ECON-C5100 Digital Markets

Iivo Vehviläinen

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Aalto University
iivo.vehvilainen@aalto.fi

Lecture 1: Introduction

The square and the tower

Market square in Siena, Italy. Source: Tuscany, Beautiful Everywhere.

Course content

Mix of *basic economics* in a digital world

- Efficiency
- Preferences

plus *Network externalities*

and some introductory *Industrial Organization (IO)*

- Strategic behavior of firms
- Impacts to markets and regulation

Course policies

Guidelines for the course:

- Check the course policies slides from MyCourses or the short video from Panopto

Of lectures:

- Aim to keep things concise
- Q&A at the end

Primary channel for discussion is Presemo, presemo.aalto.fi/digimar

You can email me for any questions or to book a virtual meeting

This week

First lecture

- Start with market efficiency

Second lecture

- Preferences and data

Phantom packages

Figure: Aliexpress.com.

Efficiency

Digital markets offer several channels for improved efficiency:

- The usual suspects:
  - Lower transaction costs
  - Lower search costs
  - Lower replication costs
- But also need to consider
  - Lower tracking costs
  - Lower verification costs
- Much of the course will be spent on these topics in detail, but we start already today

From Goldfarb and Tucker (2019).

In-class exercise: Search costs game

Take note of three things:

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, Ilvo 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 Ivo can sell his orange for 10, his payoff is 1
- The game will continue for x minutes

In-class exercise: Starts now!

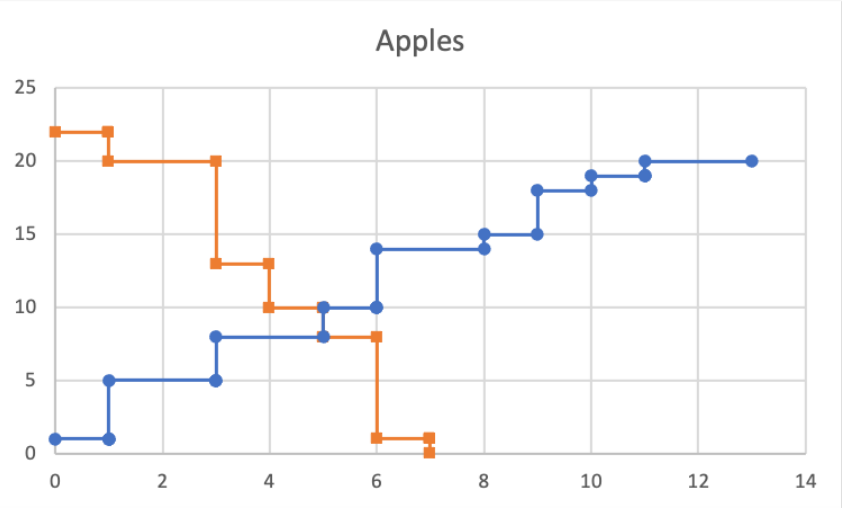
Game is run in Presemo presemo.aalto.fi/digimar

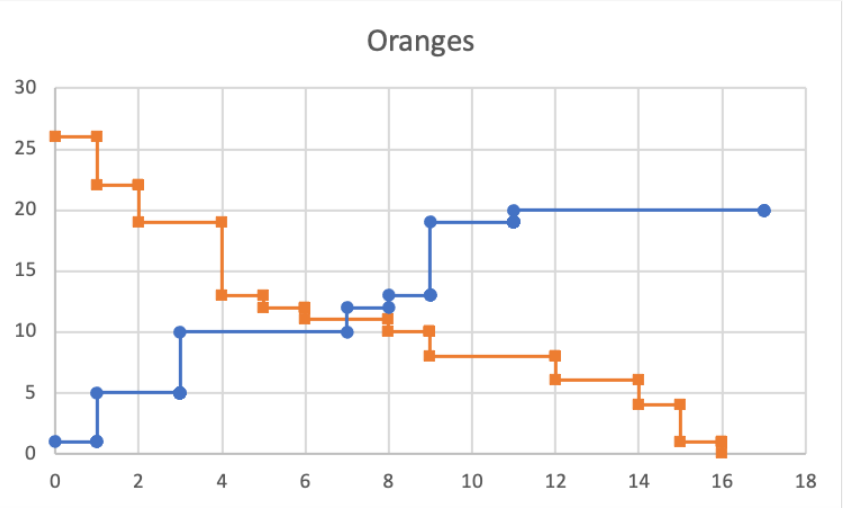
Use the Marketplace chat

Try and close the best deal you can

In-class exercise: Search costs game

Now let's organize differently...





And discuss the results

Organizing markets: Before the 19th century

Figure: *Village Fair* by Gillis Mostaert, 1590 (via Wikimedia).

Organizing markets: Recent past

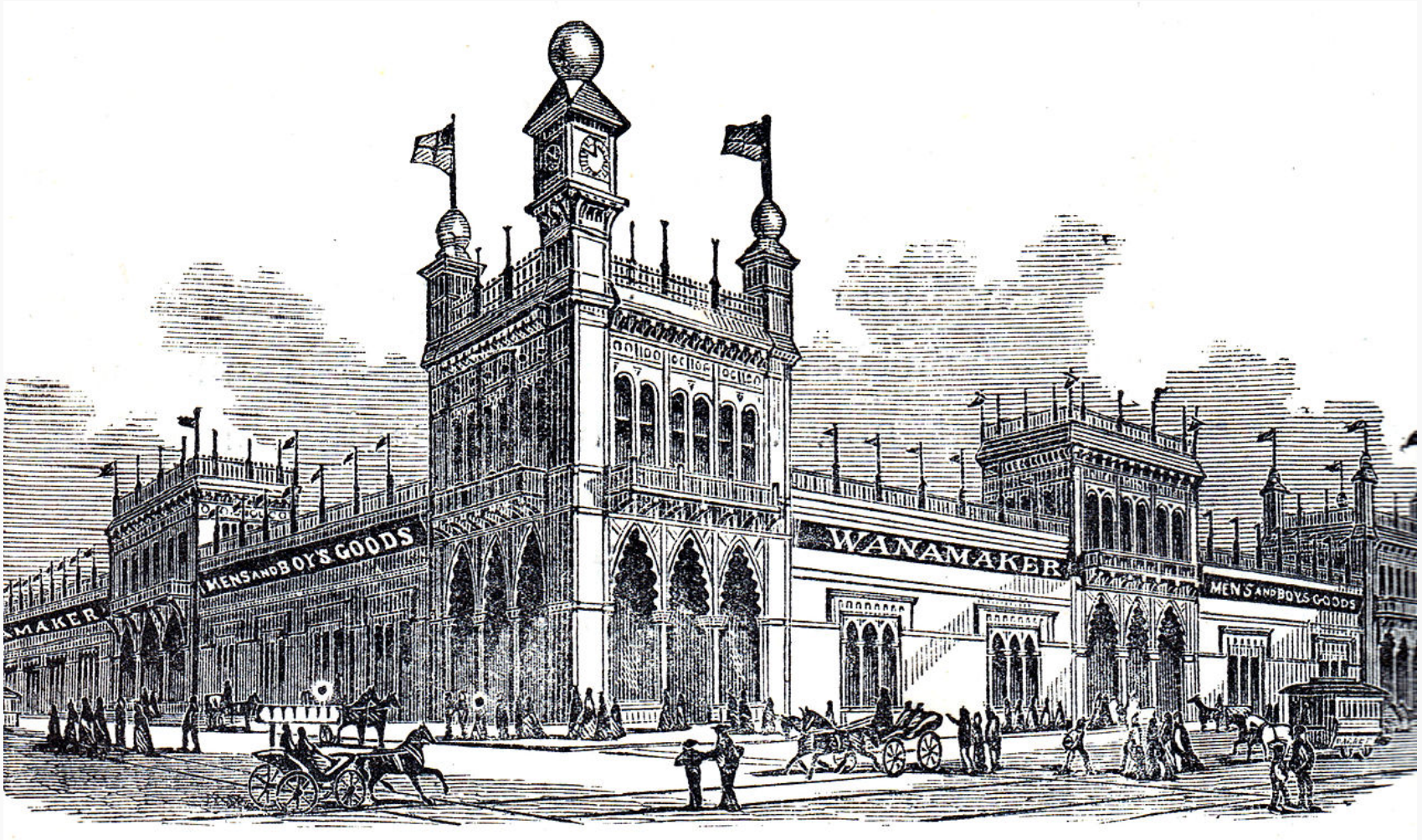


Figure: WikiCommons.

Organizing markets: Now

Figure: Alibaba.

Many new marketplaces operate as platforms

Why are platforms so popular as a business model?

- Economics of scale reduce transaction costs (e.g. Alibaba)
- Matching to reduce search costs (e.g. Amazon)
- Replication of effort through digital platforms (e.g. Apple iOS)
- Benefits from tracking users (e.g. Google)

In addition, *network effects* are going to be of crucial importance. We will return to these mechanisms in more detail

Institutions

- Institutional arrangements set the rules for "games" in marketplaces
- Marketplaces can have their own rules, e.g. stock exchanges
- Setting these rules is a question of market design, which we will return to in later lectures
- 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.
- Online access to markets in other countries challenges the ability of local governments to regulate them

> Why do you think that the ecosystems in the U.S. have grown so big? *–Bengt Holmström*

Listen to Common Good Summit: Regulation of Platforms (have a look at least the clips from 36:10 to 40:30 and 47:00-49:50.)

Takeaways from today

- Digital marketplaces increase efficiency
  - Reduction of search costs and other frictions
- Market institutions matter
- We have the new market square

  $\rightarrow$ The tower? To be discussed

Materials for this week

Reading assignment 1:

- Athey, Susan and Michael Luca (2019) "Economists (and Economics) in Tech Companies", Journal of Economic Perspectives. Read the whole article.
- Varian, H. (2012) "Revealed Preferences and its Applications", Economic Journal. Read the Introduction and Section 2 for now.

Online resources (make sure you know these before you take Exercise 1):

- Make sure you know the basics of consumer choice: e.g. mru.org: Consumer Choice and/or www.core-econ.org 3.2-3.5, 3.7.1.
- and supply–demand equilibrium e.g. mru.org: Supply, Demand, and Equilibrium and/or www.core-econ.org 8.1, 8.2.

Next time

Preferences

- Preferences online
- Estimation and prediction

ECON-C5100 Digital Markets

Iivo Vehviläinen

January 12, 2022

Aalto University
iivo.vehvilainen@aalto.fi

Lecture 2: Preferences

Last time

- The square and the tower
  - Market institutions matter
- Digital marketplaces increase efficiency
  - Reduction of search costs and other frictions

Today

- Preferences online
- Estimation and prediction

Recap: Market demand builds on preferences

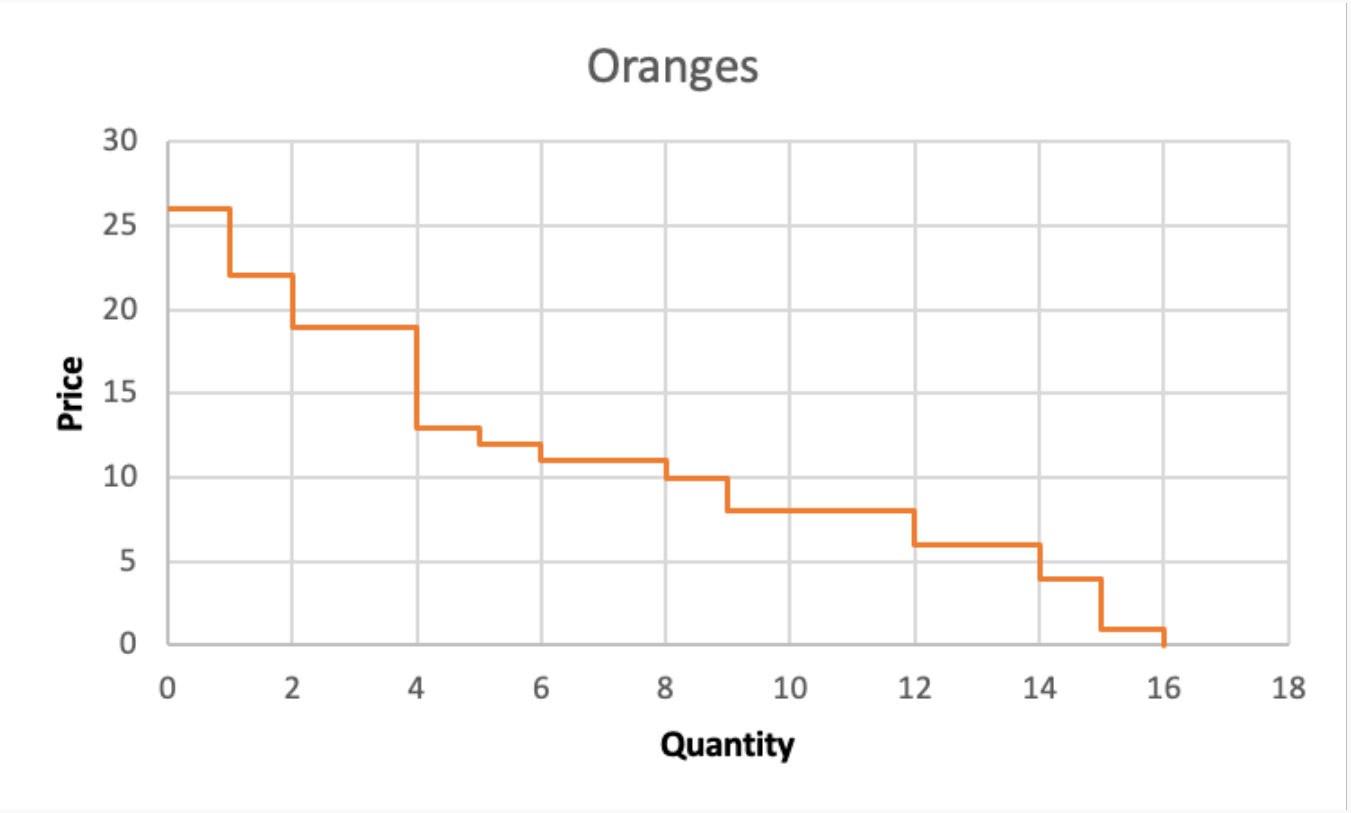


Figure. Demand of a good depends on the preferences of the individuals who participate to the market.

Preferences online

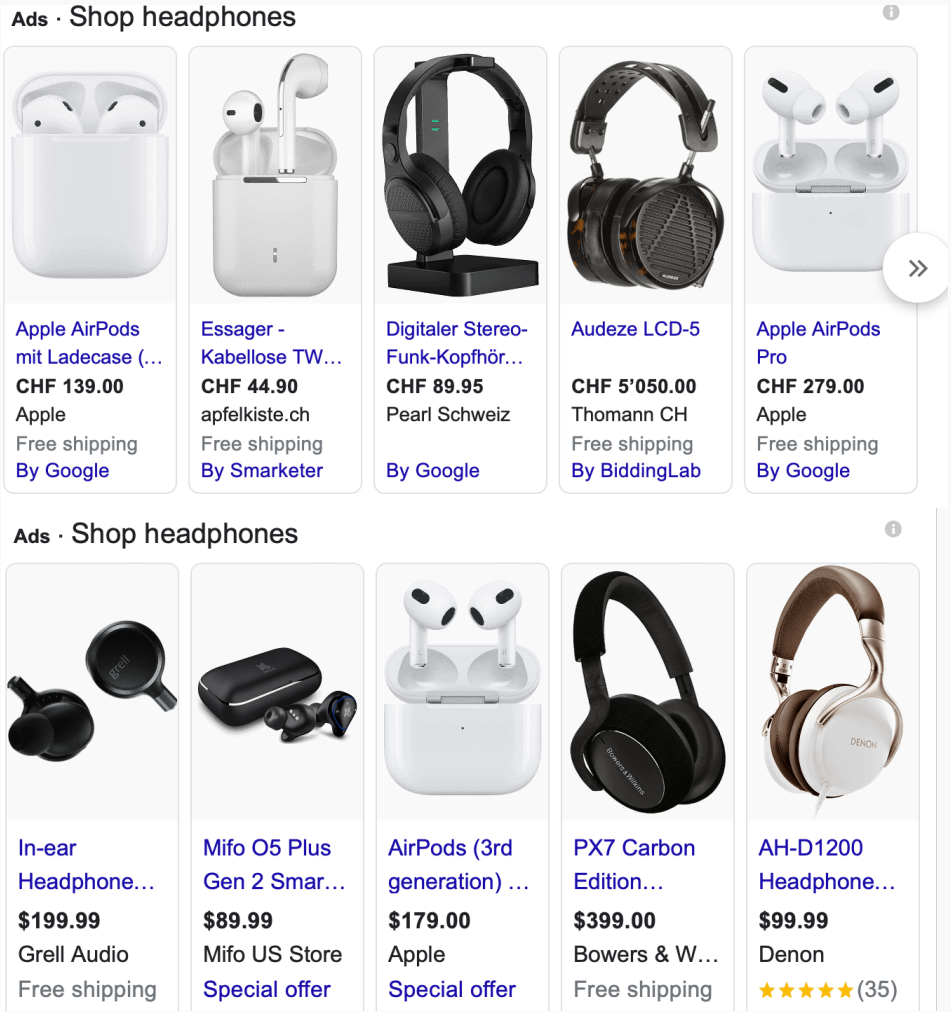


Figure. Two identical Google searches, one done from Zurich, Switzerland (top) and another from Mexico City, Mexico (bottom)

Experiment: Search engine

Google *Beats headphones*

- Report the price from the first ad that is shown to you at *Search* chat at presemo.aalto.fi/digimar
- You can use your preferred other search engine, if Google is out of the question

Use of data

- What you want to do
  - For example buy a phone, watch a movie, connect with friends
- What a firm wants to do: find out what you want to do by tracking your actions... and try to influence behavior:
  - Design a mechanism (market place, auction, platform) to discover your preferences
  - Collect and use data to improve performance

Tracking user data

- Big tech companies and others 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

Data collection

- Browser cookies are an early invention to track users
- They are still widely used, but their benefit has been reduced
  - Regulation made companies to disclose the use of cookies in the EU ("This website uses cookies to...")
  - Browsers have started to compete on privacy dimension, you can opt-out from cookies
- The tracking industry is responding with new technologies
  - Merging user information from device models to browsing behavior and keystroke or mouse signatures
  - Keeping people signed in to their devices
- With combined data from all users, it is possible to predict your behavior, even if you don't disclose it yourself

---

Bergemann et al. 2019.

