subscribers:
  - There are $n(n-1)$ potential goods, i.e. potential connections from subscriber i to everyone else and back.
  - An additional customer, $(n+1)$, provides direct network effects to all other customers in the network.
  - It adds $2n$ potential new goods through the provision of a complementary link to the existing links.

Indirect network effects

- Indirect network effects involve economies of scale.
- For example, in a credit card network:
  - A user does not directly gain if one more person has the same credit card.
  - But the additional person will encourage more merchants to accept a credit card.
  - From a cardholder's perspective there is more choice and variety of merchants accepting this card.
- Many such complements exists, e.g. hardware and software.

In-class exercise: Network effects

- We will play several rounds.
- In each round, you will have to decide whether or not to buy a commodity.

In-class exercise: Network effects

- The price of the commodity for everyone is $p_0 = 6$ € throughout the exercise.
- The value of the commodity to you in a given round is determined by two things: its maximum value to you and the number of people other than you that buy it.
- The maximum value of the commodity to you is given by alphabet ordinal number of the first letter in your first name ($A = 1$, $B = 2$, $\ldots$), use a proxy if needed.
  - Write it down to a separate piece of paper.

As an example, the maximum value for Iivo is 9 € .

In-class exercise: Network effects

- The actual value of the commodity to you is equal to its maximum value multiplied by the proportion of people other than you that buy it.
- So the actual value is always lower than the maximum value unless everyone else buys the commodity.
- The actual value is zero if no one else buys the commodity.

As an example, if 12 out of the other 20 buy the commodity, then the actual value for Iivo is $12/20 \times 9 = 5.4$ €.

In-class exercise: Network effects

- At the start of each round, you either *Do Not Buy* or *Buy*.
- After everyone has decided, you will be told the share of people who bought the commodity.
- You can then calculate your actual value.
- And your profit, as follows:
  - If your decision is *Do Not Buy*, your profit is zero.
  - If your decision is *Buy*, your profit is equal to the actual value of the commodity to you, minus its price.
- Write down your maximum value, decision, your actual value, and the profit on your score card (do not pass this along).
- Update of the maximum values: Pass the paper with maximum value to the person on your left.

Network effects

- Take 1000 people who are in a market for a network good.
- Index the people from $v = 1, \ldots, 1000$. v can be thought to be the reservation price or willingness-to-pay for the good.
- Now assume that the value of the good to person v is vn, where n is the number of subscribers to the network.
- If price is set at p, then some individual, $\hat{v}$, is indifferent between buying the good or not buying it: $p = \hat{v}n$.
- Number of people with $v \geq \hat{v}$ is $n = 1000 - \hat{v}$. Combining these we get the following equilibrium prices:

$$p = (1000 - n)n$$

Network effects

Figure. Equilibrium price as a function of people choosing subscribing to the network.

Network effects

- But to which equilibrium will the market end up?
  - The fulfilled expectations formulation (Katz and Shapiro, 1985) gives one possibility.

Model of fulfilled expectations

- Let n^e to denote consumer expectations on the number subscribers to the network service.
- $v(n; n^e)$ denotes the value for the nth buyer when n^e units are expected to be sold.
- Properties of the value function $v(n; n^e)$:
  - $v(n; n^e)$ is a decreasing function of n because the demand slopes downward (as normal).
  - $v(n; n^e)$ increases in n^e if the network effect is positive: the good is more valuable when the expected sales n^e are higher.

Model of fulfilled expectations

- As an example, we'll use:

$$v(n; n^e) = (1 - n)n^e$$

- n and n^e are normalized so that they represent market coverage, ranging from 0 to 1, rather than absolute quantities.
- Consumers that are indexed by low values of n value the subscription highly, whereas consumers that are indexed by n close to 1 place a low valuation on this service.
- This formulation was used in the very first paper to formalize network economics in the context of telecommunications subscriptions (Rohlfs, 1974).

Model of fulfilled expectations

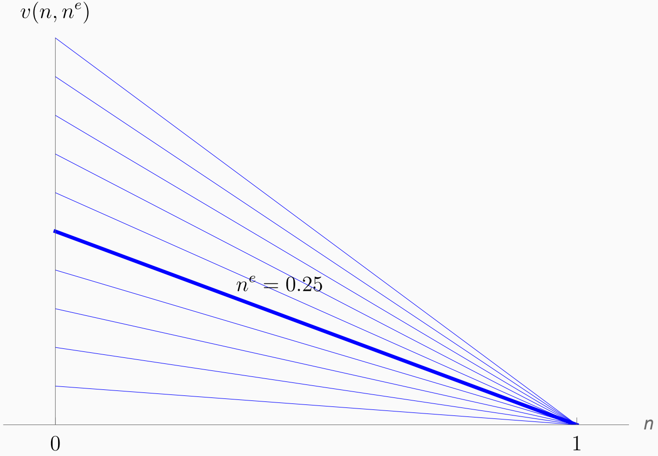


Figure. Value as a function of n when n^e is fixed to different levels, e.g. if $n^e = 0.25$ then $v(n; 0.25) = 0.25(1 - n)$.

Model of fulfilled expectations

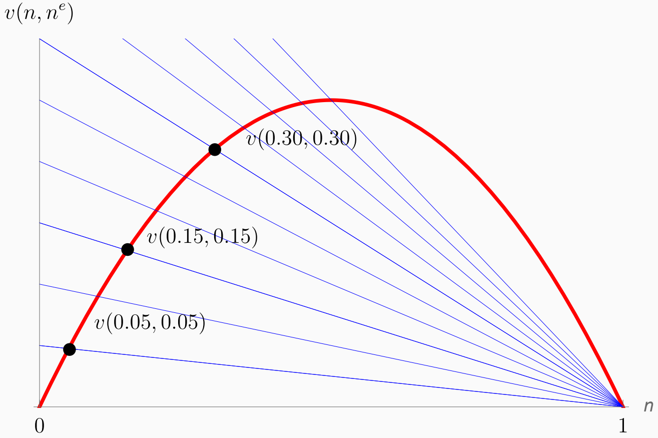


Figure. Three examples where n^e is fixed to 0.05, 0.15, 0.30 and the value is plotted as a function of n. The equilibrium points are at $n = n^e$.

Model of fulfilled expectations and prices

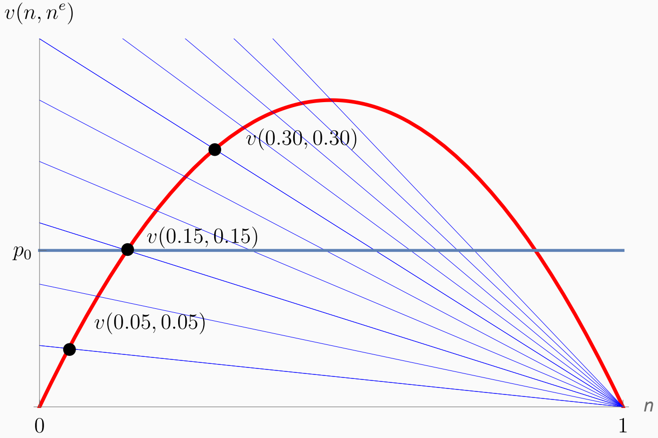


Figure. If price is set at $p_0 = (1 - 0.15) * 0.15$, then the marginal subscriber in equilibrium has a value of p_0.

Demand in network markets

The fulfilled expectations demand is increasing for small n if one of three conditions hold:

(i) The utility of every consumer in a network of zero size is zero.
   - E.g. Telecommunications, Facebook.

(ii) There are immediate and large external benefits to network expansion for very small networks.
   - E.g. Basically any WhatsApp group.

(iii) Many of high-willingness-to-pay consumers who are just indifferent on joining a network of approximately zero size.
   - E.g. Software, such as R, Python or Julia.

As a result, some portions of the demand curve can slope upwards (compare with the law of demand for traditional goods).

Source: Economides and Himmelberg, 1995.

Market clearing quantities and prices

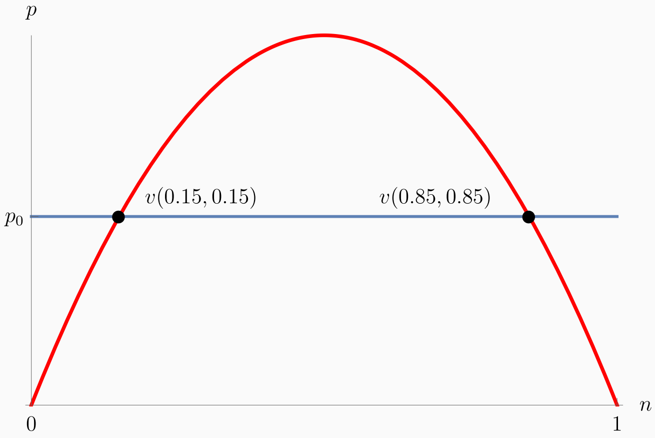


Figure. But also $(1 - 0.85) * 0.85$ is an equilibrium at the same price p_0.

Multiplicity of equilibria

- Above, the first equilibrium $(0.15, 0.15)$ is unstable:
  - A small increase in n increases the consumer surplus for all old users of the network.
  - At the same time, the producer surplus increases.
- The second equilibrium $(0.85, 0.85)$ is stable:
  - Back to the "normal" downward sloping part of the demand curve.
- Multiple equilibria are a result of the coordination problem.
  - Everyone would be better off at $(0.85, 0.85)$.
  - But need to coordinate the expectations to reach that point.
  - Network operators may facilitate coordination by e.g creating expectations and pricing differently as the network increases.

Efficiency

- In perfect competition, prices will equal marginal cost.
- But if there are network effects, then marginal cost pricing is no longer efficient.
- When making a decision to join the network, individuals count only their own benefits.
- With a positive network *externality*, the marginal benefit to the society is greater than the marginal benefit to any one individual.
- (Note that the network externality may also be negative, and then the reverse is true. Road congestion is an example.)

Efficiency

- Socially optimal size of the network is different from the size resulting from competition.
- This is an argument for government subsidies:
  - E.g. railroad networks receive subsidies in many countries.
  - But the best form of the subsidy can be problematic.
- Monopoly does not necessarily choose optimal size:
  - Incentive of the monopolist to restrict output can outweigh its incentive to increase consumer demand by influencing expectations about network size.
  - If the network firm is allowed internalize the external benefits (i.e. take the money), then the service level can be closer to socially optimal than with strict enforcement of competition.

Impact of costs

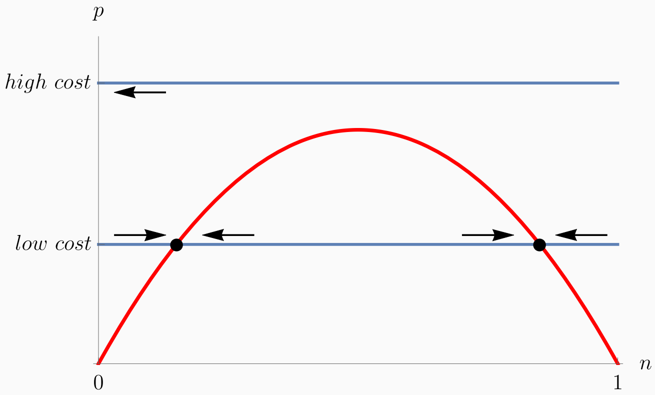
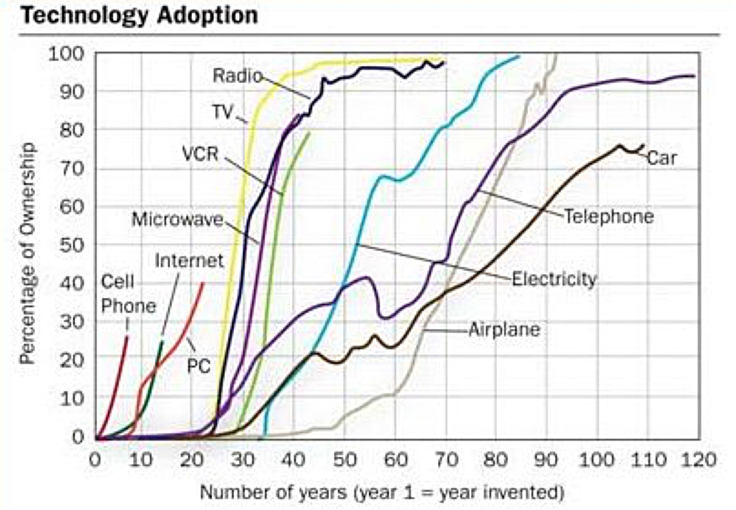


Figure. In competitive markets, the price will be set on the basis of cost. When costs are high, equilibrium is at zero. If costs come down, other equilibria become possible.

Network adoption

- The existence of an upward slopping part of the demand curve and the multiplicity of equilibria even under perfect competition also allows for a network to start with a small size and then expand significantly.
- It is possible that the industry starts at the left equilibrium as expectations are originally low or/and costs are high, and later on advances quickly to the right equilibrium.

Adoption – Examples



Source: Forbes Magazine.

Learnings today

- Network effects are generated by increasing the adoption rate (popularity) of a good or a service.
- Network effects affect demand and the market equilibria: demand curve can be upward sloping and there can be multiple equilibria.
- Social efficiency is harder to achieve, because competition does not reward for the externalities.

Readings for this lecture

- CORE (2018) "The Economy", Unit 21.4.
- Katz, M. and C. Shapiro (1994) "Systems Competition and Network Effects", The Journal of Economic Perspectives, Vol. 8, No. 2
  - Most of this should be accessible on the basis of the lecture.
  - Although some of the examples are outdated and we will update to the theory of platforms in the next lecture, this is still a comprehensive read.

Exercises for Lecture 8

1. Network effects can result in a "winner-take-all" competition.
   (a) What is the economic mechanism that supports "winner-take-all" argument?
   (b) Why do you think the argument can fail?

   For (a) there would be a correct answer, for (b) its more your best guess at this stage. Neither of the answers needs to be long.

2. Choose one successful social media network (e.g. Facebook, Instagram, LinkedIn, Snapchat, Twitter, WhatsApp). Describe, again, briefly:
   (a) How did the company manage to increase its user base early on?
   (b) How does the company manage expectations on its future size? I.e. what does it tell to the public? Quickly check e.g. their ads, websites, or annual reports.

Lecture 9: Platforms

Outline

- Typology of platforms
- Equilibria in platforms
- Strength of the externalities
- Identifying externalities

> Many, if not most markets with network externalities are characterized by the presence of two distinct sides whose ultimate benefit stems from interacting through a common platform. *–Rochet & Tirole (2003)*

Ad-supported media

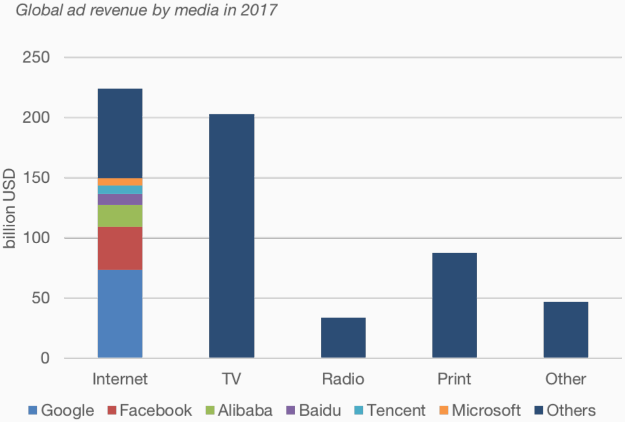


Figure. Large chunk of the ad revenue is shared by content creators.

Sources: eMarketer, Zenith.

Exchanges – Example: Andela

Figure. Andela matches African developers with global clients.

Figure: Tom Saater for The New York Times.

Software – Example: IBM

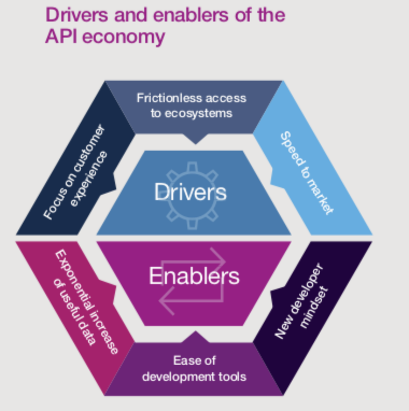


Figure. IBM creates building blocks for third party software developers who provide end customer solutions.

Figure: IBM.

Transaction services – Example: MobilePay

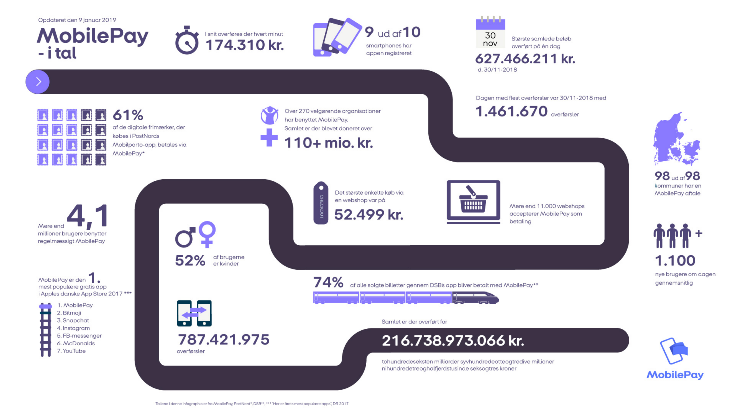


Figure. MobilePay is a mobile transaction payment system.

Figure: MobilePay.

Typology of platforms

- Advertising-supported media:
  - The platform creates content, buys content, or lets the users create content.
  - The content is used to attract viewers, the viewers are used to attract advertisers.
- Exchanges:
  - Buyers and sellers search for feasible trades and the best prices.
  - There are obstacles for them to achieve efficient allocation by bargaining with each other.

Source: Evans, 2007.

Typology of platforms

- Software platforms:
  - Users can run applications only if they have the same software platform as that relied on by the developers.
  - Developers can sell their applications only to users that have the same software platform they have relied on in writing their applications.
- Transaction systems:
  - Any method for payment works only if buyers and sellers are willing to use it.

Source: Evans, 2007.

Platforms

- Platforms are matchmakers:
  - Ads: Find right ads to viewers/users.
  - Exchanges: Match buyers with sellers.
  - Software: Match developers, users, and hardware.
  - Transaction: Match consumers with merchants.
- A platform provides a way for the parties to enter into socially beneficial exchange or transaction, provided that:
  - The groups are distinct.
  - There are indirect network effects or inter-group externalities.
  - The platform can facilitate coordination more efficiently than the parties can by themselves.

Source: Evans, 2007.

Network effects on platforms

- Platforms create value when customers find good matches.
- Scale helps: if there are more customers, the chance that any particular customer will find a good match increases.
- But most customers on most platforms are not very good matches for each other.
- A smaller platform with many good matches is more attractive than a bigger platform with fewer good matches.
- Network effects result from getting the right customers, and not just more customers.

Reminder: Network effects

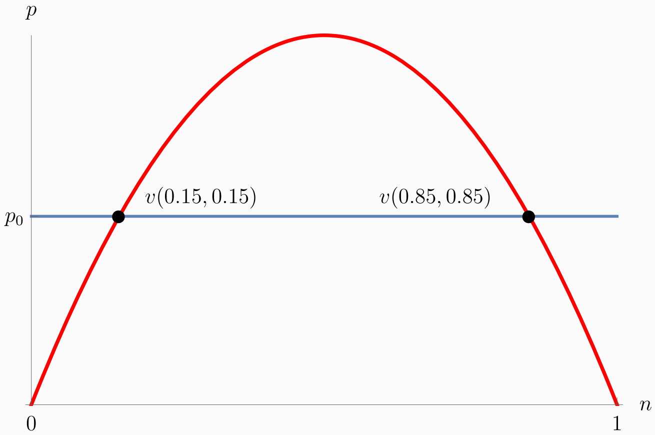


Figure. Equilibrium prices. A given price p_0 determines how many participants the network will end up having.

Reminder: Network effects

- To see how the demand curve forms, take the network effects with the people indexed from $v = 1, \dots, 1000$.
  - In the in-class exercise of lecture 8, this would correspond to the maximum value.
- Assume that the actual value for person v will depend on the number of people in the network, vn.
  - Likewise, this would be to the actual value.

Reminder: Network effects

- Consider what happens when only the person with highest maximum value, $v = 1000$, decides to join:
  - Because her/his valuation is the highest, no one else will join. The actual value from the network will be zero.
- If the 2nd highest valuation person, $v = 999$, also joins, then
  - The actual value for her/him is still low (999) because the 2nd person can only connect to 1 other person.
- When the 11th highest valuation, $v = 990$ joins
  - The actual value is much higher (9,900), because the network already has 10 others to connect to.
- At some point ($v = 501$ to be exact in this case), the decline in maximum value starts to dominate the benefits from increasing network size.

Equilibria in platforms

- With platforms, multiple user groups make even richer patterns possible.
- We will use a simplistic model for the platform demand.
- There are two sides: e.g. buyer and sellers.

Equilibria in platforms

- We assume the following valuations for the two sides:

$$\begin{aligned} v_b(n_b, n_s) &= (1 - n_b)n_s \\ v_s(n_b, n_s) &= (1 - n_s)n_b \end{aligned}$$

  where n_b is the number of buyers and n_s the number of sellers.
- This means that
  - The valuation on both sides decreases as the number of participants on their own side increases (as normal).
  - The valuation for the buyers depends on the number of sellers and vice-versa (externality).

*Note: n_b and n_s are normalized to represent market coverage, from 0 to 1, rather than absolute quantities.

Payoffs on the platform

- Assume that the platform charges a price for participation.
- Then the surpluses for the participants, if they join the network, are as follows:

$$\begin{aligned} \pi_b(n_b, n_s; p_b) &= (1 - n_b)n_s - p_b \\ \pi_s(n_b, n_s; p_s) &= (1 - n_s)n_b - p_s. \end{aligned}$$

where p_b is the price for buyers and p_s the price for sellers.

Equilibria in platforms

- The buyers and sellers will be indifferent between not-joining and joining to the platform when their gain from joining the market just equals the cost for them, i.e. the prices:

$$
\begin{aligned}
(1 - n_b)n_s &= p_b \\
(1 - n_s)n_b &= p_s.
\end{aligned}
$$

- If we fix the price, we can compute the combinations of n_b and n_s where the equations hold.
- If, for given prices p_b and p_s, there are n_b and n_s so that both of the equations hold simultaneously, then those n_b and n_s and prices p_b and p_s are a market equilibrium.

Platform equilibria

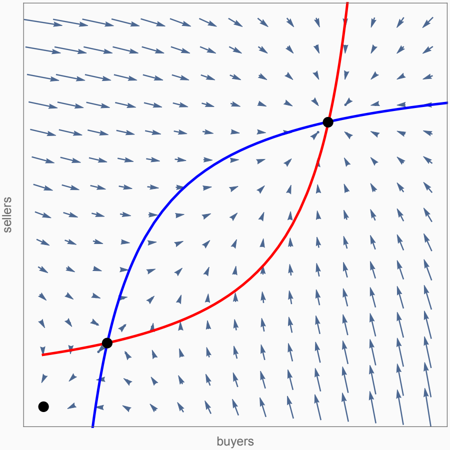


Figure. Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

Examples

Demonstration of the platform effects.

Strength of the externalities

- How does the strength of the inter-group externalities affect the platform demand?
- We can study the "strength" of externalities within our simplistic model by introducing parameters κ_b and κ_s as follows:

$$\begin{aligned} v_b(n_b, n_s) &= (1 - n_b)\kappa_b n_s \\ v_s(n_b, n_s) &= (1 - n_s)\kappa_s n_b. \end{aligned}$$

- (Above both κ_b and κ_s equal to 1.)