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 inference, is a traditional field of economics (microeconometrics)
- The second part, prediction, is what the big tech firms are doing with the availability of big data

Estimation and prediction

To pinpoint the differences:

- Let's consider a simple model

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

- X_i are data (e.g. location, past clicks).
- Y_i are variables of interest (e.g. click to an ad).
- 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. $\ell(f(x), y) = (y - f(x))^2$.

Susan Athey, 2018.

The bias-variance tradeoff

If $E[\epsilon] = 0$, the expected prediction error is:

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

for some x out of sample. Using $\epsilon = y - f(x)$, we have

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

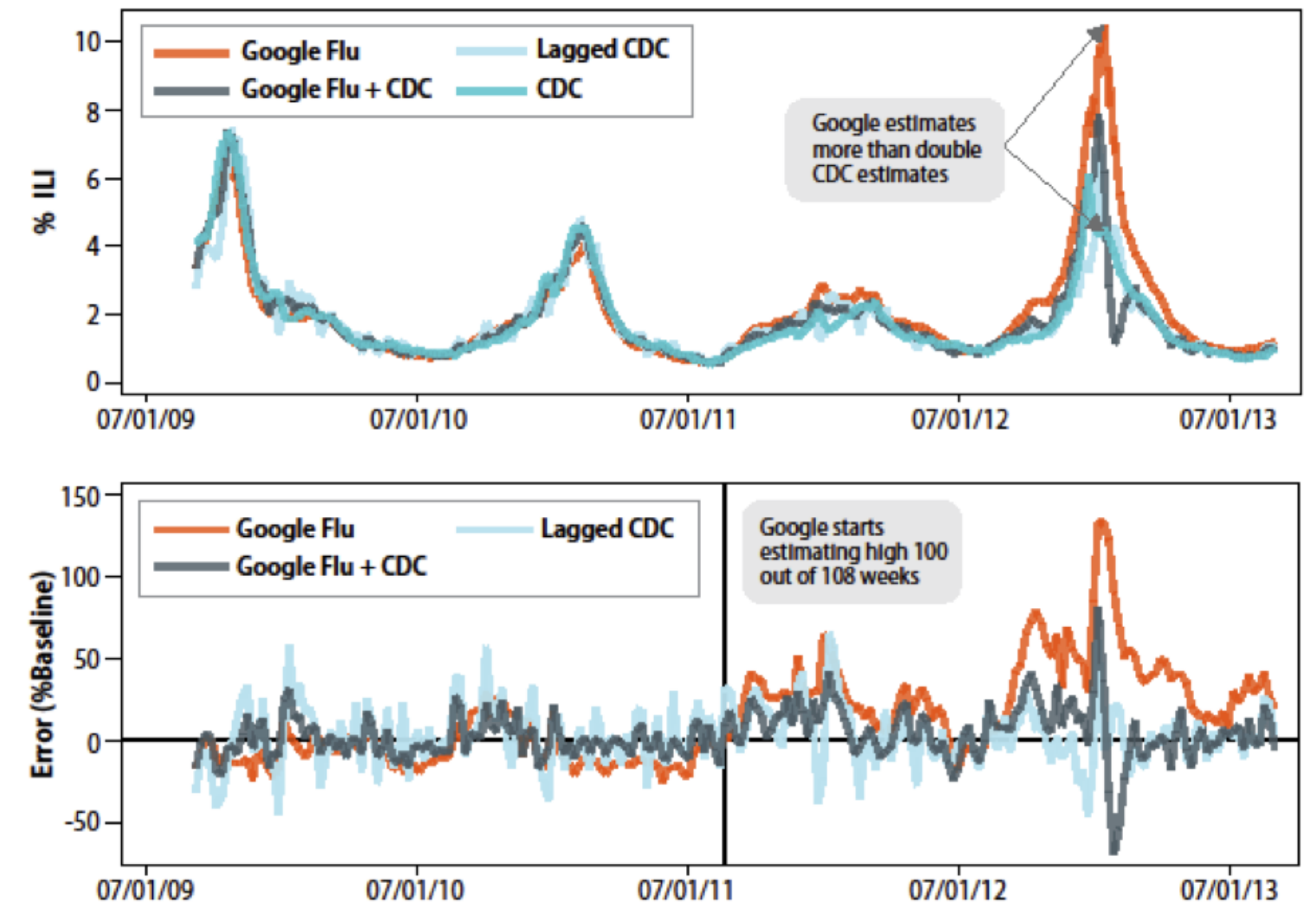
i.e. a combination of noise or variance in data ($Var(\epsilon)$), bias in estimation, and variance from the fact that a sample is used to estimate $\hat{f}$

Prediction

Basic idea:

- Data has signal and noise.
- More "expressive" functions
  - Capture the signal better
  - But also pick up the noise
- Prediction algorithms allow tuning of parameters so that the signal/noise ratio is as desired

Example: Prediction gone wrong



Source: Lazer et al. 2014.

Why can predictions go wrong?

- Let's go back to the simple model, and note that it most often is a vector valued (see e.g. Facebook example below)

$$Y_i = f(\boldsymbol{X}_i) + \epsilon_i$$

- Machine learning algorithms choose what parameters of $\boldsymbol{X}_i$ are used, automatically and based on past data
- With big data, manual analysis of data would be impossible/too costly/too slow
- In complex environments with big data, no one knows why a certain set of parameters gets chosen

Experiments and A/B testing

- A/B testing in one method to extract more data
- 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

Further example: Causal inference with prediction

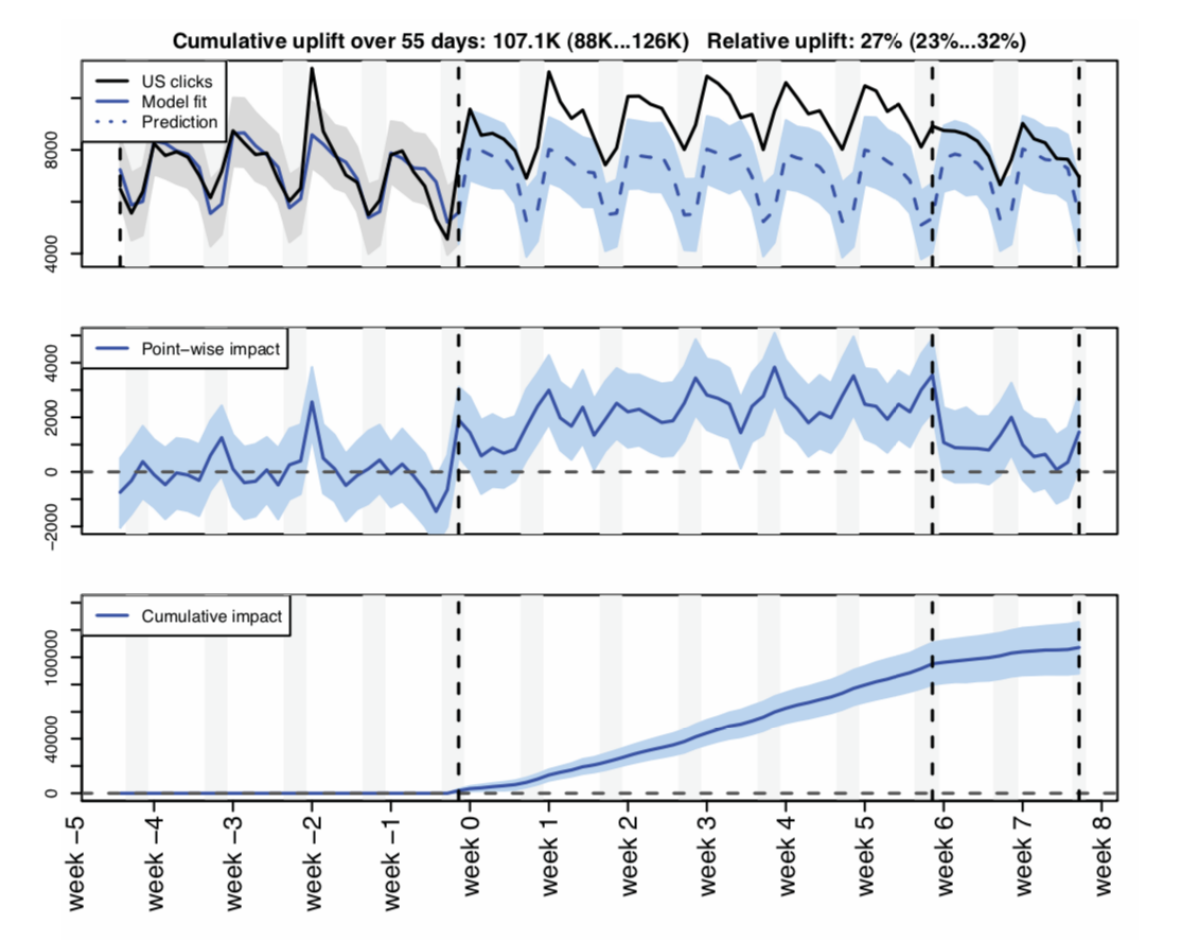


Figure. Actual clicks vs. predicted clicks and 95 % confidence interval.

Varian (2014).

Care needed in interpretation

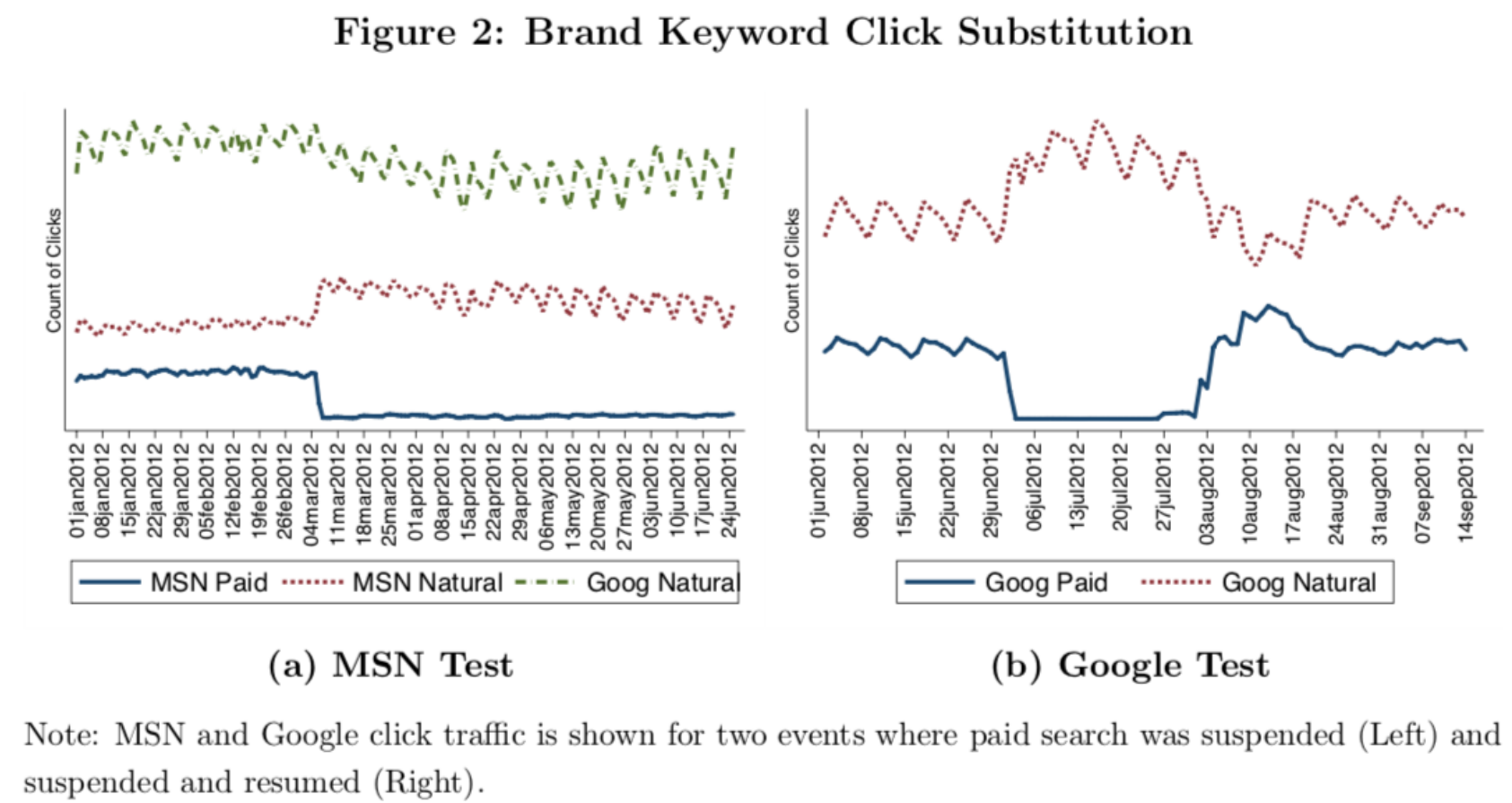


Figure. Regular search is a substitute for eBay brand ads. One explanation: selection of consumer who want to go to eBay.

Blake et al. (2014).

Takeaways from today

- Firms extract data because it is of value to them
- Collecting data online easier than ever
- Prediction and causal inference aim for different goals
  - Firms mostly interested in prediction
  - Care needed to understand what are the best tools

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Next time

Competition

- Perfect competition
- Monopoly
- Oligopoly

Appendix

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, 2018.

Example: Facebook

Figure. Categories of data that Facebook collects of you.

Figure: Facebook.

Example: Tiktok

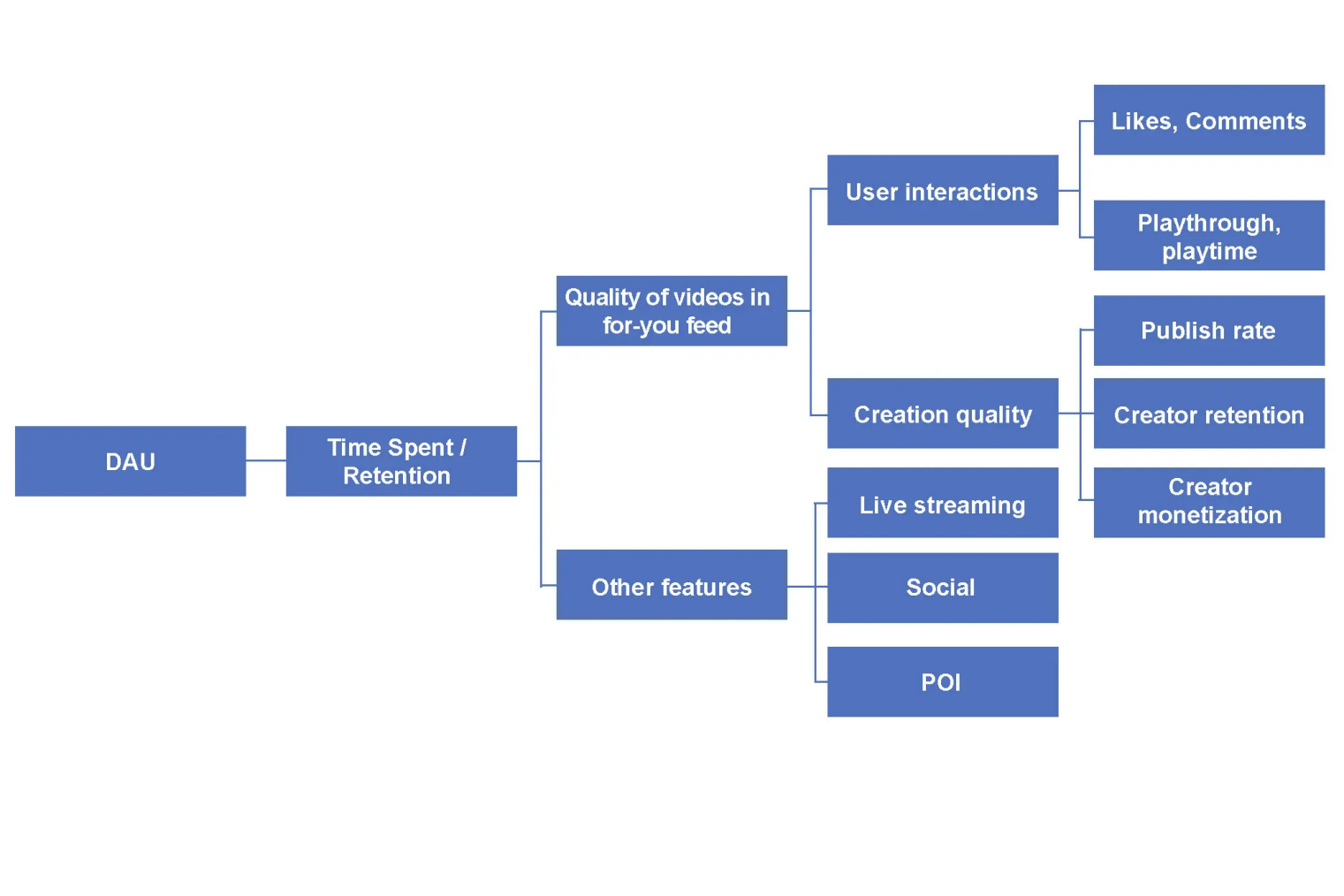
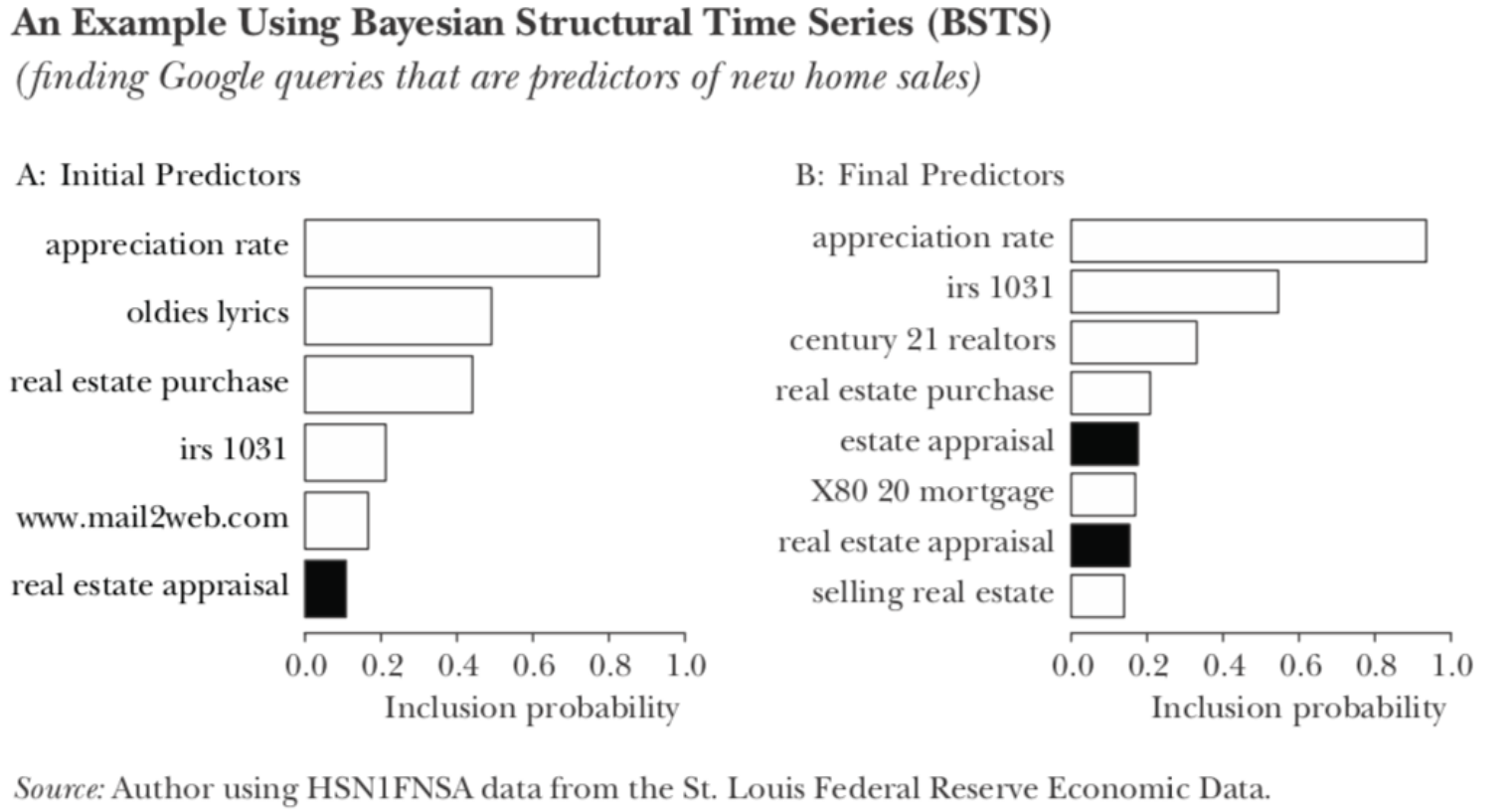


Figure. The goals of Tiktok's algorithm

Figure: How TikTok Reads Your Mind, New York Times, 5 Dec 2021

Example: Automated selection



Panel A shows uncurated Google Correlate results to predict new homes sold in the US. Choices adjusted by hand in Panel B

Source: Varian, 2014.

Simple solutions: Change one parameter at a time

- Question: What price to charge customers?
- Direct variation of prices can be problematic, instead indirect means are used to extract data (see Figure).
- Such testing, done offline as well, can provide an understanding on how demand changes when prices change.
- Online market places differ from traditional sales in the speed and reach of testing.

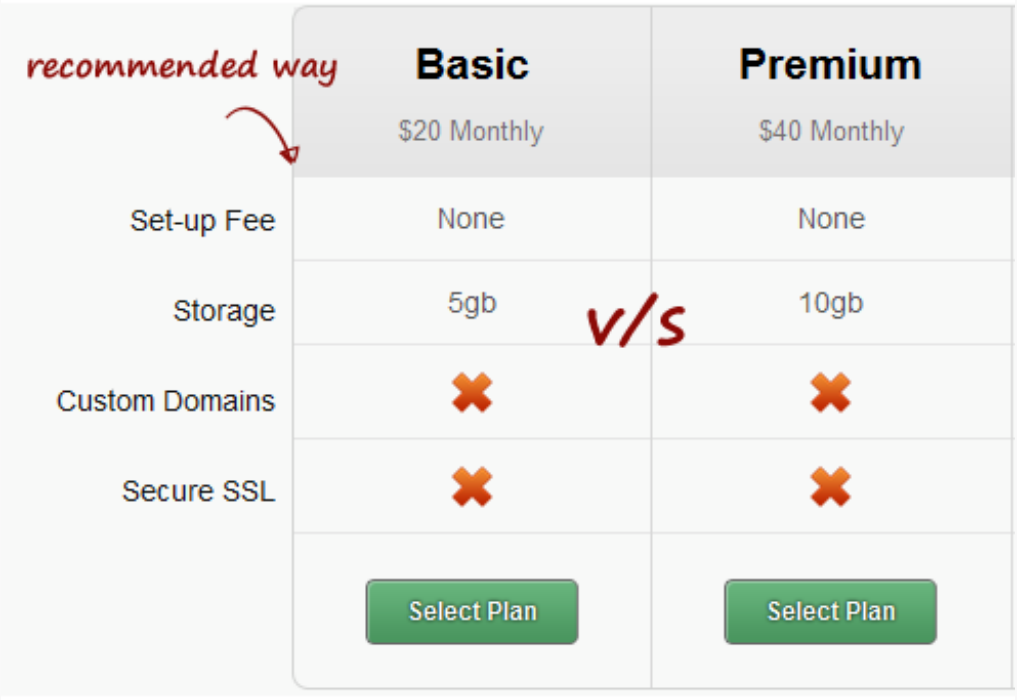
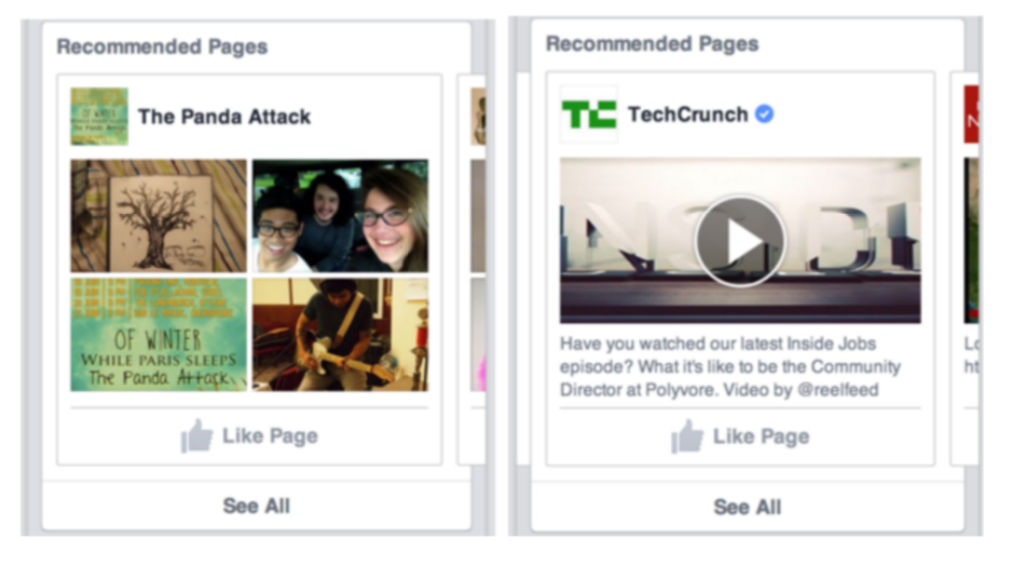
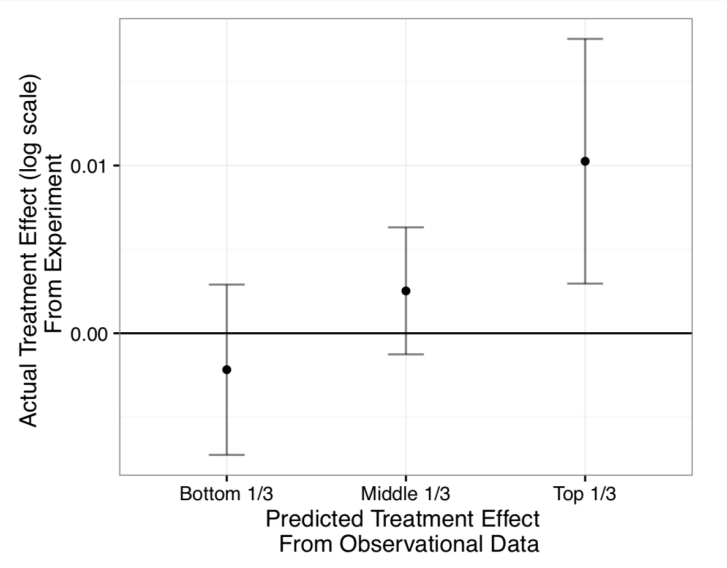


Figure: VWO.

More complex example: A/B testing at Facebook





- Problem with simple solutions is that people respond differently.
- Advanced tools with big data are actively developed to yield better identification. Above example from Facebook lab is from an A/B test with 400,000 randomly chosen users.

Source: Peysakhovich and Lada (2016).

ECON-C5100 Digital Markets

Iivo Vehviläinen

January 17, 2022

Aalto University
iivo.vehvilainen@aalto.fi

Lecture 3: Competition

Agenda

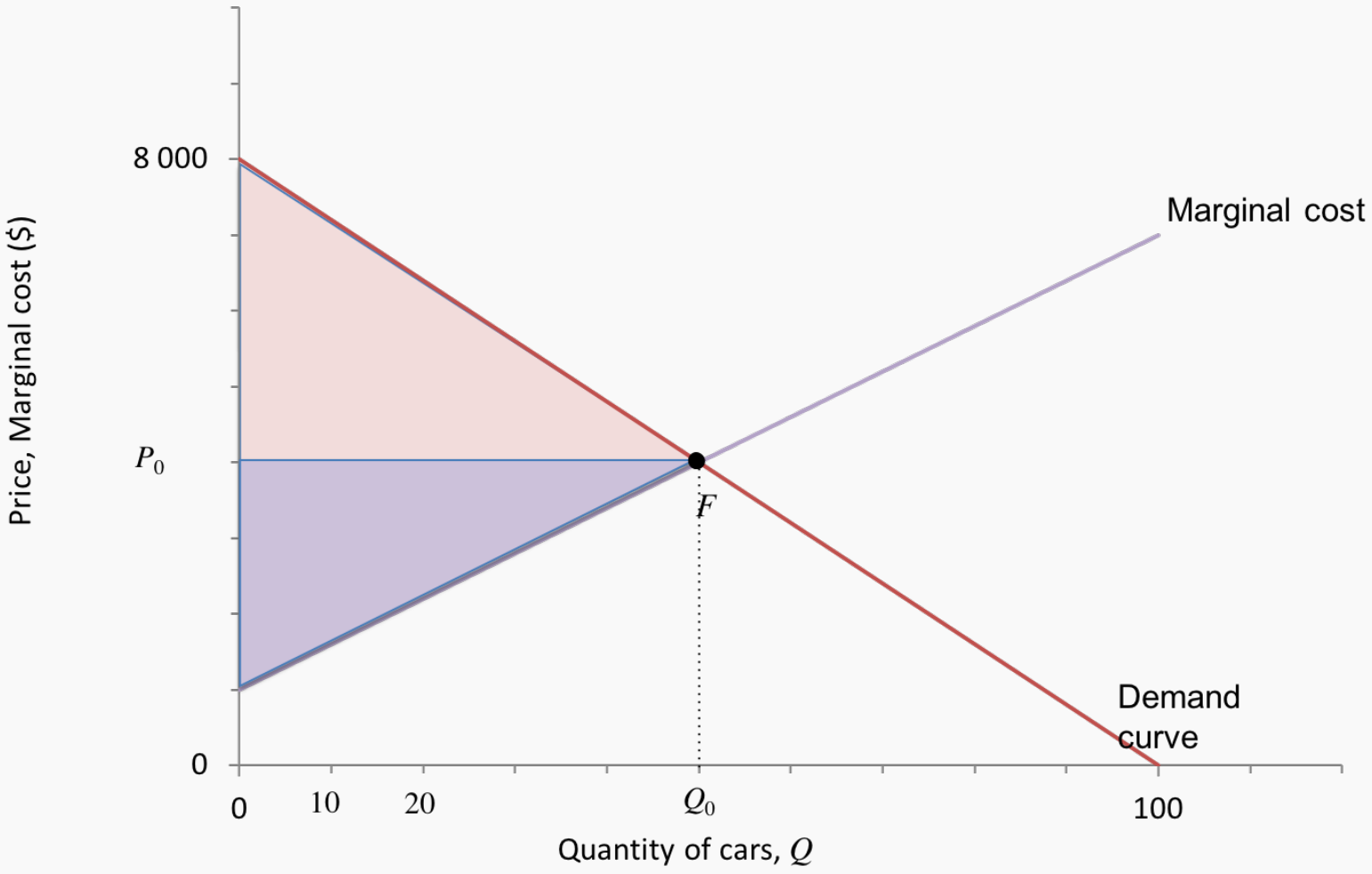
Last week

- Efficiency in the marketplaces
- Role of preferences and data online

This week

- Industry structure and competition
- Auction theory

Reminder: Competitive equilibrium



Source: CORE, The Economy.

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 industry structure affects competition:

- 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

Impact of a monopoly setting the price in the market

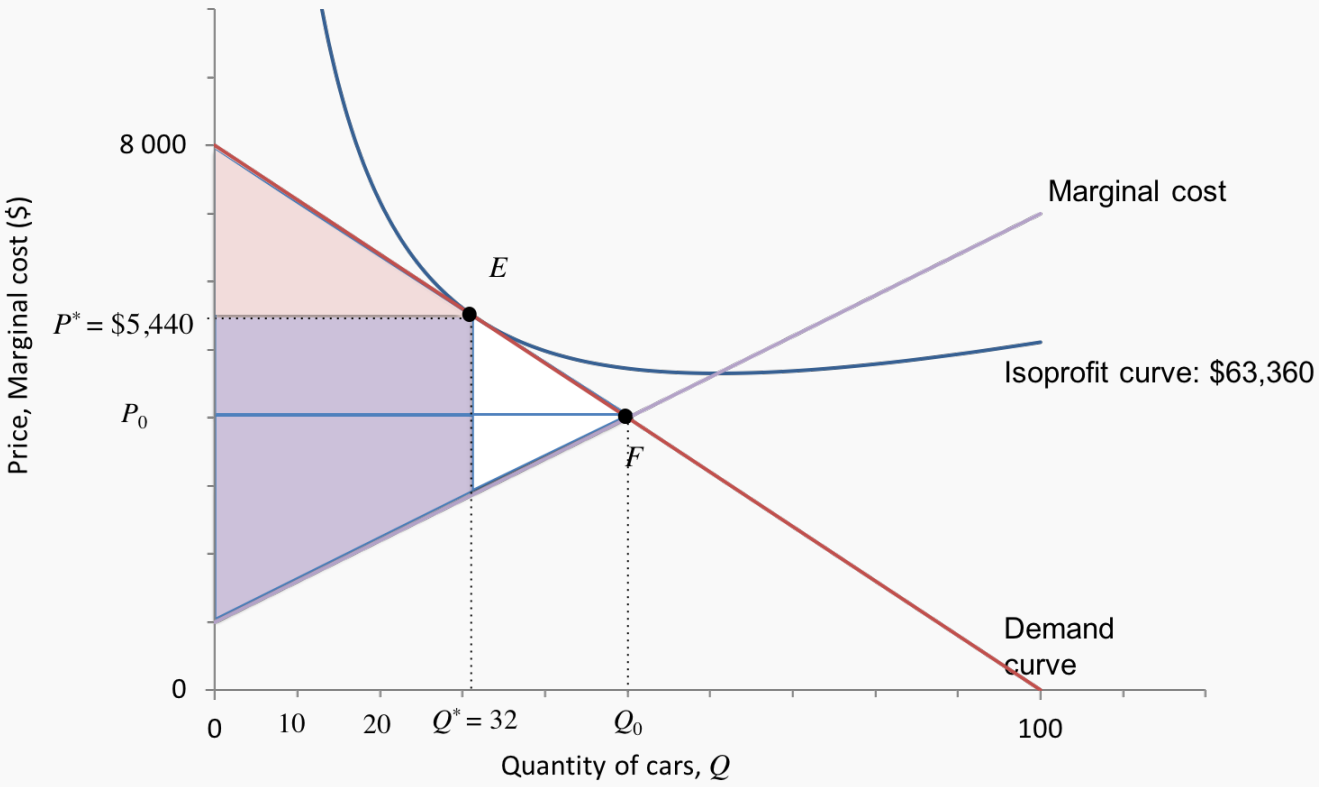


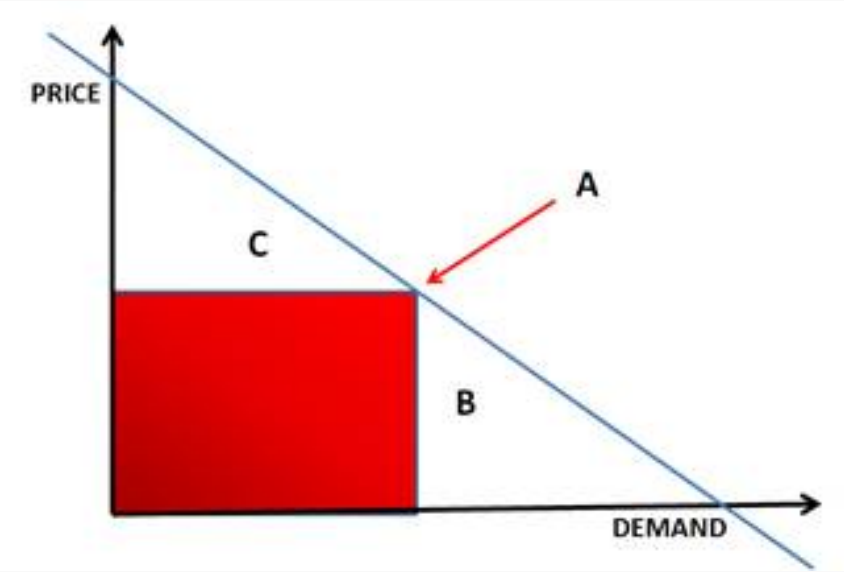
Figure. If a monopoly can charge only one price (P* here), then the allocation is not efficient.