Weak externalities: Platform does not form

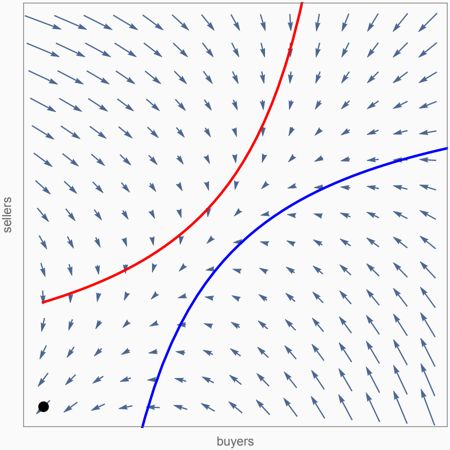


Figure. $\kappa_b = \kappa_s = 0.5$: Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

Identifying externalities

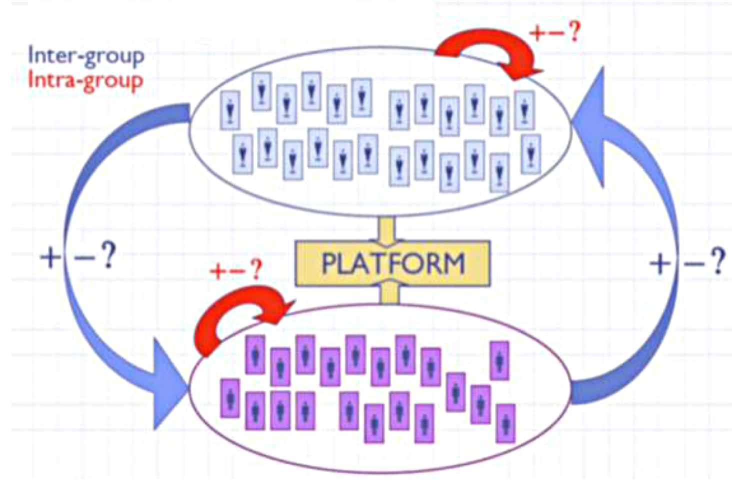


Figure. Externalities within a group and between groups.

Source: P. Belleflamme.

Identifying externalities

	side	inter-group	intra-group
Ad market (traditional)	A. Viewers/readers B. Advertisers	A to B: + B to A: –	In A: 0 In B: –
Ad market (social media)	A. Users B. Advertisers	A to B: + B to A: –	In A: + In B: –
Exchanges	A. Buyers B. Sellers	A to B: + B to A: +	In A: – or 0 In B: – or 0
Software	A. Users B. Developers	A to B: + B to A: +	In A: + In B: –
Transactions	A. Consumers B. Merchants	A to B: + B to A: +	In A: 0 In B: –

Table. Externalities within a group and between groups.

Platform equilibria

- In our simple model, the both inter-group externalities between buyers and sellers are positive, and there were no negative effects.
- How might the other cases look like?
- (Please do note, that these figures are illustrative, not a reflection of empirical situations.)

Platform equilibria

- In a simplistic social media ad market model:
  - Users benefit from other users participating to the network.
  - Advertisers benefit from users.
  - Users dislike advertisement.
- We can illustrate with the following model:

$$\begin{aligned}\pi_b(n_b, n_s; p_b) &= (1 - n_b)\kappa_b n_b - \lambda_b n_s - p_b \\ \pi_s(n_b, n_s; p_s) &= (1 - n_s)\kappa_s n_b - p_s.\end{aligned}$$

- Parameter λ_b tells how strongly the users dislike ads.

Ad market model (illiustrative)

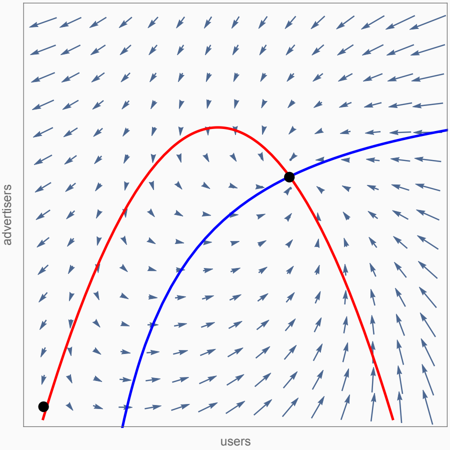
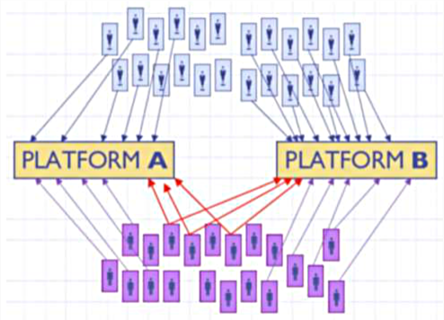


Figure. Simple ad model: Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

Single- vs. multihoming

Intuition:

- Platforms have a monopoly access for singlehomers.
- Singlehomers are courted: once captured are monopoly subjects.
- Multihomers are exploited: competition will take rents away.



Source: P. Belleflamme.

Learnings today

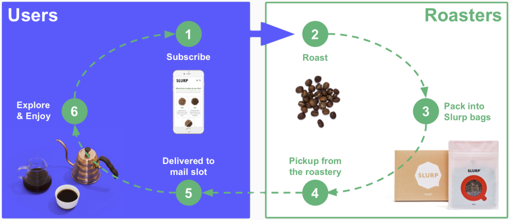
- Platforms are matchmakers: ads, exchanges, software, transactions.
- Economics within the platform are affected by externalities: both between the groups and within the groups.

Readings for this lecture

- CORE (2018) "The Economy", Unit 21.5.
- Evans, D. and R. Schmalensee (2007) "The Industrial Organization of Markets with Two-Sided Platforms", Competition Policy International.
  - Section III A. Pricing, will be discussed in lecture 10.
  - Topics of Sections V and VI will be touched in lecture 12, but the material here is quite involved and you can skip these sections.

Exercises for Lecture 9

3. Slurp is a Finnish platform connecting coffee drinkers to small roasters (see Figure). Describe:
   (a) What are the inter-group and intra-group externalities? Are they positive, negative or neutral? (Very shortly is enough, see slide 248)
   (b) What frictions the platform can solve?



4. Draw an example of the potential indifference curves for the users and the roasters in the Slurp platform (i.e. like the red and blue curves in the illustrations of slides 243, 246 or 251). Motivate your drawing shortly.

Source: Slurp.

Next time

Strategies of platforms

- Openness
- Pricing
- Competition

Lecture 10: Strategies of platforms

What this lecture is not about

> He told his son the secret of the cave, which his son handed down in his turn, so the children and grandchildren of Ali Baba were rich to the end of their lives.
> *–Ali Baba and the Forty Thieves*

Background story

- In 1998, there were more than 154,000 SMEs in China.
- Trade between the firms was based on personal relationships with partners and cash.
- Doing business outside China was all but impossible.
- In 1999, a company founded by Ma Yun (Jack Ma) opened a website to connect global buyers to Chinese sellers: Alibaba.
- Subsequently it introduced authentication services and various feedback mechanisms.
- By Dec 2001, Alibaba had more than 1 million members.

Source: Evans and Schmalensee 2016.

Background story

- China ca. year 2000:
  - Booming Chinese economy created a lot of retail demand.
  - Conventional retail was hard to scale up quickly enough.
  - Trust was a source of friction, also in the online markets.
- Alibaba launched retail online market place Taobao in 2003, providing the platform without costs.
- It introduced Alipay where payments from the customers would be released to the merchant only after delivery, and partnered with logistics companies.
- Now Taobao, Tmall, Aliexpress, Alipay and other Alibaba brands form the largest online market in the world.

Source: Evans and Schmalensee 2016.

Outline

- Pricing
- Openness
- Competition

Platform design

- Platforms are matchmakers: how matches succeed will depend on the design of the platform.
- Design of the platform needs to take into account how both, or all, sides of the platform will interact.
- Externalities within the groups and between groups make the design problem tricky even for one platform.
- Platform competition makes the design choices even more complex.

Platform pricing

- Choice of price on one side affects how many users will use the platform.
- Number of users on that side will affect the interest on other sides through externalities.
- The changes in prices affect market equilibria.

Reminder: Illustrative exchange platform

- The surplus for the participants are as follows:

$$\begin{aligned}\pi_b(n_b, n_s; p_b) &= (1 - n_b)n_s - p_b \\ \pi_s(n_b, n_s; p_s) &= (1 - n_s)n_b - p_s.\end{aligned}$$

where p_b is the price for buyers and p_s the price for sellers.

Reminder: Platform equilibria

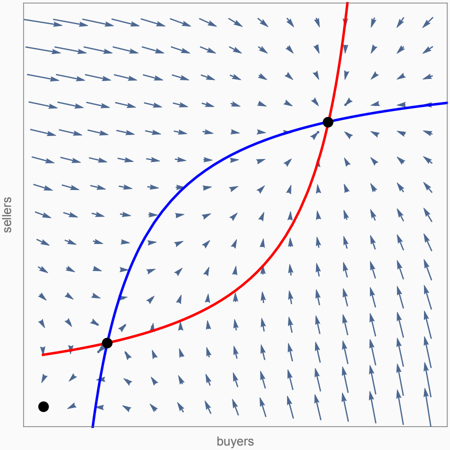


Figure. Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

Change in buyers' prices

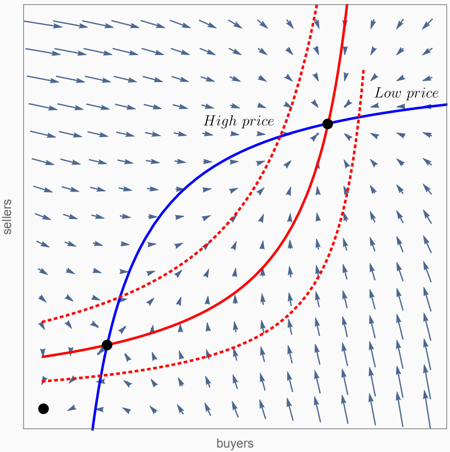


Figure. Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Dashed lines represent changes in prices for buyers.

Change in sellers' prices

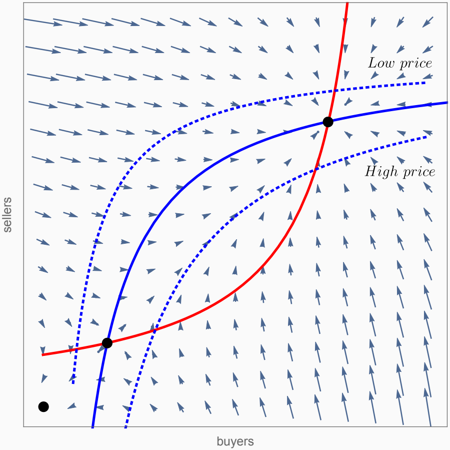


Figure. Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Dashed lines represent changes in prices for sellers.

Reminder: Simplistic ad market model

- Example of potentially non-trivial changes in equilibria.
- We used the following model:

$$\begin{aligned}\pi_b(n_b, n_s; p_b) &= (1 - n_b)\kappa_b n_b - \lambda_b n_s - p_b \\ \pi_s(n_b, n_s; p_s) &= (1 - n_s)\kappa_s n_b - p_s.\end{aligned}$$

- Main features of the model:
  - Users benefit from other users participating to the network.
  - Advertisers benefit from users.
  - Users dislike advertisement.

Ad market model (illustrative)

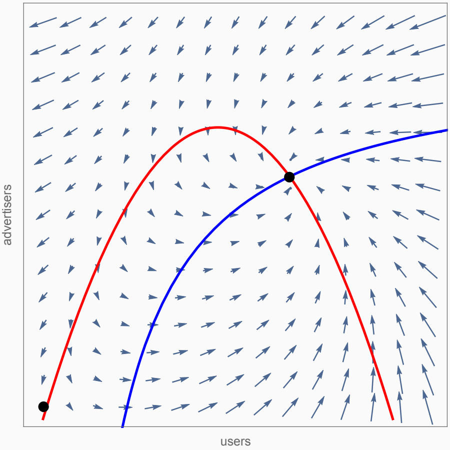


Figure. Simple ad model: Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

Ad market model (illustrative)

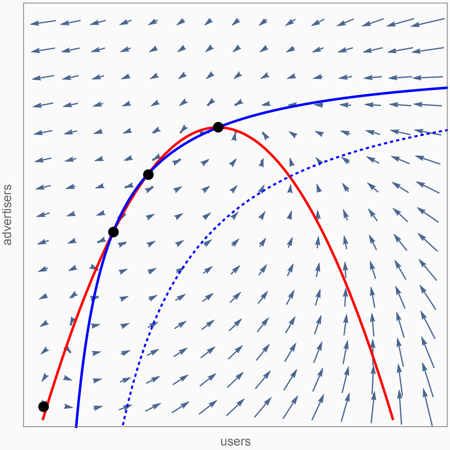


Figure. Simple ad model with lower prices for advertisers (solid blue line): Less users than with higher advertiser prices (dotted blue line). Number of advertisers can become higher, lower, or the same.

More general platform price structure

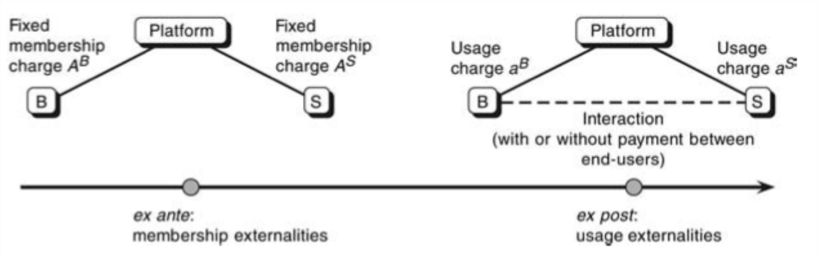


Figure. Simplified pricing structure on a platform.

- Price structure affects profits and economic efficiency.
- Firms use pricing to try to maximize profits and policy makers worry over market power and consumer harm.

Source: Rochet and Tirole, 2006.

Platform pricing

- Though similar to complementary of goods, the logic with platform pricing is different:
  - E.g. with tennis balls and a tennis racket the same consumer enjoys the complementary benefit.
  - With platforms, the benefits is divided to different sides.
- Platform pricing affects which side, or the platform operator, enjoys the benefits of complementarities.
- We will go through the intuition for these key questions:
  1. How does socially optimal pricing look like?
  2. How does monopoly pricing differ from the social optimum?
  3. How does competition affect pricing?

Platform pricing – Social optimum

- In general, prices will be different from marginal costs of providing the services to different sides.
- Socially optimal (here Ramsey) pricing aims at getting all sides on board.
- Social planner takes into account the average net surplus created on the other sides of the market when attracting an end user on one side.

Source: Rochet and Tirole, 2006; Weyl, 2010.

Platform pricing – Monopoly

- Usage prices tend to be lower on the market side with a higher price elasticity and which exerts a stronger externality on the other side.
- A profit-maximizing intermediary may subsidize one side of the market because this generates a higher volume of trade and, thereby, higher profits on the other side of the market.
- Pricing below cost may be socially desirable, but the subsidy chosen by a profit-maximizing intermediary may be too low from a social point of view,.

Source: P. Belleflamme.

Examples of pricing choices

Industry	Side	Access	Usage
Heterosexual Dating Clubs	Men	√	√
	Women	√	√
DoCoMo i-Mode	User	√	√
	Content-Provider	Ø	√
U.S. Real Estate Brokers	Seller	Ø	√
	Buyer	Ø	Ø
Magazines	Reader	√ (≤MC)	Ø
	Advertiser	Ø	√
Shopping Malls	Shopper	–	Ø
	Store	√	Ø
PC Operating Systems	User	√	Ø
	Developer	√ (<MC)	Ø
Video Game Consoles	Player	√ (≤MC)	Ø
	Game Developer	√ (<MC)	√
Payment Card Systems	Merchant	Ø	√
	Cardholder	√ (<MC)	Ø

Figure. Examples of how prices have been set on different platforms.

Source: Evans and Schmalensee 2007.

Examples of pricing choices

Company	Rake	Notes
OpenTable	1.9%	Reservation fee / average meal per person
Homeaway	2.5%	Estimated (low due to use of listing model instead of transaction)
Comparison Shopping	6.0%	Estimated
ebay	9.9%	This is partially listing fees, partially marketing fees, and part PayPal.
oDesk	10.0%	10% on top of all work billed
AirBNB	11.0%	3% + 6-12% depending on size of transaction
Expedia	11.9%	Per 2012 10-K
Amazon Marketplace	12.0%	Guess based on rate table
Fandango	12.5%	Fee charged to user / ticket price
PriceLine	18.5%	Per 2012 10-K
TicketMaster	26.0%	Estimate for tickets sold by TM (non box office) - very hard to discern
Steam	30.0%	Rate card
Itunes	30.0%	Rate card
Facebook Credits	30.0%	Rate card
GroupOn	38.2%	Calculated from 2012 10-K. Does not include direct goods.
Shutterstock	70.0%	From S-1

Figure. Illustrative examples of transactions fees charged by some online marketplaces (estimates from early 2010s).

Source: abovethecrowd.com.

Platform pricing – Example: Credit cards

- Consumers most likely to carry AmEx are those who most value the opportunity to use the card.
- These loyal cardholders therefore value the participation of merchants more than those indifferent between AmEx and another payment form do.
- Given its limited ability to price discriminate, AmEx fails to fully internalize the preferences of loyal users, putting too little effort into attracting merchants and charging them a higher price than would be socially optimal.
- However, when the costs of attracting cardholders rise and therefore cardholder incentives fall, AmEx will tend to serve only users who value merchant participation more strongly, leading them to attract more merchants with lower fees.

Source: Weyl, 2010.

Platform pricing – Example: Ad market

- Matters are quite different for the New York Times.
- Its loyal customers are high income readers who dislike advertising but are willing to pay more for the paper's content than marginal readers who are less sensitive to advertising.
- NYT fails to internalize loyal readers' distaste for advertising, leading to potentially excessive advertising as a result of below optimal pricing to advertisers despite market power.
- Increases in the costs of distribution that reduce the number of subscribers will tend to reduce advertisements as the paper internalizes the costs to its wealthier readers.

Source: Weyl, 2010.

Platform pricing – Monopoly

- The difference between the above cases is the source of user heterogeneity:
  - Credit card users primarily differ in the interaction (or usage) value they take from merchants accepting cards.
  - Newspaper readers differ most importantly in their membership value from reading the paper's content.
- Participation on one side of the market effectively determines the quality of the platform on the other side.
- Platform internalizes network effects to marginal rather than average participating users, like any monopolist who must choose a single quality as well as quantity (Spence, 1975).

Source: Weyl, 2010.

Reminder: monopoly pricing in one-sided market

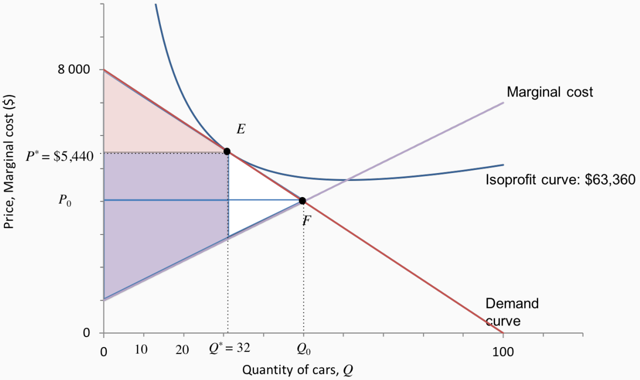


Figure. If a monopoly can charge only one price (at E here), then the allocation is not efficient (example of a classical distortion).

Source: CORE.

Monopoly vs. social planner

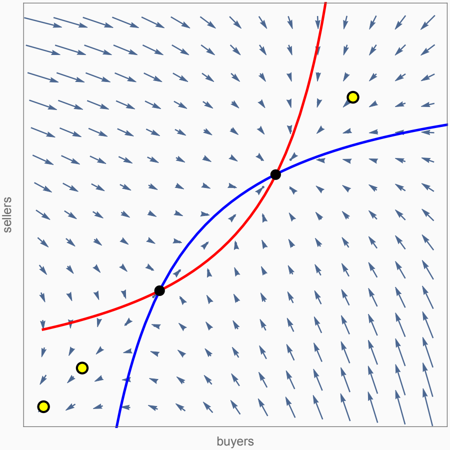


Figure. Simple exchange example with indifference curves (red for buyers, blue for sellers) and equilibria (black dots) drawn with monopoly prices. Yellow dots are equilibria with socially optimal prices.

Platform pricing – Monopoly vs. social planner

The following results hold with some generality:

- A social planner would set prices on side i as

$$p_i^* = \text{marginal cost}_i + \sum_j \text{marginal externalities}_j$$

- And a monopoly would set the price as

$$\tilde{p}_i = p_i^* + \text{classical distortion}_i + \sum_j \text{Spence distortions}_j$$

- Spence distortions from other sides $j \in \mathcal{J}$ result as the platform internalizes only network externalities to marginal users.

Source: Weyl, 2010.

Platform pricing – Price discrimination

- Results above assume uniform pricing. With uniform pricing, the additional subscriber to a platform is not rewarded for the benefit that she/he brings to others by subscribing.
- In some cases, externalities can be (partly) internalized through price discrimination:
  - Example: Cantor Fitzgerald pricing towards Salomon Brothers in secondary U.S. bonds market (before 2001).
  - Typical trader paid $20 per $1 million face value.
  - Salomon paid $1 per $1 million face value plus a fixed fee.
  - Why? Salomon brought immense liquidity to the secondary market because it controlled 40% of the primary market

Source: N. Economides.

Platform pricing – Competition

- Tremendous multiplicity of equilibria are possible in competition between platforms depending on the pricing.
- Monopoly and competitive platforms (at least in duopoly) design their price structure so as to get both sides on board.
- Price competition is intensified when consumers place a higher value on the size of the network. This leads firms to reduce prices in order enlarge their network size.
- General results in platform competition are still lacking.

Source: Rochet and Tirole 2003, P. Belleflamme.

Platform pricing – Multihoming

- An increase in multihoming on the buyer side makes undercutting competitors on the seller side more attractive and results in a price structure more favorable to sellers.
  - For example, if buyers surf more on Aliexpress in addition to Amazon, Amazon may want to seek to reach exclusivity with some sellers.
- The presence of buyers generating a high surplus on the seller side raises the seller price and, in the absence of price discrimination on the buyer side, lowers the buyer price.
  - Example: Alibaba's Tmall.
- Captive buyers tilt the price structure to the benefit of sellers. uber

Source: Rochet and Tirole 2003.

Platform pricing – Examples

- Sometimes prices are not decided by the platform:
  - Google ad auction sets the prices on the ad market.
  - Other advertisement channels compete for the same revenue.
  - Google affects advertisers by offering large user base, accurate data, and analytics services.
- Online marketplaces typically place charges on the sellers, not buyers
  - However, if buyers and sellers can bargain efficiently (in a Coasian manner), then the side on which the chargers are placed does not matter (Rochet and Tirole, 2003).
  - In practice there are inefficiencies and distortions (e.g. Amazon selling directly and charging third parties a transaction cost) that affect competition within the platform.