Source: CORE.

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
- This result hold in the case if the firm is only able to offer *uniform pricing*, the same price for everyone

Price discrimination, good or bad?



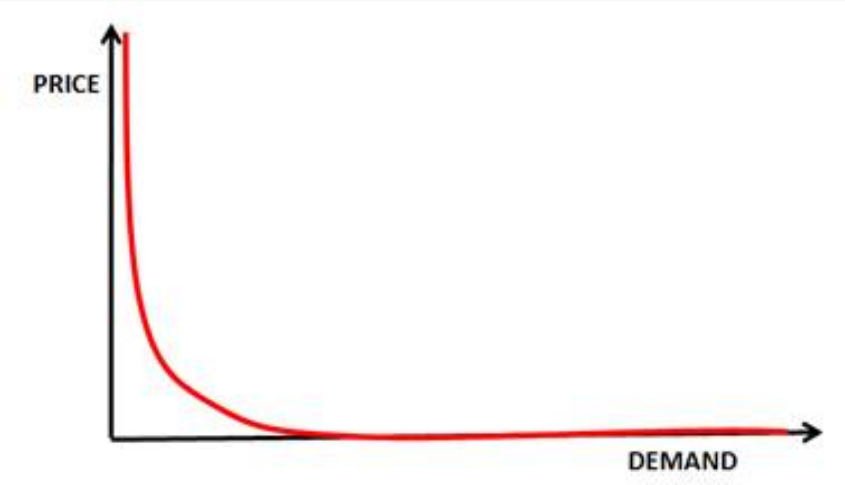


Figure. Linear demand (left). Model for demand in a free-to-play game (right).

- Setting one fixed price at A leads to buyers that could have paid more (C) and consumers that do not buy the game and thus do not pay anything (B)
- Empirically, it seems that some 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.

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 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

- 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; typically this is considered to be problematic.

Discussion: What about zero prices?

Is Google search a monopoly?

Take the poll in Presemo presemo.aalto.fi/digimar.

Use the chat to discuss.

Real world competition

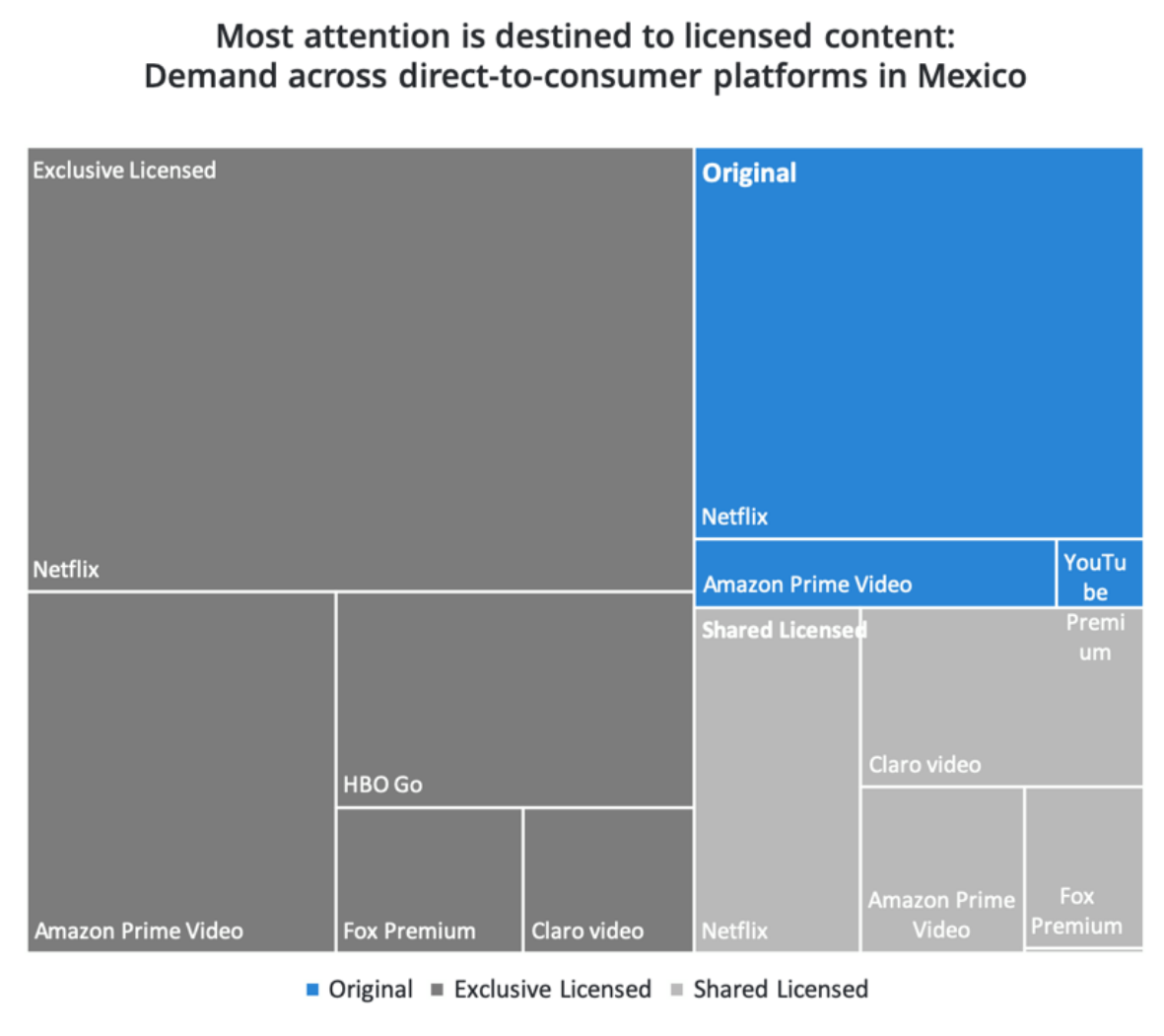
- When there is a limited number of firms, then each of these may have some market power, i.e. they can gain by bidding differently from their marginal cost
- When doing so, they must take into account the actions of the other firms
- Game theory is helpful in understanding how these non-cooperative games can play out
- Outcomes typically between perfect competition and monopolies

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 sales at cost 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 cooperate, or collude, to achieve monopolistic control over the market.

Illustration: Online streaming



Source: PARROT analytics, 17 Oct 2019.

Illustration: Online streaming

- Two firms, i and j, invest to produce original content.
- Firm i has a studio with capacity K, firm j a smaller k.
- Demand is defined by an inverse demand function $p(Q)$.
- Marginal cost of production for both firms is c.
- Payoffs defined with:

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

Illustration: Online streaming

Assume that the payoffs of the firms are

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

Illustration: Online streaming – Duopoly competition

- In a *Nash equilibrium* both firms provide content:

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

- Cost for consumers is $20 + 10 = 30$.
- If the firms could coordinate their actions:
  - they would limit the production,
  - increase prices, and
  - increase their joint profits ($90 > 30$).

Institutions and regulation

- Reminder: Market institutions are crucial
  - Efficient marketplaces with free entry improve competition
- Protection against the misuse of market power is one of the key regulatory concerns
  - Competition law (=anti-trust in the U.S.) is covered later
- Network externalities will impact the nature of competition
  - Will be tricky, we cover as much as we can later

Takeaways from today

- Market structure matters for the equilibrium outcomes
- Lack of competition leads to lower output and higher prices
  - Lower output is a social loss, market is no longer efficient
  - High prices have distributional effects, consumer pay too much
- If competition is insufficient there is a need for regulation

Materials for this week

Online resources (for Lecture 3):

- **Perfect competition**. www.core-econ.org 8.5 and 8.8.
- **Monopolies**. Here MRU section on Monopolies mru.org: Monopoly is better suited for the course than www.core-econ.org 7.5.1.
- **Oligopolies**. MRU on Cournot mru.org: Cournot.

Reading assignment 2 (for Lecture 4):

- Easley, David and Jon Kleinberg (2010), Chapter 9 from "Networks, Crowds, and Markets: Reasoning about a Highly Connected World". Advanced material (9.7) not obligatory.
- Einav, Linar, Chiara Farronato, Jonathan Levin and Neel Sundaresan (2018) "Auctions versus Poster Prices in Online Markets". Very selective reading expected: Introduction, with the exception of the literature review in the end, and Section II.

Next time

Auction theory

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

Appendix

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.

Example: Is consumer electronics a competitive market?

Figure: Aliexpress.com.

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Iivo Vehviläinen

January 19, 2022

Aalto University
iivo.vehvilainen@aalto.fi

Lecture 4: Auction theory

Outline

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

Example: Ascending price 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.
- Remaining bidder pays her bid.
- Common applications
  - Traditional auction houses selling all sorts of fancy stuff.
  - eBay, huuto.net (Finnish eBay) and the like.

How should you bid?

- 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 last two digits of your student number
  - As an example, I'd have 96 (IIRC)
- You can bid above the current price or exit.
- Auction ends when just one bidder remains.
- Final bidder wins, and pays her/his bid.

Use the poll in Presemo presemo.aalto.fi/digimar to place bids.

Auctions online

- Online advertising is the key application
  - E.g. advertising made up 80% of Google's annual revenue in: 147 billion U.S. dollars in 2020.
  - Early enthusiasm of online auctions for other stuff (e.g. eBay) has quieted somewhat
- Data created through individual tracking and e.g. unique search term create thousands of ad sales opportunities *per second*.
- How to choose price for thousands of ads sold to billions of consumers?

Reminder: Preferences online

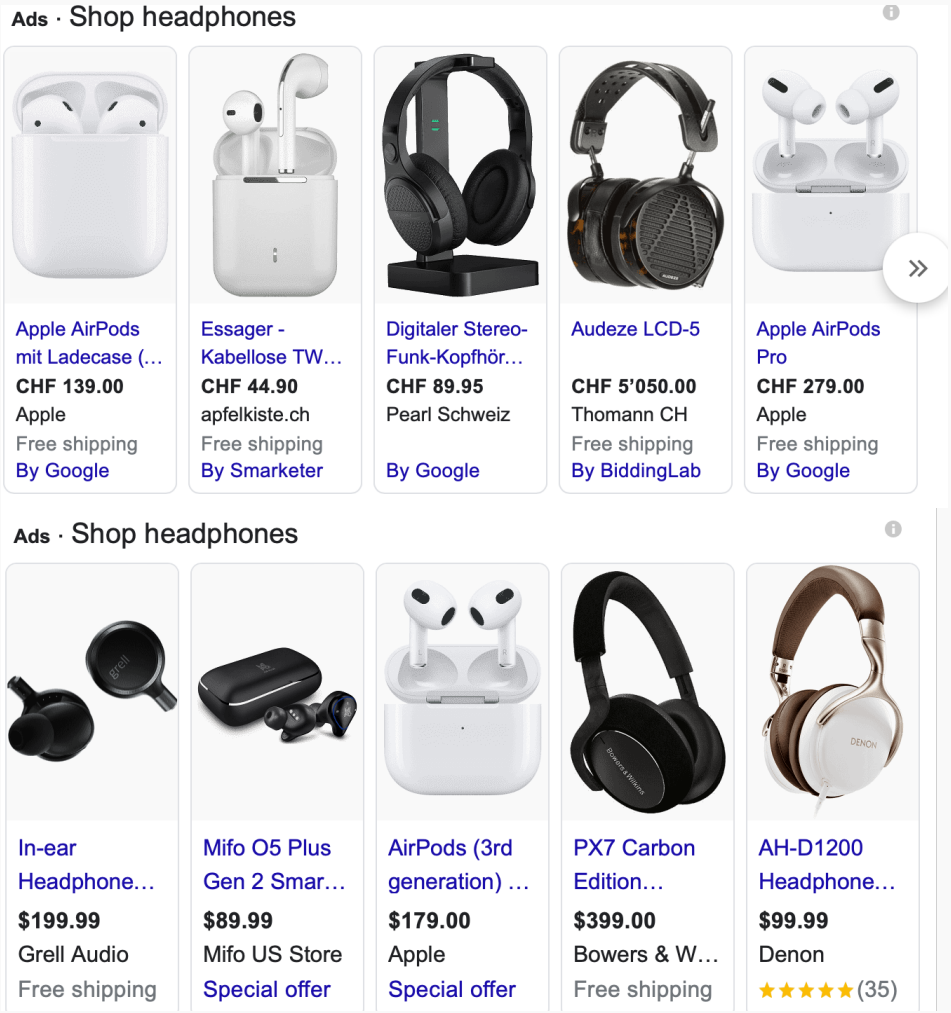
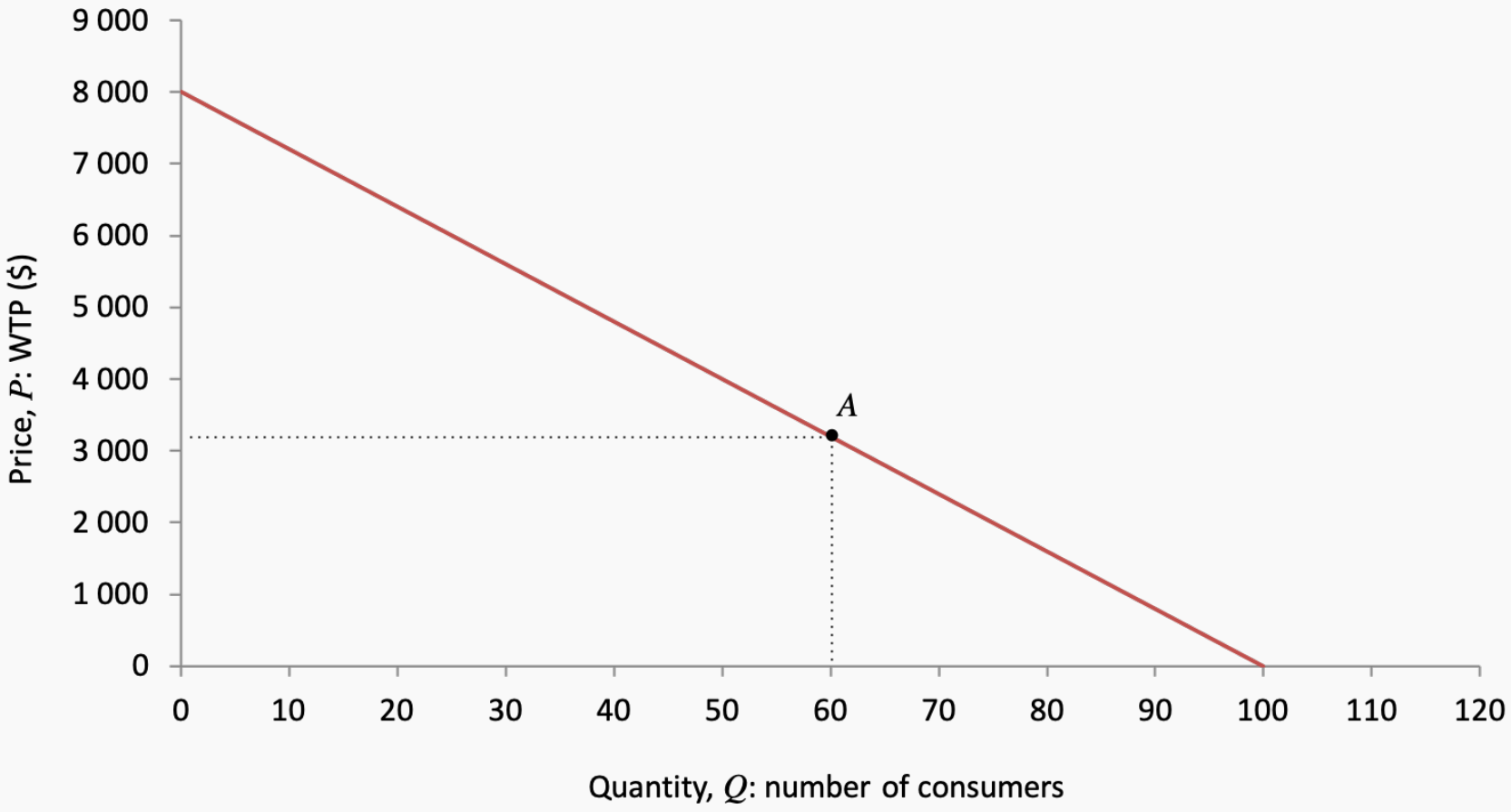


Figure. Two identical Google searches, one done from Zurich, Switzerland (top) and another from Mexico City, Mexico (bottom)

How to set prices?



Source: CORE, The Economy.

Auctions as a tool for selling stuff

- We start by considering a situation where a seller has a single item for sale and there are 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.

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 $[0, 100]$.
  - In practice, the distribution of such valuations could be estimated from past decisions, or modeled based on some assumptions.
- 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.

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 exits 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:

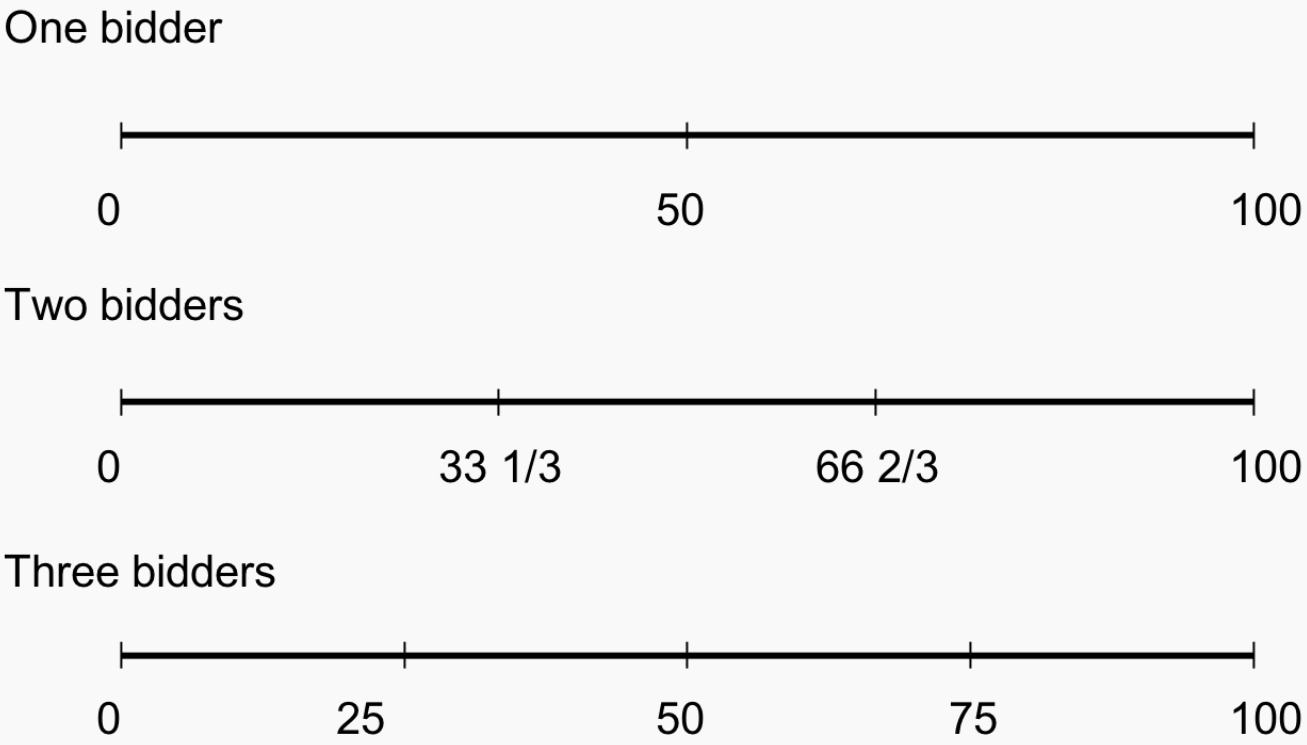


Figure. Expected bid values drawn from uniform $[0, 100]$ distribution as the number of bidders increases.

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.
- An auction can be costly for both the seller and the buyers.
  - Transaction costs, think of a traditional auction selling arts.
  - But also indirect costs for both sides (delay, hassle).
- 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.

Illustration: Trade-off between auctions and posting prices

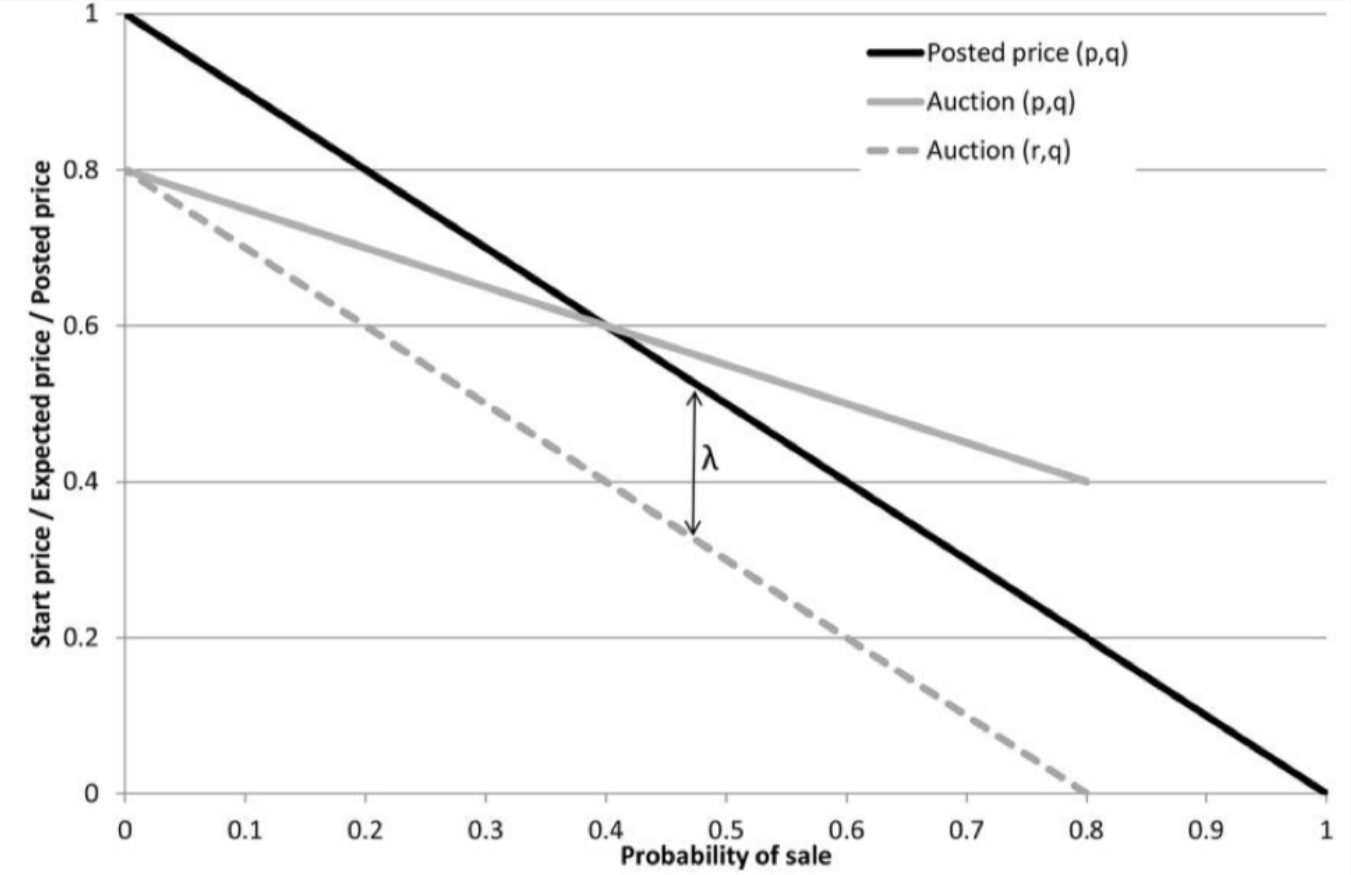


Figure. Trade-off between auctions and posting prices.

Figure: Einav et al. 2018.

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.
- 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?

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.
- Variation: Descending price auction
  - Price starts high, is lowered until someone buys.
  - Highest bidder wins and pays her 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, i.e. we are in incomplete information setting.
- 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.
- First discovered by Vickrey (1961), extended by Myerson (1981) and Riley and Samuelson (1981).

Revenue Equivalence Theorem

The Revenue Equivalence Theorem:

- Take any auction that allocates the goods efficiently and offers no profit to a zero value bidder.
- Each such auction has the same expected profits for every bidder valuation and the same expected revenue for the seller.

Revenue Equivalence Theorem

- Intuition: Auctions are a method to extract the valuations of bidders.
  - For each bidder it is 1) the probability of winning and 2) the expected price in the case of winning that matter.
  - In an equilibrium of the bidding game, a bidder correctly perceive how her bids map to the other bidders chances of winning and prices.
- It's assumed that bidders are subjective expected utility maximizers and can quantify the uncertainty over other bidders' private information.

Learnings today

- Auctions are an efficient way to organize markets.
  - They offer a method for price discovery and to induce competition.
  - Cost of arranging an auction low 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.

Materials for this week

Online resources (for Lecture 3):

- **Perfect competition**. www.core-econ.org 8.5 and 8.8.
- **Monopolies**. Here MRU section on Monopolies mru.org: Monopoly is better suited for the course than www.core-econ.org 7.5.1.
- **Oligopolies**. MRU on Cournot mru.org: Cournot.

Reading assignment 2 (for Lecture 4):

- Einav, Linar, Chiara Farronato, Jonathan Levin and Neel Sundaresan (2018) "Auctions versus Poster Prices in Online Markets". Very selective reading expected: Introduction, with the exception of the literature review in the end, and Section II.
- Easley, David and Jon Kleinberg (2010), Chapter 9 from "Networks, Crowds, and Markets: Reasoning about a Highly Connected World". Advanced material (9.7) not obligatory.

Next time

Market design

- Auction design
- Ad auctions
- Market design

Appendix

Auctions are loved by economists!

- Three Nobel prizes
- Including the 2020 prize to Paul Milgrom and Robert Wilson:
  - Common value auctions
  - Implementation of auctions
- Others main contributions
  - William Vickrey (1996): formal auction theory
  - Roger Myerson (2007): revelation principle

Additional topics in auctions: Common values

- In this course, we mostly assume 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.
- Here optimal bidding strategies change: you want to bid cautiously to avoid *Winner's curse* (see Appendix).

Additional topics in 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.

See Paul Milgrom's treatment on the topic in "Auctions and Bidding: A Primer." Journal of Economic Perspectives.
https://www.aeaweb.org/articles?id=10.1257/jep.3.3.3

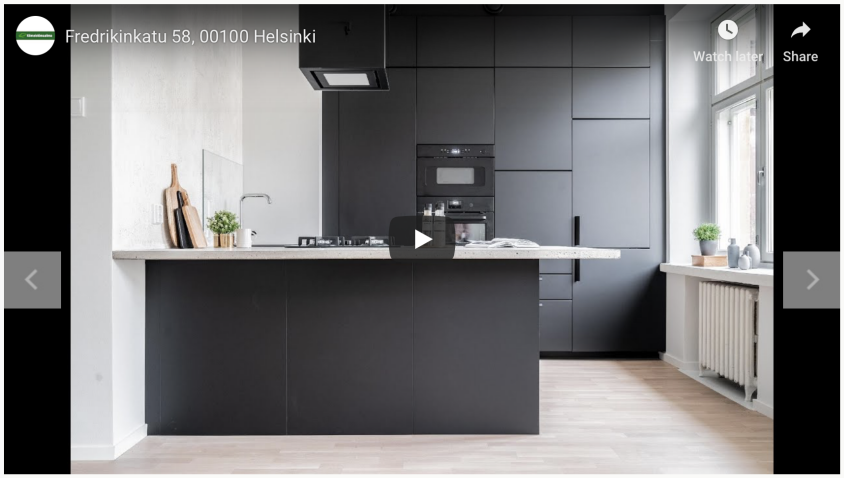
Additional topics in auctions: Other auction methods

- Auctions can be generalized to auctions when many identical items are sold simultaneously.
  - Uniform price auctions where all successful bidders get the same price.
  - Pay-as-bid auctions where each winning bidder pays her own price.
- 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

Example: Online auction for an apartment

Fredrikinkatu 58, Etu-Töölö, Helsinki

40 m² | KT, 1h, avok, kph, vh



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

Source: Kiinteistömaailma.

Example: Online auction for an apartment

Date	Bidder id	Bid
27.01.2019	1	347 000 €
25.01.2019	2	346 000 €
24.01.2019	1	345 000 €
23.01.2019	2	343 000 €
22.01.2019	1	342 000 €
20.01.2019	2	340 000 €
01.01.2019	3	337 000 €
30.12.2018	4	336 000 €
29.12.2018	3	335 000 €
27.12.2018	4	332 000 €
25.12.2018	3	331 000 €
25.12.2018	4	329 000 €
23.12.2018	3	328 000 €
22.12.2018	4	326 000 €
21.12.2018	3	324 000 €
20.12.2018	5	319 000 €
20.12.2018	3	318 000 €
19.12.2018	4	315 000 €
19.12.2018	6	307 000 €
19.12.2018	3	306 000 €

ECON-C5100 Digital Markets

Iivo Vehviläinen

January 24, 2022

Aalto University
iivo.vehvilainen@aalto.fi

Lecture 5: Market design

Agenda

Last week

- Industry structure
- Auction theory

This week

- Designing markets, the case of ad auctions
- Online markets

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?

Revelation principle

Given the vast amount of possibilities, is there hope to determine the best possible design? Somewhat surprisingly: Yes!

- Definition of the game:
  - Suppose that we have buyers with a type (private value) v_i and a seller able to commit to some mechanism Γ to sell an item
- Alternative game: Direct mechanisms
  - When reported type v, the seller allocates the good with probability $q(v)$ if the buyer pays $t(v)$
- The *Revelation principle*:
  - Given Γ, a buyer with type v_i chooses the best response $\sigma(v_i)$
  - For every Γ and equilibrium σ there is a *direct* mechanism Γ' which 1) gives the same expected allocation and payoffs as with σ and 2) it is optimal for the buyer to report the true type
  - Task to design allocation and payment rules that are *incentive compatible* and *individually rational*.
- Deeper look in the theory left for further classes.

Designing auctions – Auction mechanisms

- From last week, 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, in particular by
  - Introducing reserve prices.
  - Increasing competition.

Effect of reserve prices to revenues

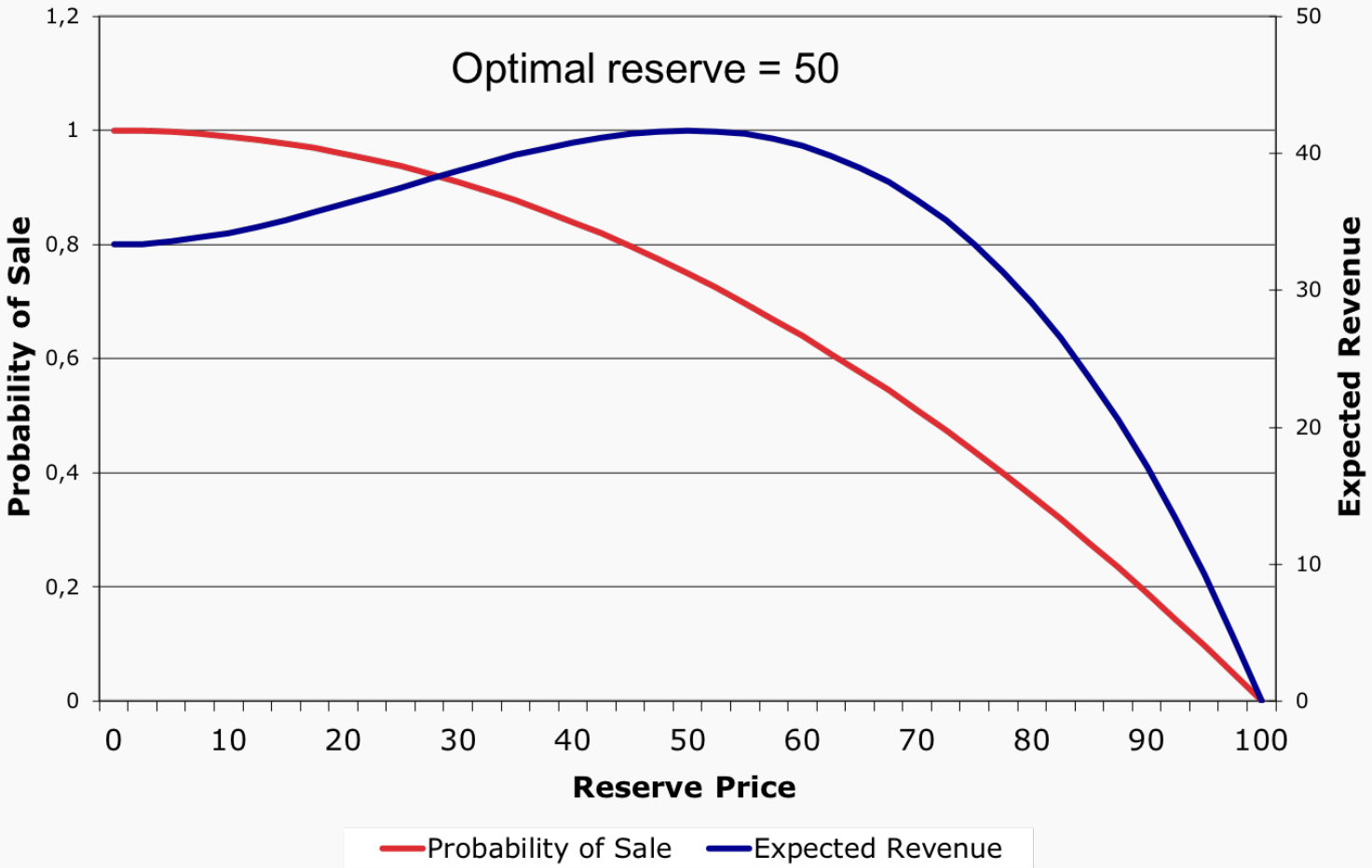


Figure. Optimal reserve price for N=2 in an ascending price auction.

Figure: J. Levin.

Optimal mechanisms

- Myerson (1981): Expected revenue maximizing auction is the second price auction with a reserve price.
  - With some assumptions on buyer valuations (independently drawn from a regular distribution).
- But reserve prices can introduce inefficiency:
  - If the reserve price is not met, then there is no trade even though some buyer might have been willing to buy above cost.
- Trade-off between efficiency and extracting information.

Trade-off between reserve prices and competition

- What if the number of buyers is not fixed? Is more competition or optimal reserve prices better?
- Bulow-Klemperer (1996) find:
  - The expected revenue of the second-price auction on $n+1$ agents is at least the expected revenue of the optimal auction on n agents.
- For the seller, it is better to recruit one more bidder for a second-price auction without a reserve price than to run the optimal auction with reserve price.

Now to ad auctions

Global ad spend estimated to be 650 billion U.S. dollars in 2020:

- 30 % to TV
- 23 % to Google
- 13 % to Facebook

Source: CNBC, 24 Oct 2019.

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, rehabilitation.
  - Offer a payment per click.
- Google arranges separate ad auctions for *every query*.
  - Conditional on sufficient number of bidders.
- Ad space also auctioned outside Google search.
  - Various mechanisms, including first price auctions.

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

This leads to:

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

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 bid their values of 10, 5, 2 cents.
- Market clearing prices are determined by the bid (in cents) of the bidder below the winner.

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

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

Goolge ad auctions

- In addition to the auction method above, Google uses a measure for "ad quality":
  - The quality of ad affects 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).
- Potential loss in the efficiency of the monetary allocation.

In-class exercise: Ad auction

- Your private value for the ad position, i.e. the maximum price you are willing to pay per click is
  - Take the last two digits of your student number
  - As an example, I'd have 96 (IIRC)
- You will design an ad and place a bid to get the ad published.