Platform pricing – Examples

- Free of charge pricing can be useful to attract users initially.
- However, it may not be trivial to introduce charges later and hold on to the user base:
  - E.g. early transition attempts of traditional media to internet.
- Additional services with extra costs are a way to price-discriminate:
  - Same idea as with the free-to-play games (see lecture 5).
  - Alibaba's strategy has been to attract large user base.
  - Capitalization e.g. through payment services (Alipay, PayPal), premium services (Tmall, Amazon Prime) or logistics.
- Or introduce other sides to the platform, e.g. Youtube ads.

Openness

- Sometimes a firm can decide if it is a platform or not and how many sides it opens:
  - Apple launched iOS as a one-sided business with in-house apps, the possibility for third parties to sell through AppStore came later.
  - Netflix has decided not to sell ads.
  - Alibaba has decided to sell ads on Taobao instead of charging for transactions.
  - Amazon decides if it sells a product themselves.
- Sometimes the "platformness" is part of the business:
  - Exchanges and transaction systems.

Complementarity and compatibility

- Links on a network are potentially complementary.
- Compatibility makes complementarity actual (nuts and bolts).
- Some network goods are immediately combinable because of their inherent properties (like roads).
- However, for many complex products, actual complementarity can be achieved only through the adherence to specific technical compatibility standards (like Internet).
- Within a platform, the firm chooses whether to provide all services itself or allow others to do some.
    - E.g. choose a logistics partner (UPS, DHL) or build own (Amazon, Alibaba).

Complementarity and compatibility

Arguments for compatibly:

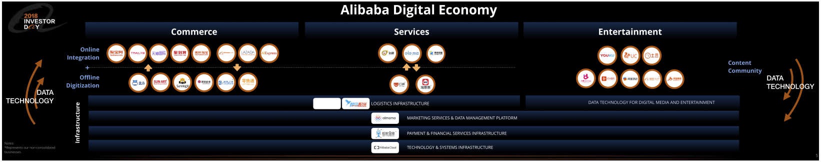
- Producers' profits can be enhanced when they coordinate on a standard that permits the production of compatible components as there is less competition.
- A network good has higher value than a traditional because of the network effects.
- Different firms conforming to the same technical standard can create a larger network effect while still competing with each other in other dimensions (such as quality and price).
  - Android is a good example. Main code is developed by Google and shared as open source for end application customization.

Complementarity and compatibility

Arguments for incompatibly:

- Providers of platforms often prefer incompatibility because it locks in current customers and locks out competitors.
  - Apple iOS is an obvious counterexample to Android.
  - Oftentimes in digital world compatible services are hard to envision: e.g. Google search, Facebook or Amazon.
- Network effects that are associated with the installed base generate *switching costs*, which are the costs of switching from one brand to another incompatible brand.
- Also, if users "pay" with e.g. the data that they generate, harder to split profits compared to users paying money for compatible products to different firms (nuts and bolts).

Example: Alibaba platform



> “Alibaba is what you get if you take all functions associated with retail and coordinate them online into a sprawling, data-driven network of sellers, marketers, service providers, logistics companies, and manufacturers.”
> –Ming Zeng, Alibaba Academic Council

Figure: Alibaba.

Remember this?

Figure: Wikimedia.

Competition

- In general, the effect of competition is market specific.
- In the video game industry (like Xbox vs. Playstation) competition can improve the availability of games:
  - Competition leads to greater attention to "switching" users who are indifferent between the platforms.
  - Competing firms cater more closely to infra-marginal consumers' strong taste for greater game availability.
- In newspapers competition may further distort the amount of advertisement:
  - High- and low-quality papers have distinct loyal reader groups.
  - They compete for readers with moderate taste for advertisements. These readers poorly represent the average readership of either paper.

Source: White and Weyl, 2016.

Competition

Multiple platforms are more likely to coexist, if

- Platforms are sufficiently different
  - Android and Apple iOS
  - Facebook and Twitter
- Multihoming is feasible
  - Travel search engines
  - Exchanges
- It is hard to differentiate within a platform
  - Advertisers in auctioned ad markets

Source: Rysman, 2009.

Winner-take-all competition or not?

Examples of past dominant platforms

- AOL/Time Warner
  - In-house messaging system lost to broadband internet.
- Microsoft Windows
  - Mobile dominated instead by Apple and Android.
- eBay
  - Amazon taken over in the U.S. Alibaba in China etc.
- Apple iTunes
  - Second to Spotify.
- MySpace
  - Lost to Facebook.

Winner-take-all competition or not?

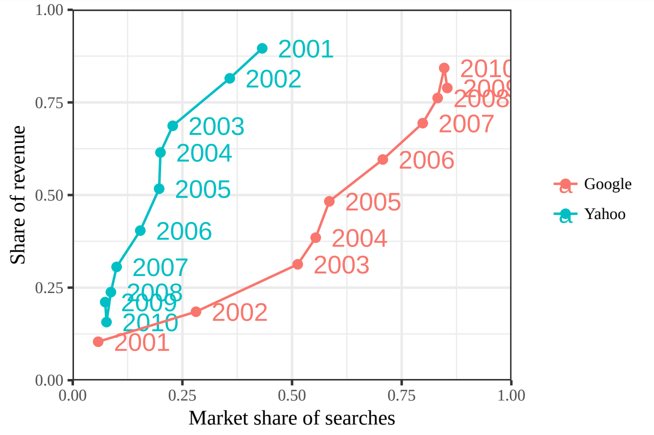


Figure. Development of the share of revenue (for the two) against the share of user searches (total market) for Google vs. Yahoo.

Source: distilled.net for user shares, revenues from multiple sources.

Entry

- Reminder of the earlier example, where the surpluses for the participants are as follows:

$$\begin{aligned} \pi_b(n_b, n_s; p_b) &= (1 - n_b)n_s - p_b \\ \pi_s(n_b, n_s; p_s) &= (1 - n_s)n_b - p_s. \end{aligned}$$

  where p_b is the price for buyers and p_s the price for sellers.
- Established platform can extract price p from the participants as a payment for the externalities.
- A new platform cannot offer the externalities: it needs to overcome this initial "chicken-and-egg" problem.

Learnings today

- Pricing on platforms is complex. The price on one side affects demand on that side. In pricing there is a need to take into account the externalities that change in demand on one side causes in the other sides.
- Platform competition in the digital domain is even more complex; the outcomes are dependent on the specific market.
- In general, neither monopoly or competition seem to guarantee social optimum in platform markets.

Readings for this lecture

- Rysman, M. 2009. The Economics of Two-Sided Markets. Journal of Economic Perspectives, Volume 23, Number 3.
  - Section on Public Policy will be discussed in lecture 12.

Exercises for Lectures 10–12

Note! To enable short discussion on the model answers on Thursday 14 Feb lecture, the strict deadline for the assignments is on Thursday 14 Feb by noon.

1. Consider the ad market that Google is running.
   (a) Explain why search is free in Google but advertisers are charged.
   (b) Why so many advertisers want to have their ads on Google?
2. List 5 reasons why you think Alibaba has been so successful. (You can compare this to the list on Amazon that you did in the very first assignment set). No need for long answers.
3. Why do you think trust is particularly important in peer-to-peer markets?
4. Consider the regulation of data in an online environment.
   (a) List 3 regulatory concerns.
   (b) Who should be responsible of the regulation? Motivate shortly.

Next time

- Extra from lecture 10: Platform design
- Sharing economy / peer-to-peer markets
- Reputation
- Course feedback

Lecture 11: Sharing economy

Outline

- Recap: Platform design
- Sharing economy / peer-to-peer markets
- Reputation
- Externalities
- Course feedback

Reminder: Platform design

- Platforms are matchmakers: how matches succeed will depend on the design of the platform.
- Design of the platform needs to take into account how both, or all, sides of the platform will interact.
- Externalities within the groups and between groups make the design problem tricky even for one platform.
- Platform competition makes the design choices even more complex.

Reminder: Openness

- Sometimes a firm can decide if it is a platform or not and how many sides it opens. Sometimes the "platformness" is part of the business.
- Network effects key to deciding on compatibility:
  - Compatible systems bring have larger networks (e.g. Anrdoid).
  - Incompatible systems protect the platform because of *switching costs* (e.g. Apple iOS).
- Within a platform, the firm chooses whether to provide all services itself or allow others to do some.

Reminder: Platform demand and pricing

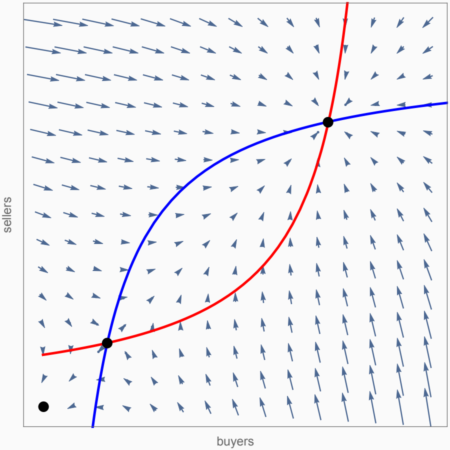


Figure. Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Pricing on each side affects demand on that side, but also on the other sides through externalities.

Other considerations: 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.

Source: Roth 2008.

Platform design – Thickness

Figure. Low number of shoppers at the newest shopping mall in Helsinki.

Figure: Uutisklubi.

Platform design – Thickness

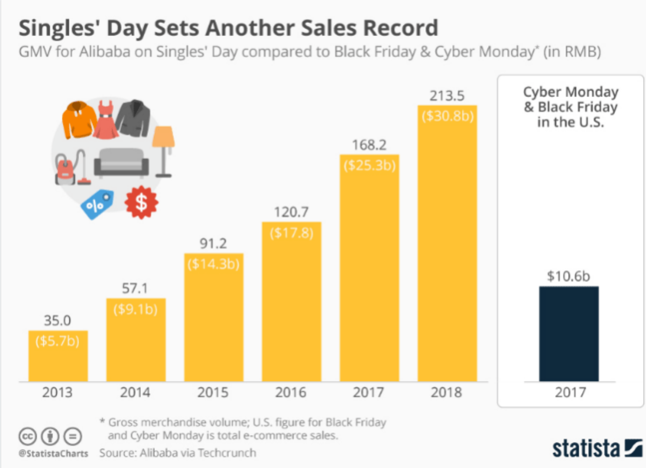


Figure. One day sales at Alibaba.

Figure: Medium.

Platform design – Thickness

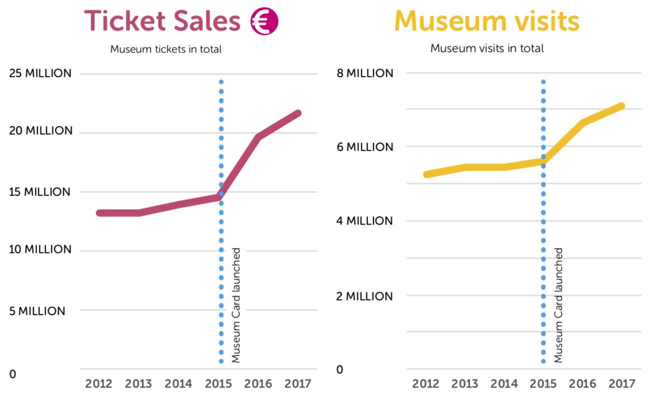


Figure. Museum Card was launched in 2015. The card currently is valid in 280 museums and has some 150,000 subscribers.

Source: Museum Card.

Platform design – Congestion

Figure. Opening of a new art museum in Helsinki led to continuously long lines. Access with Museum Card (Museokortti) is free.

Figure: Jouni Immonen / Yle.

Platform design – Congestion

Figure. Newest "smart" warehouse by Alibaba partner Cainiao uses e.g. Internet of Things, big data, edge computing and artificial intelligence.

Figure: Alizila (News from the Alibaba Group).