In-class exercise: Ad auction

Bidding rules:

- The ad can be shown in one of two slots.
- You will place a bid in terms of ¢ per click.
- These bids will be multiplied with ad quality.
  - Ad quality is determined by the votes that your ad gets.
- The highest quality weighted bid will get the first slot and the second highest the second slot.
- The winners pay the minimum amount needed to retain their positions.
- Payoff is the difference between the payment and your value, times the number of clicks.

In-class exercise: Ad auction

As an example Iivo V. could bid of 96 ¢ for his ad as follows:

> Economics is your new superpower, click to learn more! (96).

Use the vote in Presemo presemo.aalto.fi/digimar to place bids.

Discussion.

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.

Materials for this week

Reading assignment 3:

- **Ad auctions**. Easley, David and Jon Kleinberg (2010), Chapter 15 from "Networks, Crowds, and Markets: Reasoning about a Highly Connected World". Read at least Sections 15.1, 15.5, and 15.7.
- **Online markets**. Levin, Jonathan (2011) "The Economics of Internet Markets", NBER Working Papers 16852. Read Section 4.
- **Macro impacts**. Cavallo, Alberto (2018) "More Amazon effects: Online competition and pricing behaviors", NBER Working Paper 25138. Sections I Introduction and VI Conclusions enough.

Next time

Online markets

- Frictions between buyers and sellers
- Use of data
- Macro impacts

Appendix

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.

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 1: Impact of competition to sales.

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

Example from eBay auctions

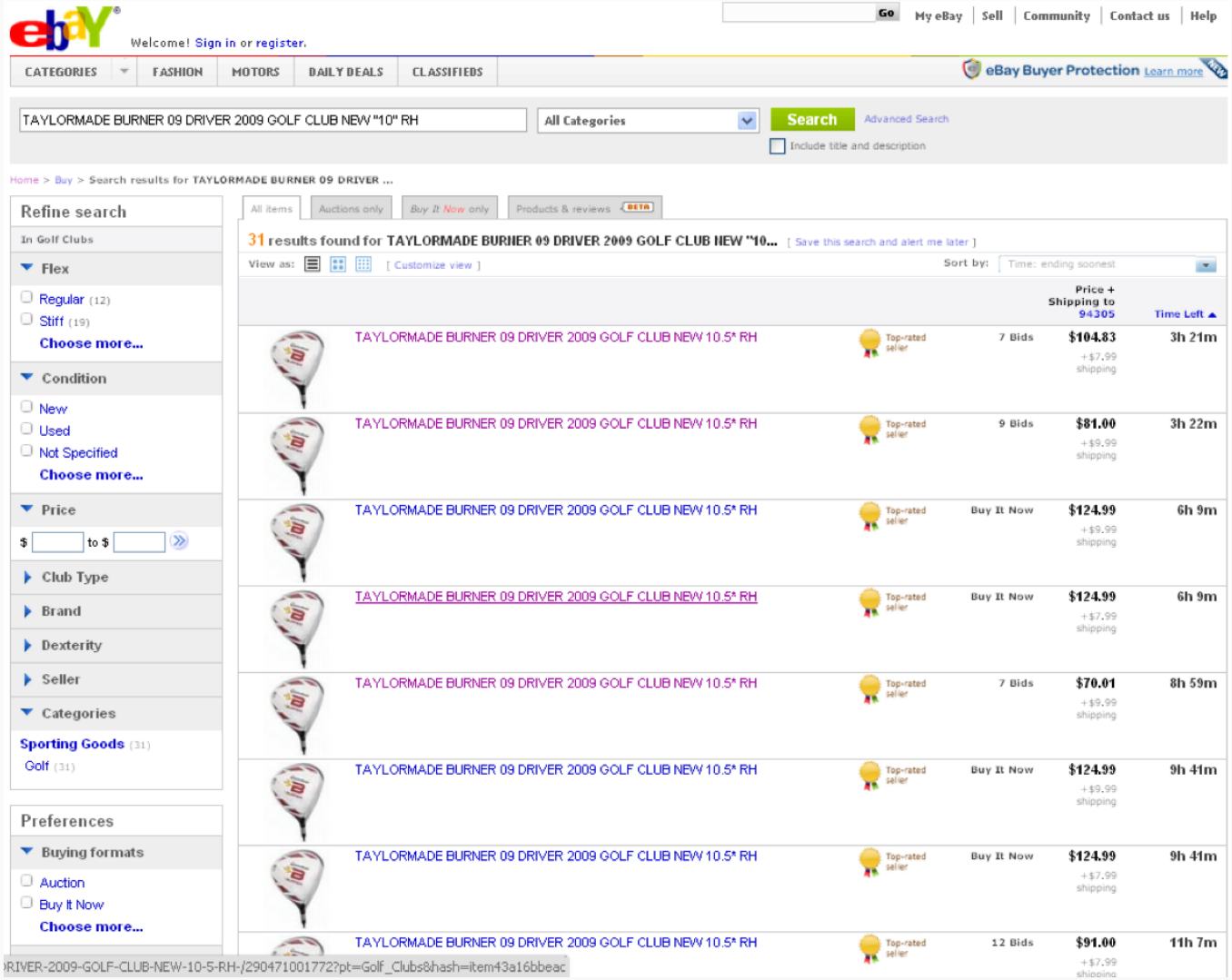


Figure: Einav et al. 2012.

Example from eBay auctions

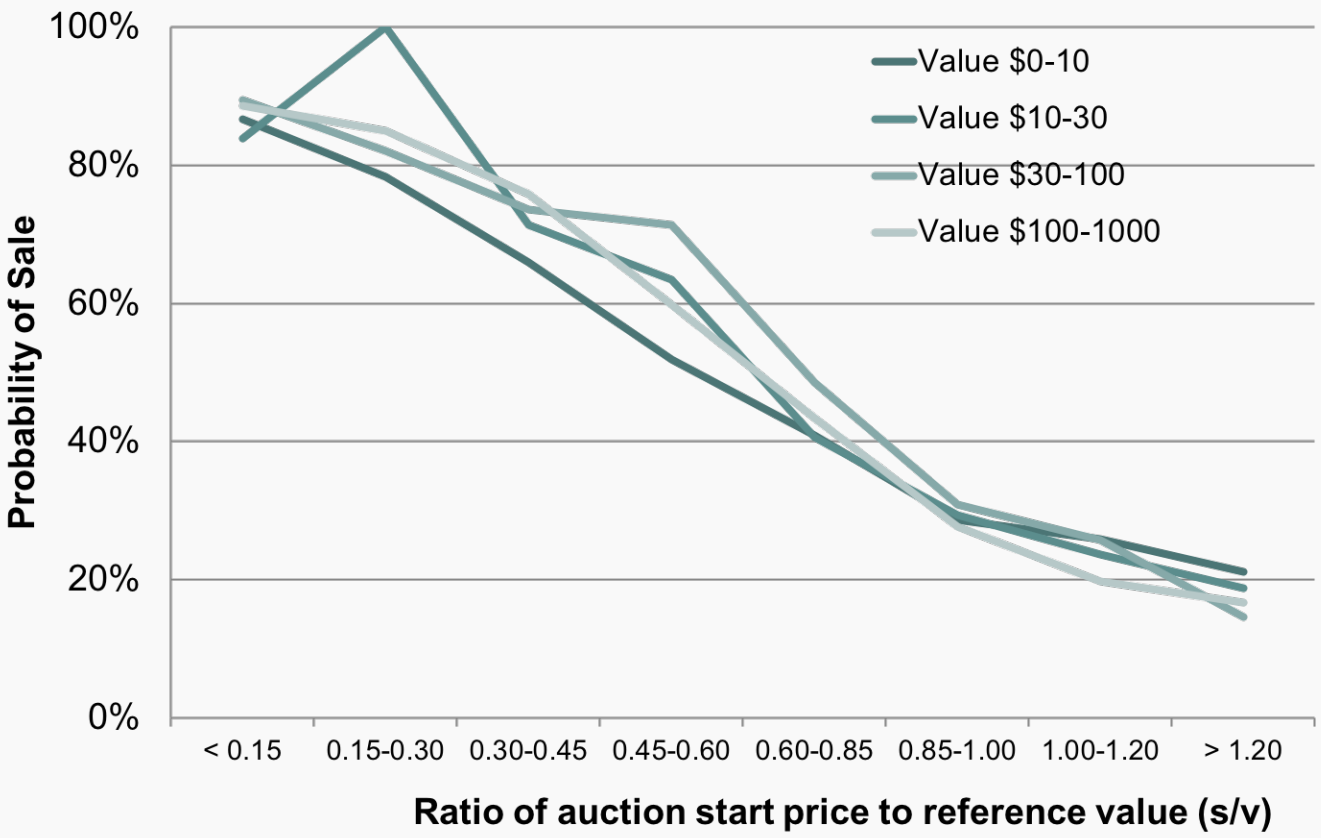


Figure. Impact of reserve price to sales probability.

Figure: Einav et al. 2012.

Example from eBay auctions

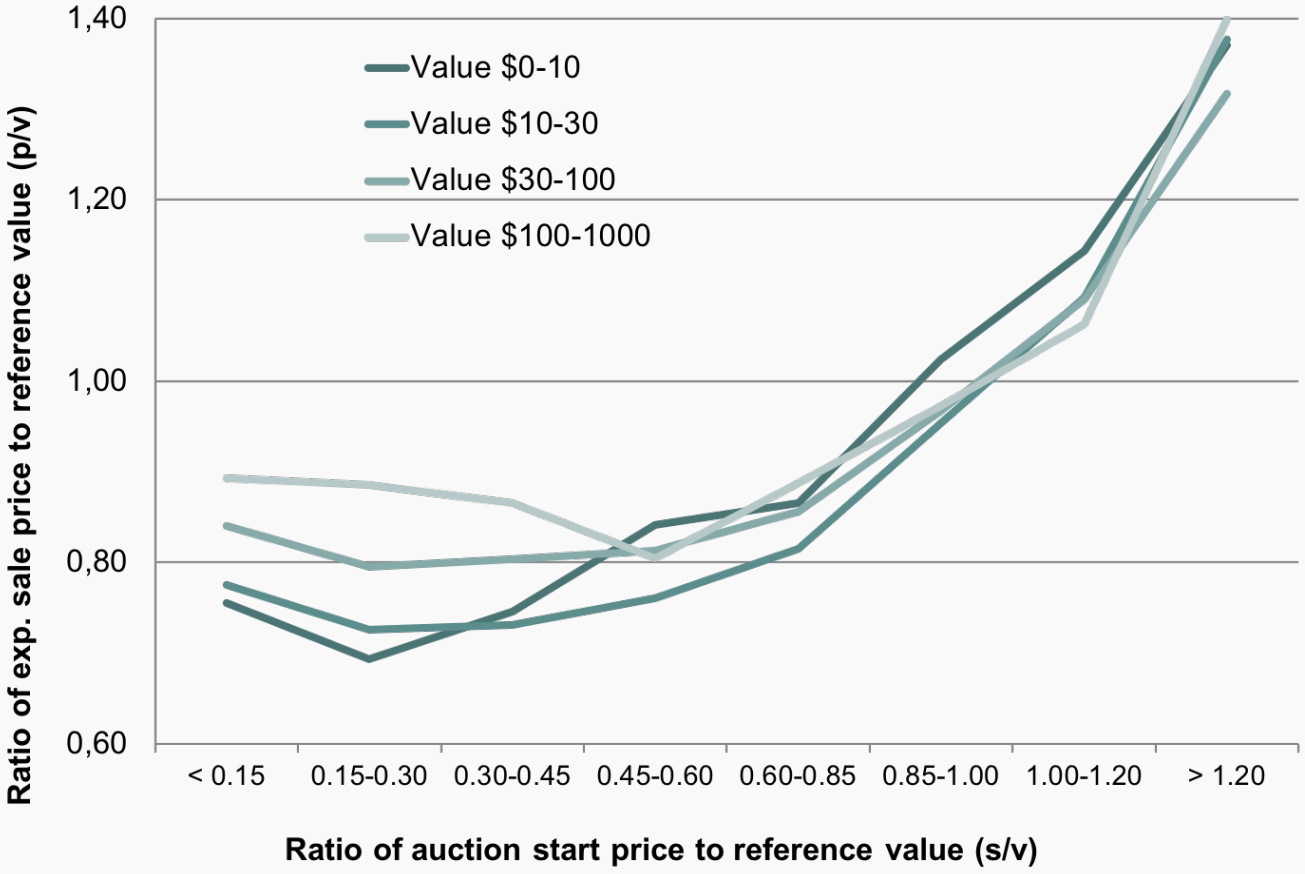
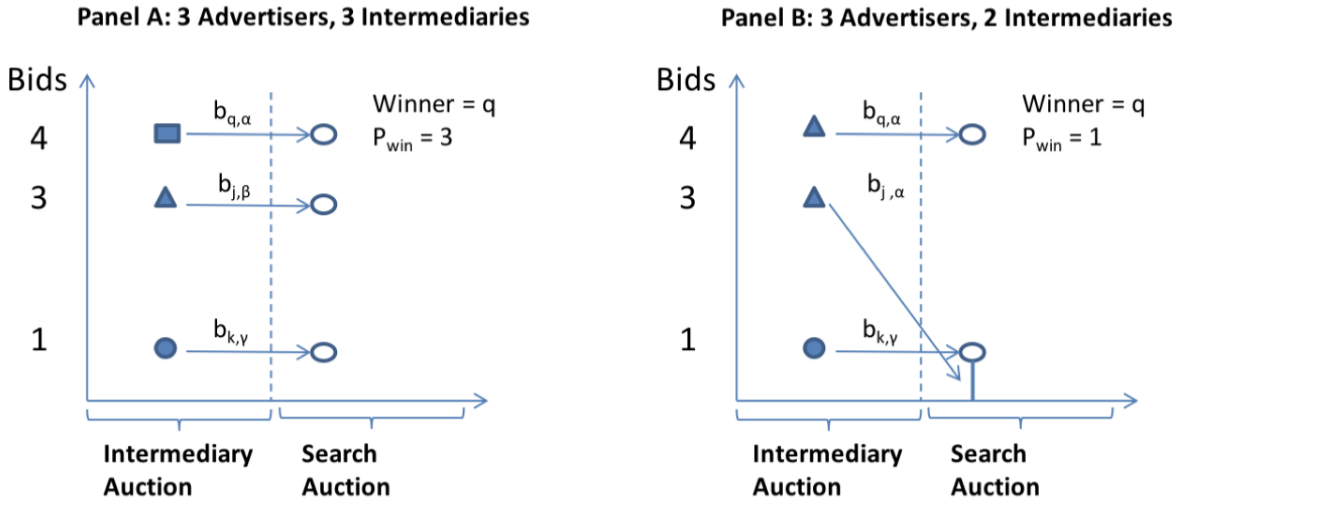


Figure. Impact of reserve price to revenues.

Figure: Einav et al. 2012.

Does it matter if auction scheme is not optimal in theory?



Notes: There are three advertisers (q, j and k) submitting arbitrary bids ($b_q = 4$, $b_j = 3$ and $b_k = 1$) to a second price auction held by the intermediary to which they are affiliated. In panel A, each advertiser has a different intermediary (α, β and γ). In panel B, q and j share intermediary α. The arrows indicate how the intermediary translates the bids in its own auction into the bids placed on the search auction. In panel A, bids are transmitted without distortions; in panel B, j's bid is reduced. q wins in both cases, paying the second highest bid which is either 3 (panel A) or 1 (panel B).

Figure. Example of how an ad intermediary can affect auction outcomes.

Decarolis and Rovigatti, 2019.

Further detail on auctions

- Generalized second price auction
  - Adopted early, dominant in search ad auctions.
  - "Easy" to understand.
  - Exposed to collusive bidding strategies.
- Vickrey-Clarke-Groves (VCG)
  - The winning bidder pays the cost their presence imposes on the other bidders.
  - Flexible, e.g. sell only 1 big ad for 3 slots.
  - Strategy proof: Always optimal to bid truthfully.
  - Collusion less of a concern.
  - More complex to understand.
- All auction forms have advantages and disadvantages, no single best mechanism.

Varian and Harris, 2014; Decarolis, Goldmanis and Penta, 2019.

ECON-C5100 Digital Markets

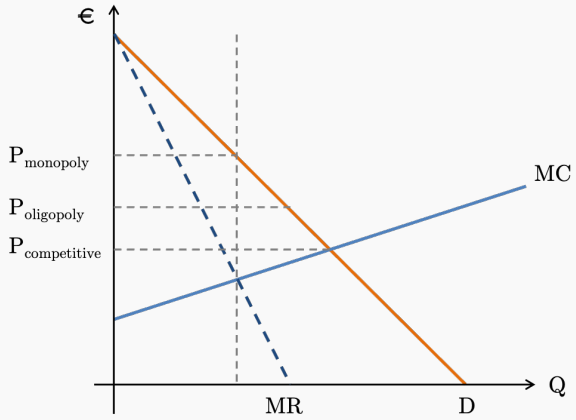
Iivo Vehviläinen

January 26, 2022

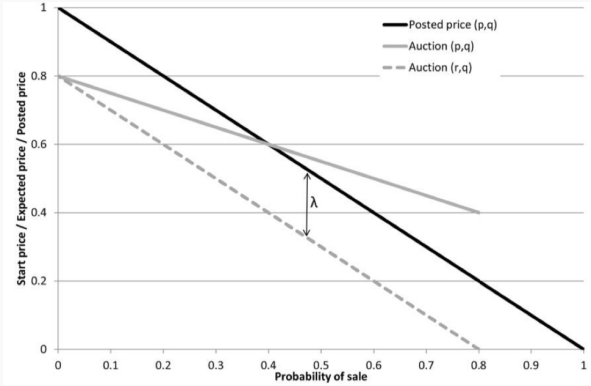
Aalto University
iivo.vehvilainen@aalto.fi

Lecture 6: Online markets

Happened previously: Trade-offs in market design



N	E[revenue]
1	0
2	33
3	50
4	60
5	67



`left:` Competition between the sellers lowers prices.

`mid:` Competition between the buyers leads to better deals for the sellers.

`right:` Hassle cost: e.g. trade-off between auctions and posting prices.

Figure on the right: Einav et al. 2018.

Outline

- Frictions between buyers and sellers
- Use of data
- Wider economic effects

Reminder: Reducing frictions in trade

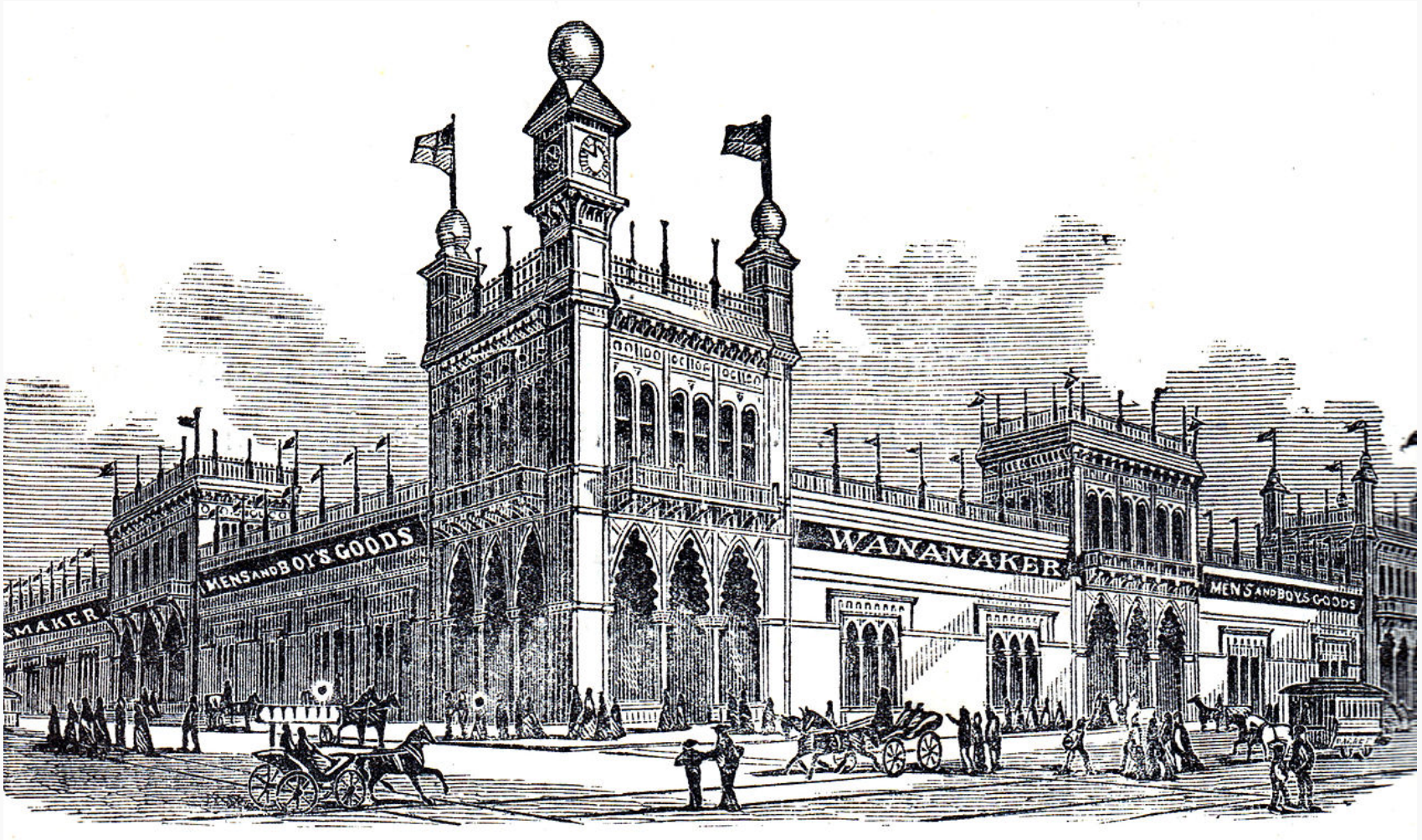


Figure: WikiCommons.

Online marketplace: Conflicting incentives?

Low cost for buyers:

- Transparent and low prices attract buyers.
- To serve buyers, marketplaces want 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 (price obfuscation).

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 and/or data.
   - Or through advertising or product recommendations.
   - Or based on the private interests of the marketplace.
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.

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

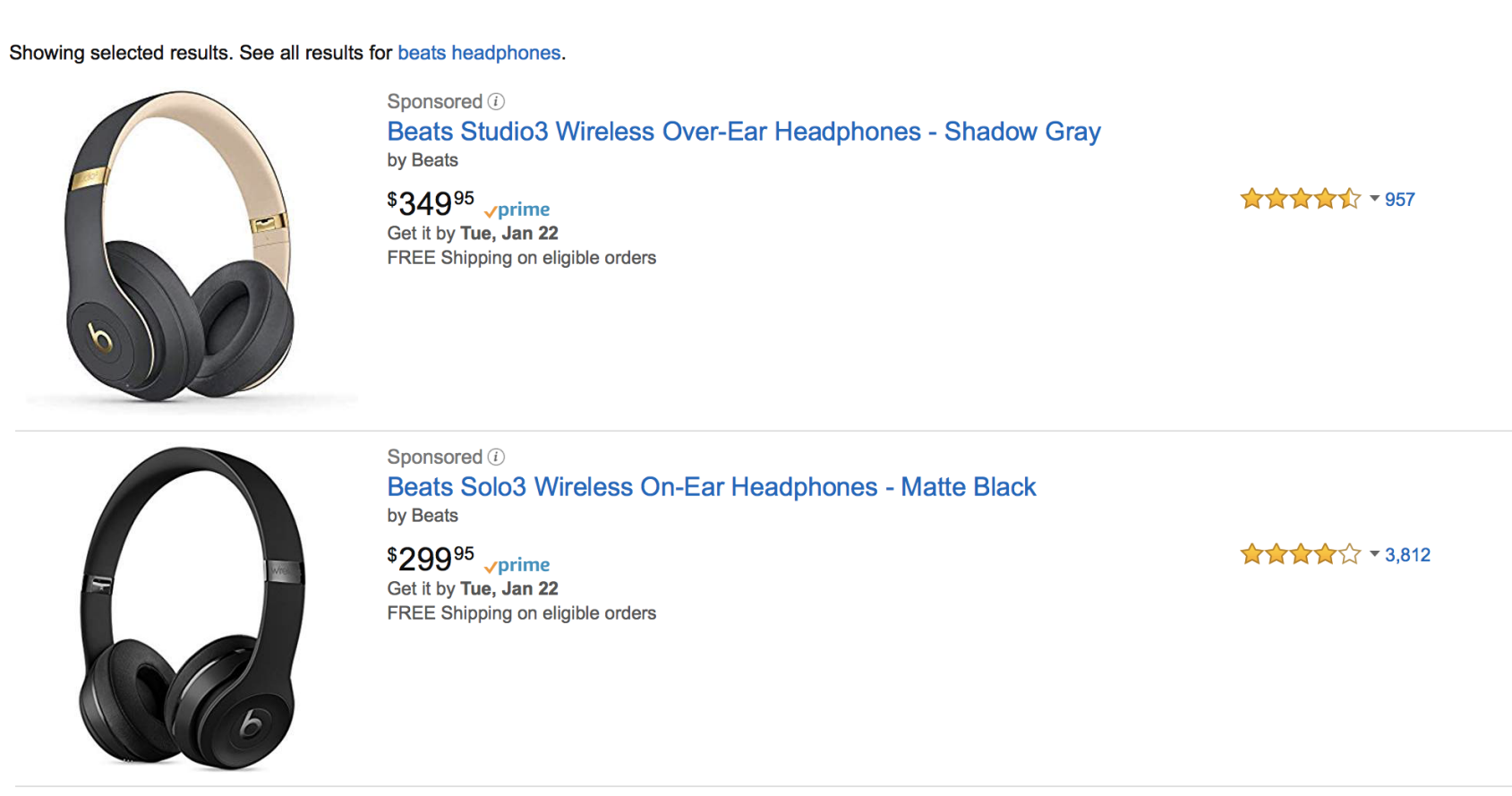


Figure: Amazon.

Example: Search in eBay (U.S.)

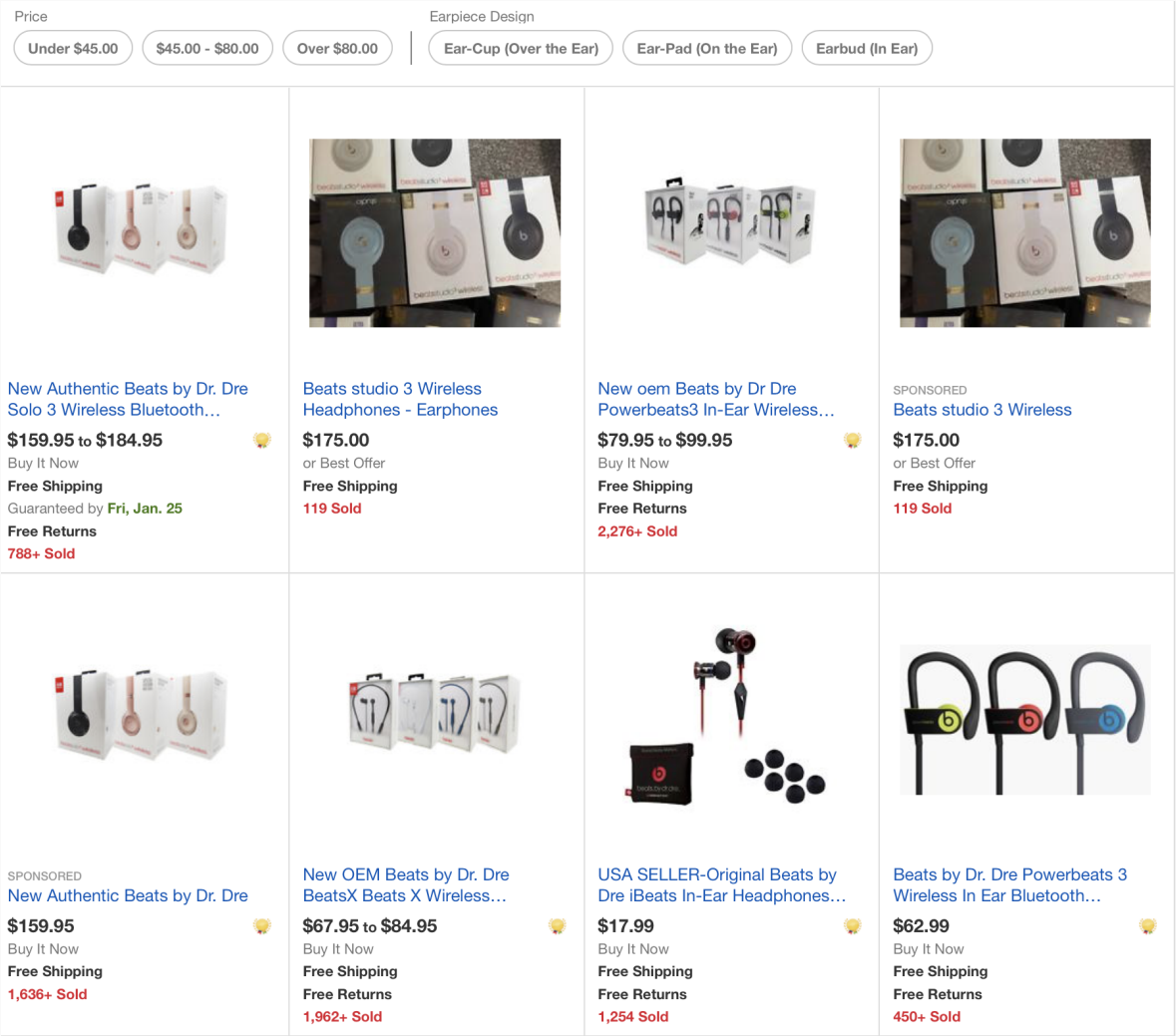


Figure: eBay.

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 ($\rightarrow$ moral hazard problem).
- The available customer choices will start to affect the pricing (and other) decisions by the sellers.

See the example from eBay in the Appendix.

Simple consumer search model

- Consider a simple search model, where the utility of buying product with price p and characteristics x is given by

$$u(p, x, \gamma) = \gamma x - p,$$

  where γ describes the consumer preferences over the characteristics.
- Consumers search through alternatives, but this has a cost s.
- Consumers with $s = 0$ buy the product with highest utility and consumers with $\gamma = 0$ buy the cheapest product.
- If the consumers are assumed to have some prior understanding on the distribution of the potential values, then the optimal search rules can be written out and solved.

Source: Weitzman, (1979).

Illustration: Search options

Example of options to buy a CD (this is from 2007...).

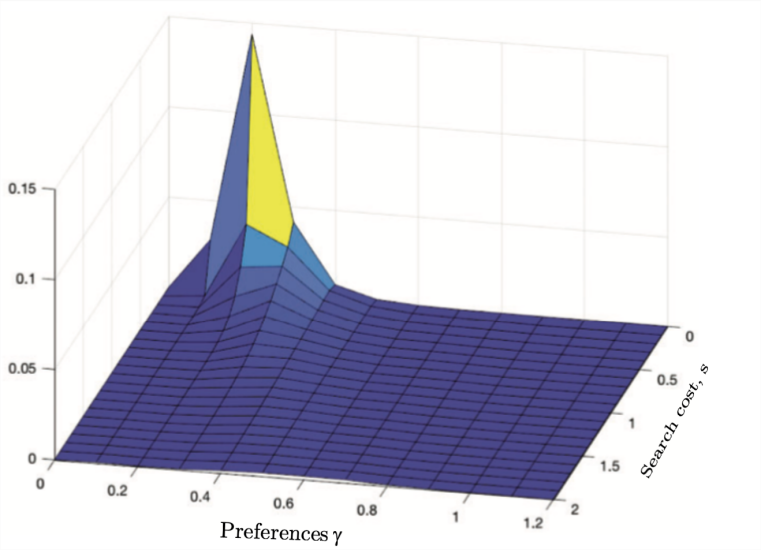


Figure. Estimated distribution of preferences γ and implied costs s. Largest mass at $s = 0$ and $\gamma = 0.2$: consumers care about non-price characteristics.

Jolivet and Turon (2019).

In-class exercise: Search costs

Go to Amazon.com. Find the cheapest price for the product with following specifications:

- A sleeve for a laptop.
- Needs to be a good fit for a 2021 MacBook Pro 14".
- Sustainable.
- Ships to Finland.

Use the chat in Presemo presemo.aalto.fi/digimar to report your price and the link.

Use of data

- 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.

Law of one price

- 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

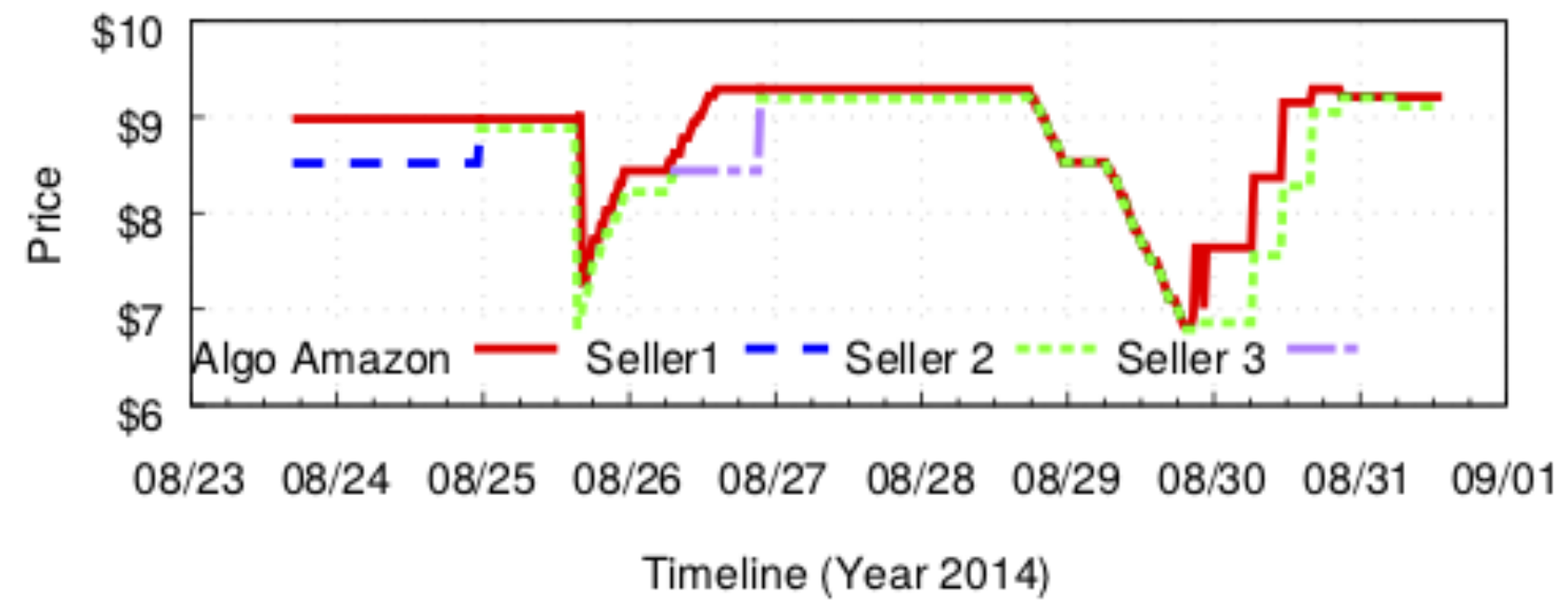


Figure. Example of Amazon matching the lowest seller.

Source: Chen et al. 2016.