Platform design – Safe

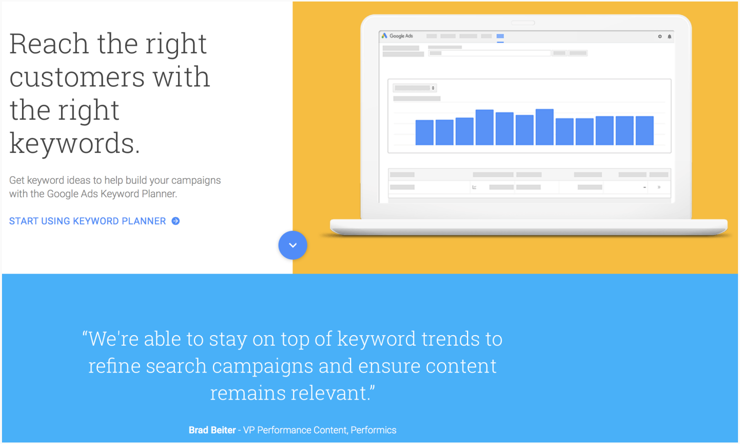


Figure. Example of the analytics tools offered to advertisers by Google.

Figure: Google.

Platform design – Repugnancy

COUNTRY	NAME	ALTERNATIVE NAME	SYMBOLS / SLOGANS	SYMBOLS / SLOGANS	SYMBOLS / SLOGANS
Indonesia	Front Jihad Islam	FJI			
Indonesia	Laskar Pembela Islam - LPI	Soldiers of the Defenders of Islam			
International	International Goyim Party	IGP			
Israel	Lehava	למניעת התבוללות בארץ הקודש			
Italy	Comunità Militante Dei Dodici Raggi, Do.Ra	Do.Ra.			
Italy	Lealtà - Azione				
Italy	MAB Manipolo D'avanguardia Bergamo	MAB			

Figure. Internal list of hate figures at Facebook. Moderators are expected to remove any post praising, supporting or representing any listed figure.

Source: New York Times.

Platform design – Experimentation

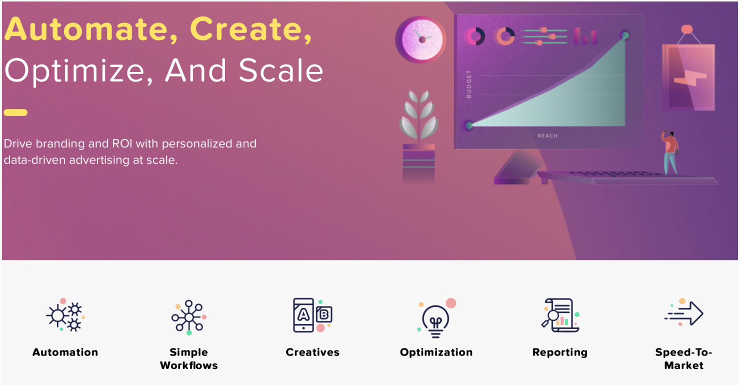


Figure. Data and algorithms provide a method to continuously optimize online advertisements.

Figure: Smartly.io.

Summary of platform design

- Openness
  - Decide the sides on the platform.
  - Decide compatibility with others.
- Pricing
  - Set pricing an all sides of the platform.
  - Take into account the externalities that a change in demand on one side causes in the other sides.
- Other considerations
  - Thickness, congestion, safe, repugnancy, experimentation.
- From a societal point of view also
  - Efficiency, consumer protection, market power, externalities.
  - More on regulating these in lecture 12.

Figure. BlaBlaCar connects people driving from A to B with passengers looking for rides.

Figure: BlaBlaCar.

Sharing economy

- Sharing economy or peer-to-peer markets increase efficiency of the use of durable goods or labor.
- Success based on new technologies, but also experience from market design.
- Sharing economy platforms solve frictions between the parties.

Peer-to-peer or “sharing economy”

- In traditional rental markets, owners hold assets to rent them out in a professional capacity.
- Sharing economy has introduced a new kind of rental market, in which owners sometimes use their assets for personal consumption and sometimes rent them out.
- Such markets are referred to as peer-to-peer or sharing economy markets.

Sharing economy provides flexibility

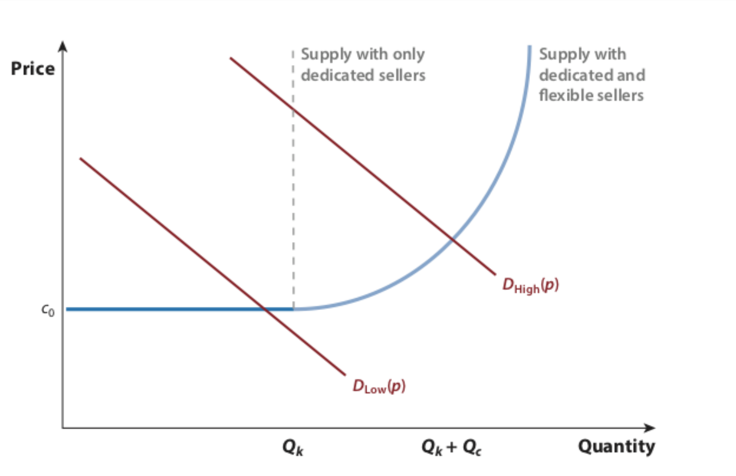


Figure. Sharing economy can increase capacity in traditional businesses.

Source: Einav et al. 2016.

Examples of P2P markets

- Accommodations (Airbnb, Uniplaces).
- Babysitting (Care.com)
- Computer programming (Upwork, Freelancer).
- Consumer loans (Prosper, Lending Club).
- Crafts (Etsy).
- Currency exchange (TransferWise, CurrencyFair).
- Deliveries (Foodora, Instacart, Postmates, Wolt).
- Household tasks (TaskRabbit, Handy),
- Local goods and services (Craigslist).
- Rides (Uber, Lyft, BlaBlaCar).
- Start-up financing (Kickstarter).

Source: Einav et al. 2016. Note that the list is not definitive and as usual, the classification may not be fully accurate, for example firms may operate differently in the U.S. and elsewhere (Uber and Lyft).

P2P market design

- P2P markets require efficient search and matching algorithms and platform pricing.
  - cf. Lectures 7 & 10: Online market & Strategies of platforms
- But recommender systems and reputation systems are central to P2P rental markets. Consider e.g. Airbnb:
  - If apartment posters would be afraid to accept strangers to their home or apartment seekers would be afraid to go strange persons' homes, the platform would not exist.
  - Feedback on the quality of apartments and visitors establishes trust to individual participants and the system as a whole.
- In the words of Joe Gebbia, co-founder of Airbnb, "a crucial element of success of this platform is designing trust".

Sharing economy compared to traditional business

- Effects of the removal of a professional third party owner:
  - Greater risk that the provider may fail to deliver.
  - The product will not be of the quality expected.
  - Safety may be a cause for concern.
  - The buyer may not pay.
  - Limited practical recourse after a transaction.
- The question for the sellers is how to signal their quality?
  - Note that the sellers own concerns need also to be accounted for by the platform, e.g. through insurance.

Remember this guy?

Figure. Earl Munz.

Figure: CBS Television.

Reviews

- In addition to information asymmetries, the offering is not standardized (taxi vs. Uber, known hotel brand vs. Airbnb), and can be complex (e.g. coding services).
- Reviews are a natural response to each of these problems:
    - Describe the performance of a transaction counterpart, a user can alert others to what went right and what went wrong.
    - Simultaneously improving future matches and penalizing bad behavior.

Reviews: Airbnb experience

- Consider a two-sided review mechanism, used early on in Airbnb, where the other side gives the review first.
    - If the review is negative, then reply is likely to be negative.
    - If the review is positive, then reply is likely to be positive.
- The dominant strategy for the first reviewer was to give a positive review if she/he wanted a positive review in return.
- Overall, the reviews became too positively biased.
    - Observed also earlier, e.g. on eBay.
- As a result, Airbnb adjusted their review system so that reviews to parties are revealed only after both have been written (or after some time).
    - Alleviates but does not remove the problem.

Reviews

Review process has other complications as well:

- At the start, no reviews are available.
    - Reviews can't assist the first users of the platform.
    - Can't help matching with a rookie or a new product.
    - Invite free-riding: why be the first to try out?
- User reviewed unfavorably might decide to start over.
- Users who submit reviews might differ systematically from normal users, by selection or by collusion.
    - Targets of the reviews have an incentive to inflate their ratings.
    - Remember the phantom packages?

Source: Edelman 2017.

Other mechanisms to build trust

- Large volume of transactions makes the monitoring of feedback manually inefficient.
- AI algorithms may help to automatize such tasks, for example
    - Assess the quality of sellers by analyzing the communication between the buyers and the sellers.
    - Create a market for feedback by automatic ranking the informativeness of user feedback.
- Platforms can also add other information to reduce the need for reviews
    - Conduct their own verifications.
    - Collect and publish other information.

Source: Milgrom and Tadelis 2018.

Externalities – Discrimination

- To increase trust, many platforms encourage users to provide personal profiles and even to post pictures of themselves.
- These features may facilitate discrimination based on sellers' race, gender, age, or other aspects of appearance, e.g.
  - Non-black hosts charge ca. 12% more than black hosts for the equivalent rental on Airbnb in NYC (Edelman and Luca 2014).
  - Gender wage gap on a freelance labor online platform (Barzilay and Ben-David, 2017).
  - Minority males set lower prices at the beginning of their career on Blablacar platform (Lambin and Palikot 2017).

Externalities – Discrimination

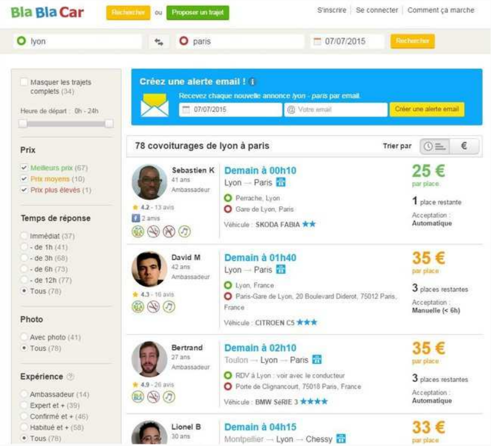


Figure. Example of pricing on BlaBlaCar.

Figure: Farajallah et al. 2016.

Externalities – Discrimination

- Building trust without discrimination can be challenging:
  - Informational asymmetries need to be solved.
  - Hard to pick the proper signal.
- To reduce gender bias, symphony orchestras have started to arrange blind auditions:
  - In 1952, the Boston Symphony conducted an experiment with a series of blind auditions.
  - To their surprise, their initial audition results still skewed male.
  - Then they asked the musicians to take off their shoes. The reason? The sound of the women's heels as they entered the audition unknowingly influenced the referees.

Externalities – Labor

- Gig economy platforms typically try not to have employees, but contract their workers as self-employed.
  - Workers are outside the normal labor law protections.
  - Status has been challenged in the courts of many jurisdictions.
- Algorithms that control the worker hours and pay bring efficiency to the users, but are insensitive to workers.
- Workers with no office and no knowledge on their colleagues may find it hard to organize.
  - Bargaining power more in the hands of the platforms.

Externalities – Labor

Figure. UberEats workers arranged a strike by ordering pizzas via Uber.

Figure: Mark Kerrison / Alamy.

Externalities – Social

- The possibility to rent out assets may lead to increase in consumer purchase of such assets.
  - Increase in car ownership to rent them out (e.g. NYC, Fraiberger & Sundararajan 2017).
  - Professional landlords switch to Airbnb.
- Additional demand may cause unexpected externalities
  - Increased apartment prices, together with preference of short-term over long-term rentals, leads to more congested housing market.
  - Regulatory backslash in many places, e.g. "Zweckentfremdungsverbot" in Berlin in 2016.

Externalities – Social

- Change from long-term rentals to short-term stays causes externalities to the neighbors.
    - Long-term tenants have incentives to limit the externalities to their neighbors.
    - Short-term tenants may be less sensitive.
    - Unlikely that bargaining is feasible.
    - Traditionally zonal planning protects housing.
- The efficiency of allocation will depend on who decides whether short-term rentals are allowed or not:
    - Individual tenants: too much hosting.
    - Cities: too little hosting.
    - Building owners: optimal level of hosting.

Source: Filippas and Horton 2017.

Externalities – Environment

- Though the evidence is by no means conclusive, some studies indicate that the increase in ride-hailing may increase traffic (e.g. Henao et al. 2018). Vehicle miles traveled increased mainly due to two factors:
  - Additional empty miles from ride-hailing drivers going around without passengers.
  - Ride-hailing substituting more efficient and sustainable modes such as transit, biking and walking.
- Autonomous vehicles could also increase congestion (Millard-Ball 2019). This is a more extreme example what could go wrong in theory:
  - Cruising around is cheaper than parking, and cruising is less costly at low speeds.
  - In simulations, autonomous vehicles can implicitly coordinate to reduce the cost of cruising for parking, through self-generated congestion.

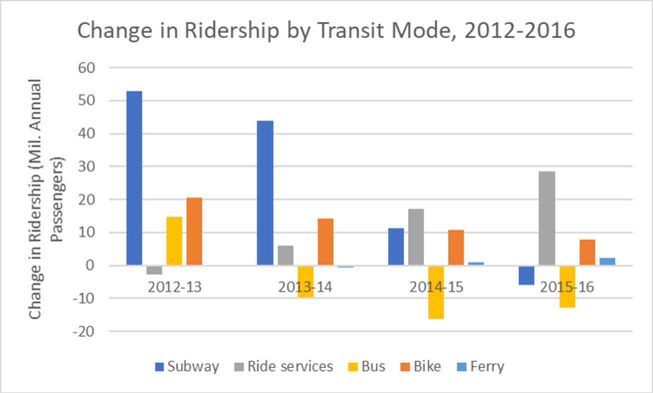


Figure. Transportation mode change in New York City.

Figure: NYCEDC.

Regulation of externalities

- Critics charge that the primary competitive advantage of P2P platforms is their ability to duck costly regulations that protect third parties.
- Rules and regulation in place for traditional businesses to protect consumers and limit externalities:
  - For example, environmental regulation, consumer protection law, copyright law, health and safety laws, labor laws etc.
- Conflicts when non-traditional business models make rights and compliance requirements of the platforms participants unclear.

Course feedback

> At the end of the course the student has learned how to use the tools of economic analysis to analyze firm decisions and strategies, and competition in online and digital markets. The student has learned how the special features of such markets affect the strategic decisions. A key objective is to introduce the students to applications of game theory and mechanism design by connecting these tools to practical applications.

Learnings today

- Platform design choices have real world implications.
- Sharing economy can increase economic efficiency, but does not magically solve old externalities.
- Establishing trust is essential for sharing economy transactions; implementation through reviews or other means complex.

Readings for this lecture

- Luca, M. 2016. Designing Online Marketplaces: Trust and Reputation Mechanisms. Harvard Business School Working Paper. No. 17-017.
  - Light read on reviews (also, a working paper so some rough edges).
  - Connects the discussion on this lecture to online market design.
  - Raises the fact that externalities (in this case discrimination) are a result of the platform design choices.

Exercises for Lectures 10–12

Note! To enable short discussion on the model answers on Thursday 14 Feb lecture, the strict deadline for the assignments is on Thursday 14 Feb by noon.

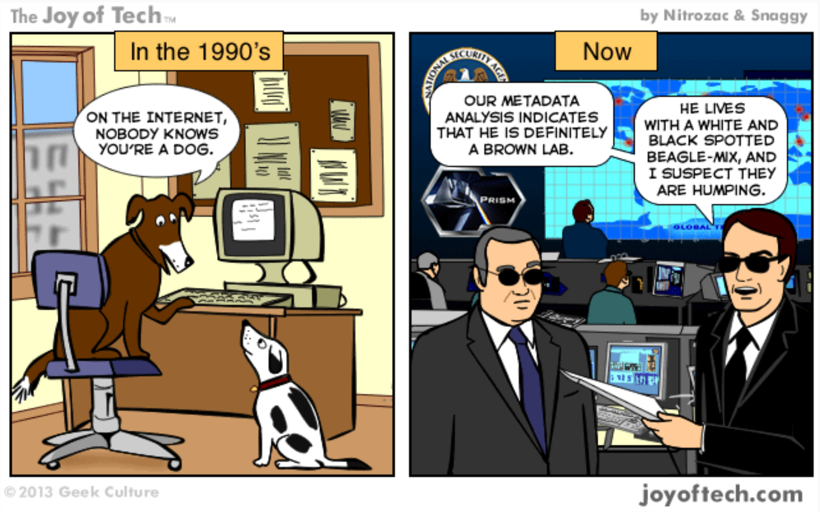
1. Consider the ad market that Google is running.
   (a) Explain why search is free in Google but advertisers are charged.
   (b) Why so many advertisers want to have their ads on Google?
2. List 5 reasons why you think Alibaba has been so successful. (You can compare this to the list on Amazon that you did in the very first assignment set). No need for long answers.
3. Why do you think trust is particularly important in peer-to-peer markets?
4. Consider the regulation of data in an online environment.
   (a) List 3 regulatory concerns.
   (b) Who should be responsible of the regulation? Motivate shortly.

Next time

Regulation

- Regulation
- Big data
- Property rights
- Market power

Lecture 12: Regulation


The Joy of Tech™
by Nitrozac & Snaggy
In the 1990's
ON THE INTERNET, NOBODY KNOWS YOU'RE A DOG.
Now
OUR METADATA ANALYSIS INDICATES THAT HE IS DEFINITELY A BROWN LAB.
HE LIVES WITH A WHITE AND BLACK SPOTTED BEAGLE-MIX, AND I SUSPECT THEY ARE HUMPING.
PRISM
© 2013 Geek Culture
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Outline

- Regulation
- Big data
- Property rights
- Market power
- Exam

Regulatory concerns

- Typical motivations for regulation are the limitation of market power, consumer protection and externalities.
- In the context of online and digital markets some of the key concerns are:
  - Privacy: Data collection and use.
  - Market power: Leads to efficiency loss.
  - Collusion: Same, algorithmic collusion a new phenomena.
  - Equality: Discrimination (cf. lecture 11).
  - Externalities, time use (+cf. lecture 11).
  - IPR: Ownership of digital content.
- Big data and algorithms that process data are relatively new phenomena, that could warrant caution to limit unforeseen misuses.

Overall gain from online shopping to consumers

- Variety gain:
  - Online retailers are less constrained by physical space, they can offer a wider variety of products.
  - E-commerce also enables consumers to access stores that do not have a physical location near them.
- Convenience gain:
  - Consumers can purchase a product online that they may have previously purchased at a brick-and-mortar store without making a physical trip.
- Share of online trade in the U.S. reached 10 % of in 2017.

Source: Dolfen et al. 2018.

Private regulation

Also possible to decide *not* to regulate despite concerns:

- Need to consider how regulation can be implemented and what the cost of regulation to consumers will be.
- Benefits of online markets and other platforms can be large enough to compensate for the costs and risks.
- Rapid development of new innovations may be unnecessarily hampered with too stringent or early regulation.
- Private regulation by the companies themselves purely on market based incentives (e.g. Amazon year 2000 DVD case) may be sufficient.

Video

Watching random video game from Twitch.

Intellectual property

- Ownership of physical things is most often clearly defined (in our times and parts of the world).
- Such clarity is missing online and with digital content.
- Copyright laws offer some guidance:
  - Copyright protects original works of authorship, e.g. literary, dramatic, musical, and artistic works, including movies, songs, and computer software.
  - But fair use clauses allow the use of copyrighted material in some circumstances.
- Copyright holder is entitled to the earnings created by the use of the protected work.
  - Who is entitled to the ad revenue from video gameplay in Twitch or remix in YouTube?

Property rights and liability laws

- *Coase Theorem* states that negotiation and trade always lead to an efficient allocation if
  1. Property rights are well defined.
  2. Transaction costs are negligible.
- It may be optimal to share some of the content for free to increase consumer awareness (Mustonen 2019).
  - Publishers less eager to enforce their rights.
- But because of transaction costs, a need to balance:
  - Relying on the assignment of property rights and markets.
  - Setting liabilities with regulation and rules.
- The old institutions governing copyright are clearly stretched by these online phenomena.

> Big data and privacy. . . represents one of biggest challenges to our society, and to competition law and consumer protection.
> *–J. Stiglitz, 2018.*

What are the concerns on data?

Example – Facebook in the news in 2018:

- An indictment of Russians who hacked Facebook.
- Facebook's role in Myanmar's tragedy.
- The mess that Cambridge Analytica made.
- Thousands of Facebook ads for which Russia paid.
- Details of undisclosed deals with device makers (e.g. Huawei).
- Info about an Iranian network of frauds and fakers.
- A report about Facebook's tools for gender discrimination.
- A massive data breach of 50m users' information.
- A confession they lied about video advertising metrics and terms.
- A report Facebook weaponized opposition research firms.
- A report that 6.8m users' photos were stolen by strangers.
- Facebook shared personal info with partners despite the dangers.

Source: Hustle.

Big data and privacy – Informed consent

- Individuals often don't know the value of data that they are giving to companies . . .
  - American companies alone are expected to spend close to $20 billion by the end of 2018 to acquire and process consumer data (NYT 18 Dec 2018).
  - Sales of location-targeted advertising reaching an estimated $21 billion in the U.S. in 2018 (NYT 10 Dec 2018).
- . . . or even that their data is being taken
  - Reading the privacy policies an average American encounters in a year would take 76 work days. (McDonald and Cranor 2008).
  - And there can be data breaches, by malignant third parties or the companies themselves.

Big data and privacy

Figure. Example of mobile phone location data in New York City.

Figure: NYT 10 Dec 2018.

Big data and price discrimination

- Data provides new tools for price discrimination and product steering (cf. lecture 7 – Online markets).
- There may be returns to scale in data
  - Firms with more data have a competitive advantage and can grow.
  - Not necessarily firms that are more otherwise more efficient.
- In some cases, there may be social value in the data; in many other cases, data is being used to extract more consumer surplus out of buyers.

Source: Stiglitz, 2018.

Big data and algorithms

- Big data together with efficient algorithms leads to high level of selection:
  - The purpose is to offer user specific content that will lead to more business.
  - This can be a purchase decision, click on a ad or more time spent on the platform.
- Algorithmic externalities
  - The content provided may be divisive.
  - Many social media apps use habit-forming technologies: infinite scroll, constant updates, likes etc. These may result in excessive use and addictions.

Big data benefits

Use of user data has also societal benefits:

- Service provision can be made more efficient:
  - Data can be used to present relevant content (e.g. Google).
  - More accurate demand predictions may lead to lower costs of logistics, lower waste etc.
- Advertisement supported content benefits from big data
  - Ads can be targeted with greater accuracy, reducing mismatches and the costs on both sides.
  - Can be argued that similar to targeting by e.g. viewer groups or by the magazine a reader chooses.
  - Advertisement income enables "free" services (e.g. Facebook).

Market power – Google

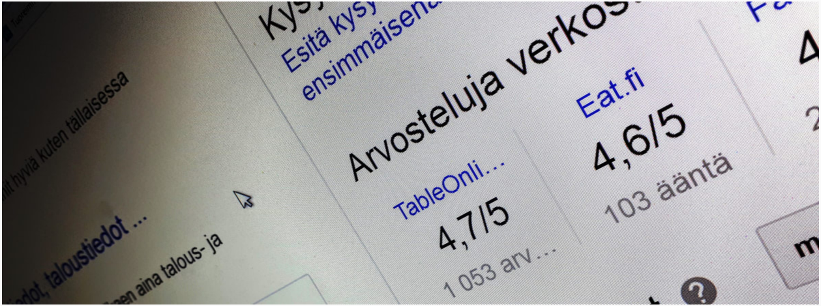


Figure. Example of how Google uses third party data directly on their user search webpage (Yle News 12 Oct 2018).

Figure: Yle.

Market power

- Foundem.com was a vertical-search engine for finding cheap online prices, founded in 2006.
  - Foundem first came up high in Google's search results whenever people submitted price comparison queries.
  - After only a few days in opeartion, the traffic stopped.
  - Foundem site had moved down tens of pages in Google search results; and was forced out of the business.
- In 2017, Google was ordered to stop giving its own comparison-shopping service an illegal advantage and was fined €2.42 billion, the largest such penalty in the European Commission's history.

Source: NYT 20 Feb 2018.

Market power – Google

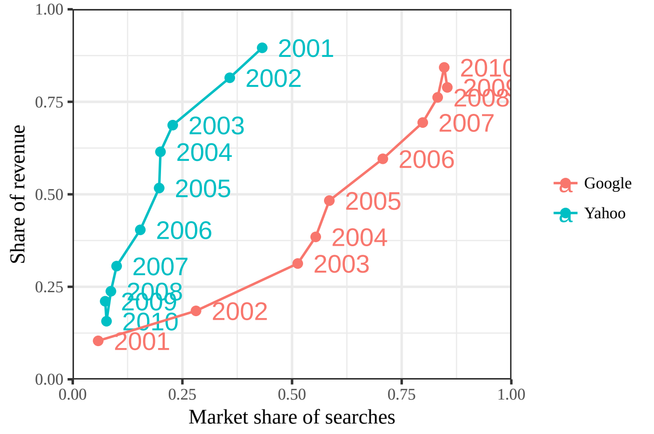


Figure. Development of the share of revenue (for the two) against the share of user searches (total market) for Google vs. Yahoo.

Source: distilled.net for user shares, revenues from multiple sources.

Market power – Google

- What makes Google tricky for regulation is that the search engine is hugely effective.
- The original PageRank algorithm scaled up as internet grew:
  - The placement of a webpage in search results was based on how many links there were from other pages to it.
  - As the number of webpages grew, so did the links to "important" sites.
  - Traditional search engines, such as Yahoo, lacked similar mechanism which led to congestion of search results.
- The issue now is that the current Google search algorithm ranks results based on many other things.
  - Combination of algorithms and data, might be that even Google does not know any longer.

Market power – Google

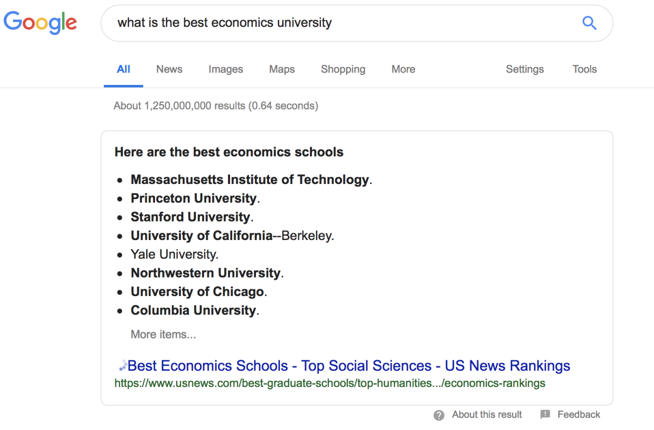


Figure. Example of the power of Google, search "what is the best economics university" in the U.S.

Figure: Google.

Market power – Google

Top Universities for Economics in 2017

Top 10 Universities for Economics Worldwide Based on the QS World University Rankings by Subject 2017

Rank	**Name of Institution**	**Location**
3	**Stanford University**	US
4	**University of California, Berkeley** (UCB)	US
5	**London School of Economics and Political Science** (LSE)	United Kingdom

8 weitere Zeilen • 16.03.2017

Top Universities for Economics in 2017 | Top Universities

https://www.topuniversities.com/university.../university.../top-universities-economics-20...

Informationen zu diesem Ergebnis   Feedback

Figure. Example of the power of Google, identical search "what is the best economics university" in Germany.

Figure: Google.

Market power – Amazon

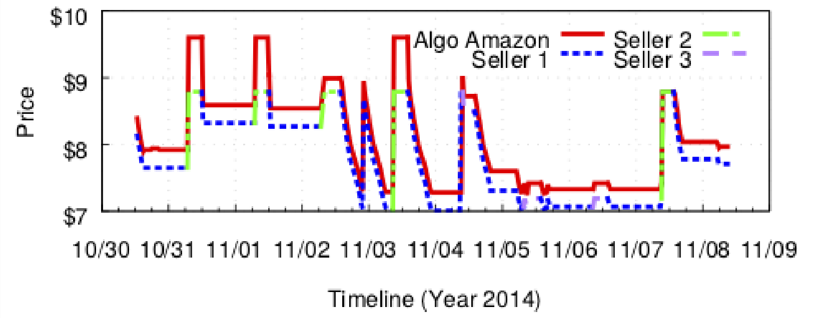


Figure. Example of Amazon keeping a premium over other sellers.

Source: Chen et al. 2016.

Market power – Amazon

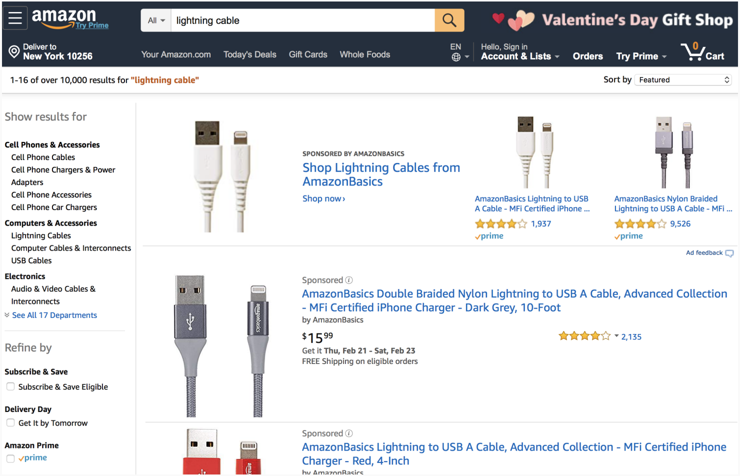
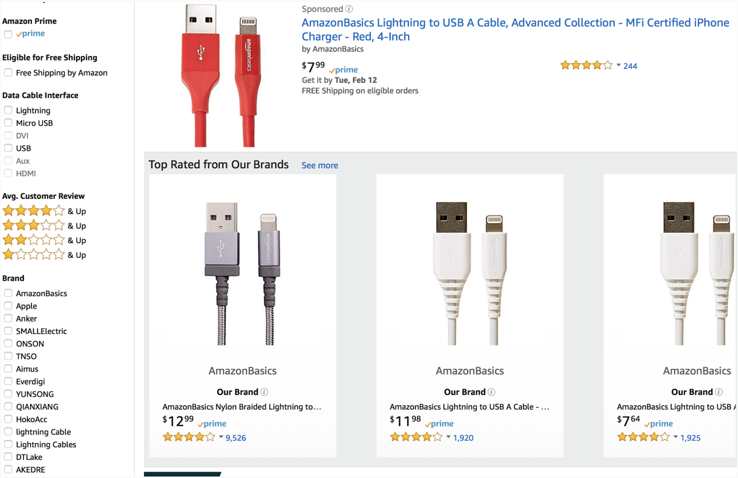


Figure. Example of Amazon search for "lightning cable".

Figure: Amazon.

Market power – Amazon



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Market power – Amazon

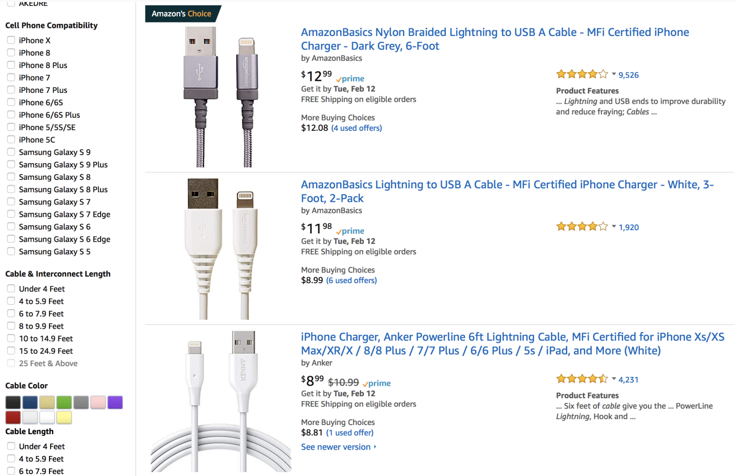

Figure. Example of Amazon search for "lightning cable".

Figure: Amazon.

Market power – Regulation

- Are the companies too big and powerful?
- Competition can still provide a remedy:
  - In 2008 Von Blanckenburg and Michaelis suggest that regulation of eBay is necessary, because "even in the longer term there will probably be no competition in their market".
  - Obviously, in 5 years or so, Amazon surpassed eBay's revenues.
- Lack of regulatory options:
  - E.g. how to split up the companies to enhance competition?

Collusion – Algorithm pricing

- Algorithmic pricing might contribute to overt collusion or facilitate tacit collusion.
    - Coordination between pricing algorithms leads to lower competition and higher prices.
    - Algorithms can match rival's discount instantaneously and eliminate incentives to discount.
- Sophisticated price discrimination may lead to narrower relevant product markets.
    - Implications e.g. to merger control.

Source: McSweeney and O'Dea, 2017.

Collusion – Algorithm pricing

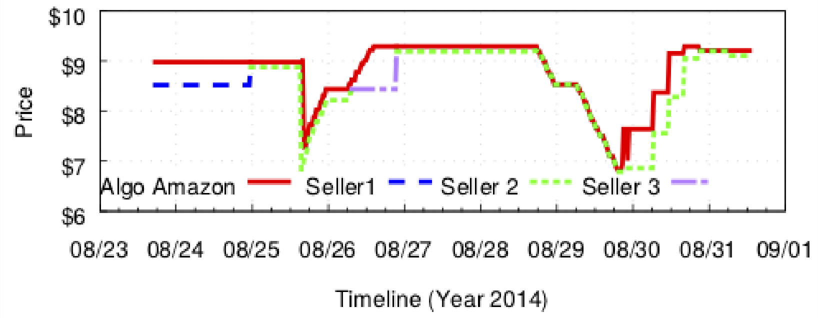

Figure. Example of Amazon matching the lowest seller.

Source: Chen et al. 2016.

Regulatory responses

- The complexity of platform economics, data and algorithms makes the regulatory challenges complex.
- European Union's General Data Protection Regulation (GDPR) is along the lines of J. Stiglitz:
  - "There needs to be far stronger regulation on individual privacy and the transparency of those who acquire data, on combining data sets, on the uses to which data can be put."
- Global firms often operate beyond the reach of national regulators, leading to calls on global regulation:
  - Japan to propose "the creation of a framework for discussing global data governance at the G20 summit to be held in Osaka in June 2019". (NHK news 23 Jan 2019)

> “There are two kinds of games in economics. One is the game where people use only legal moves. Then there is the true game, the one like real life, where the strategies and moves people make, some of them contain illegal gains. So you take into account when you write the rules of the game that the players will try to cheat. *–Leonid Hurwicz.*”

Learnings today

- Motivations for regulation are the limitation of market power, consumer protection (privacy, discrimination) and negative externalities (social, environment).
- Sufficiency of private regulation and the lack of guaranteed regulatory options makes the regulators cautious.
- Online, big data, the concentration of users, and the lack of transparency in what algorithms are doing, are the largest sources of concern.

Readings

- Demange, G. (2018) "Mechanisms in a Digitalized World", CESifo Working papers.
  - Lighter read and a working paper so some rough edges.

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