Example: Dynamic pricing

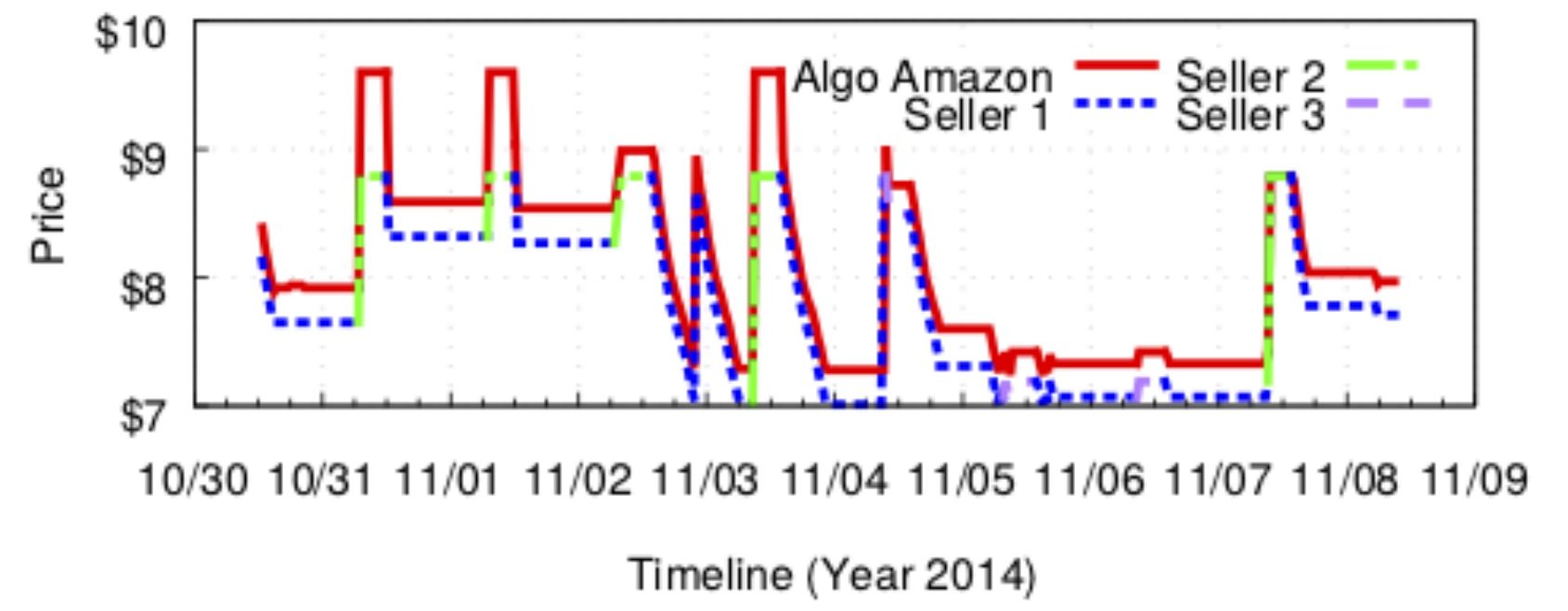


Figure. Example of Amazon keeping a premium over other sellers.

Source: Chen et al. 2016.

Algorithmic collusion?

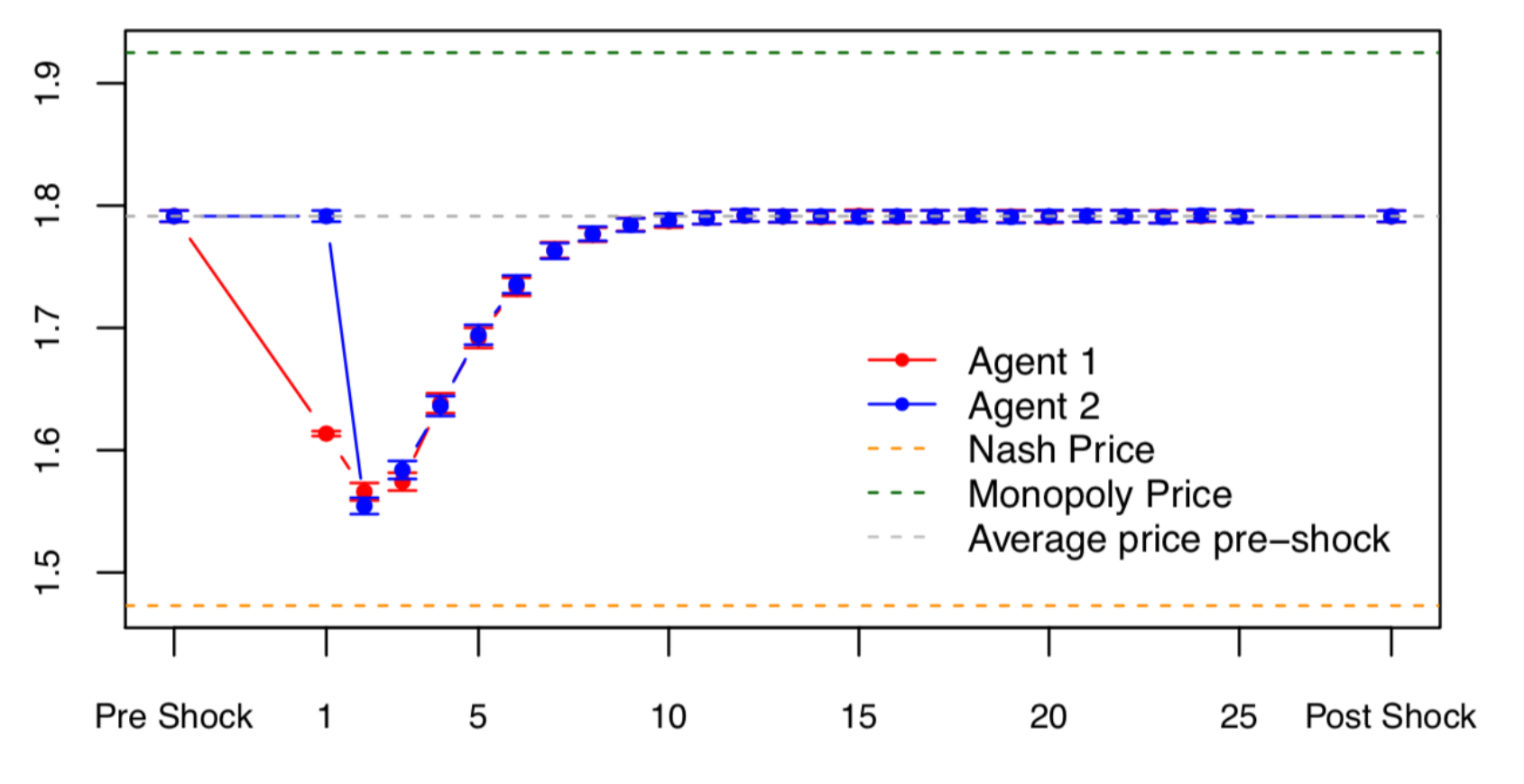


Figure: Calvano et al. 2019.

Product steering

- Reminder: If a firm has market power, but can only set one price:
  - The price will be based on the marginal benefit to the company (set to equal the marginal cost).
  - There will be a loss in efficiency.
- Similarly: If a firm has market power, but can only set one quality level:
  - The quality will be based on the tastes of the marginal user.
  - There will be a loss in efficiency.
- Product steering is one way to "discriminate" on quality.

Source: Spence, 1975.

Product steering

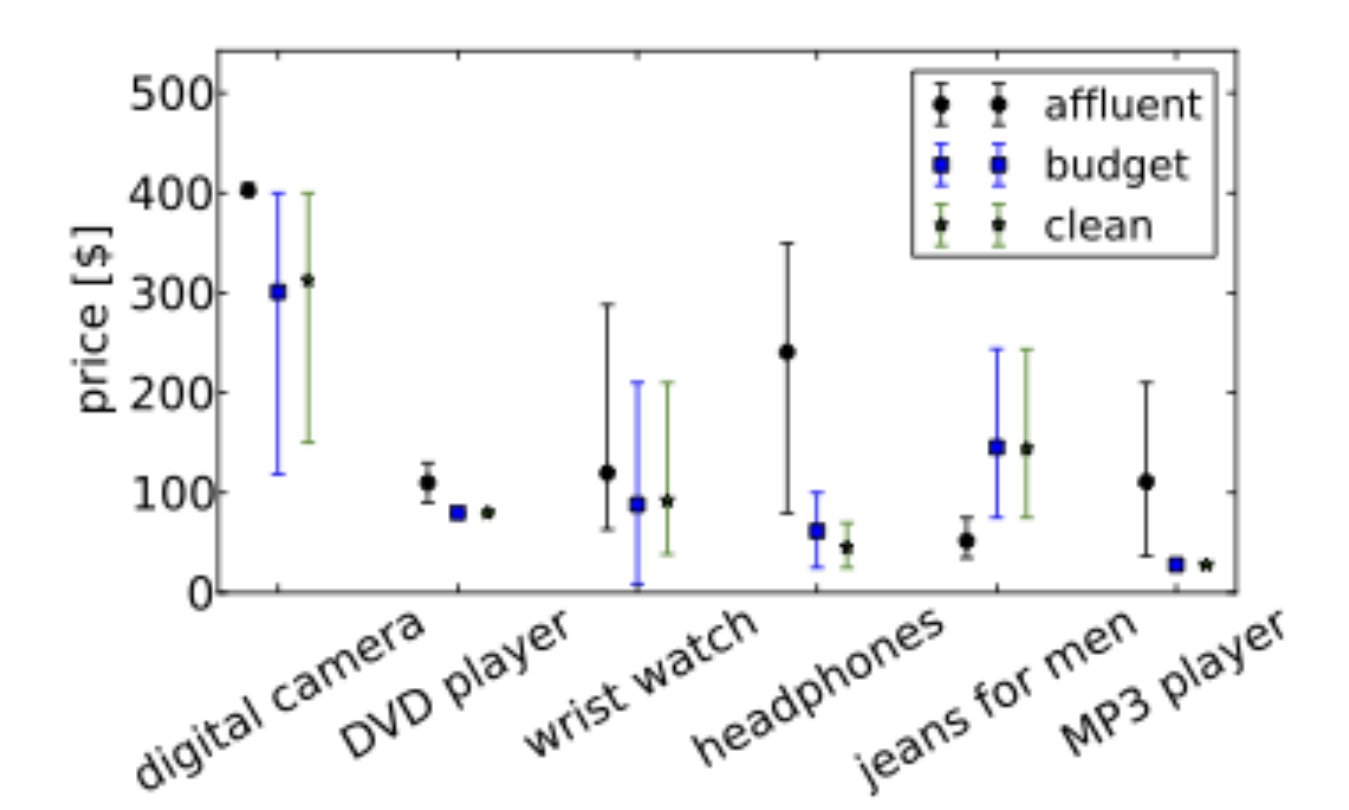


Figure. Example of the use of data to steer product selection, see e.g. the prices offered in headphones or MP3 players.

Figure: Mikians et al. 2012.

Product steering – Amazon and moral hazard

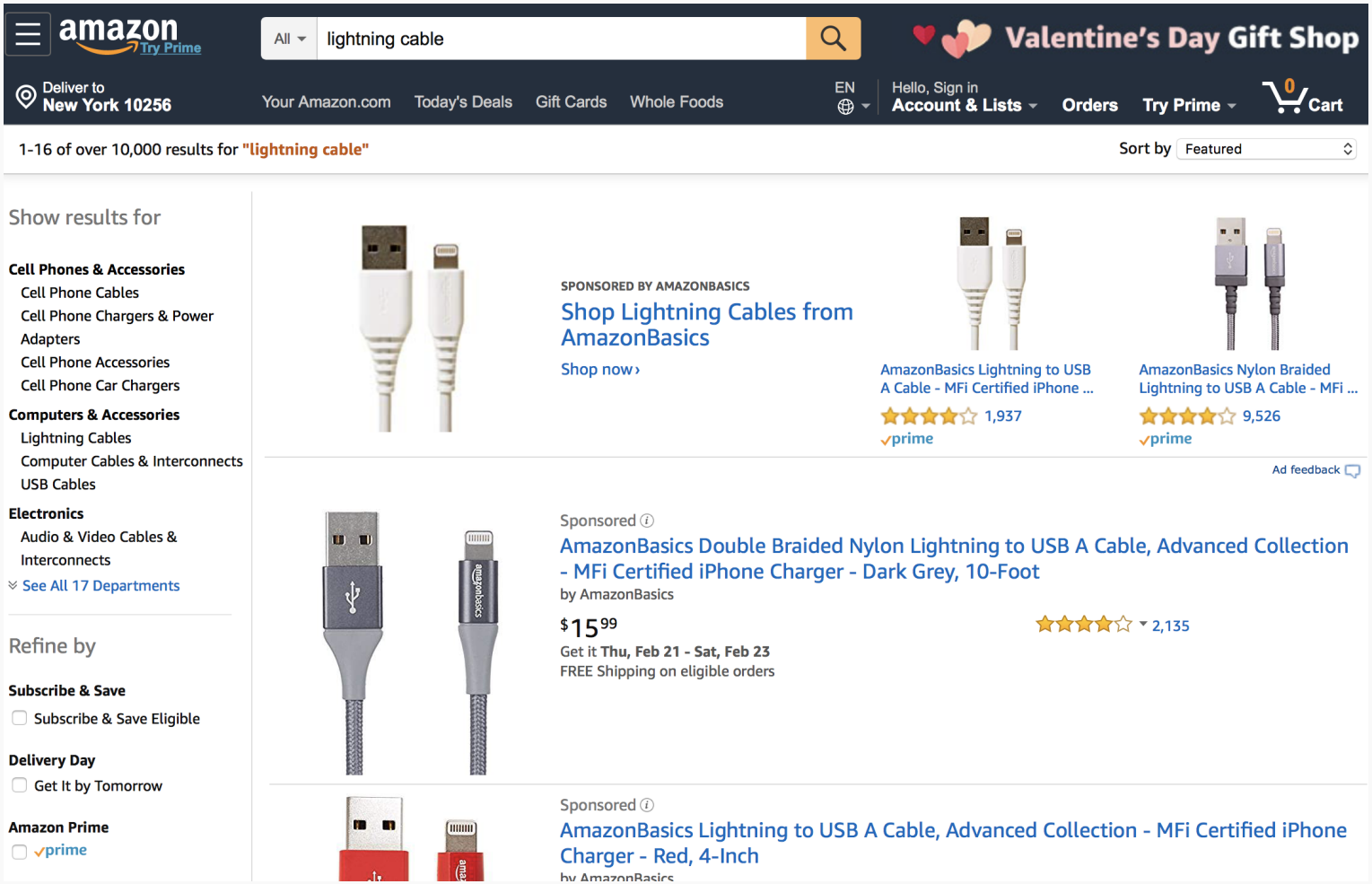


Figure. Example of Amazon search for "lightning cable" (1/3).

Figure: Amazon.

Product steering – Amazon and moral hazard

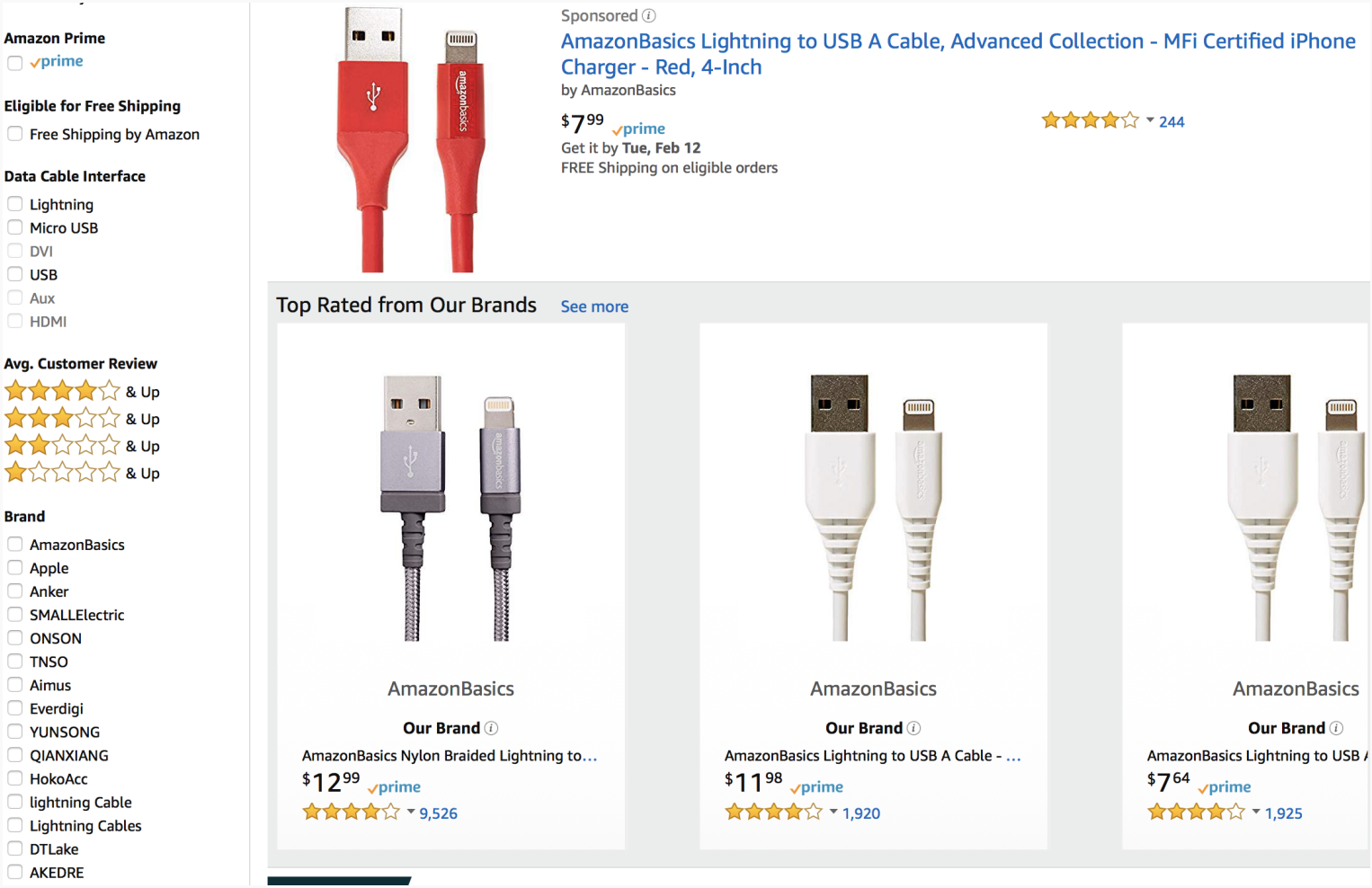


Figure. Example of Amazon search for "lightning cable" (2/3).

Figure: Amazon.

Product steering – Amazon and moral hazard

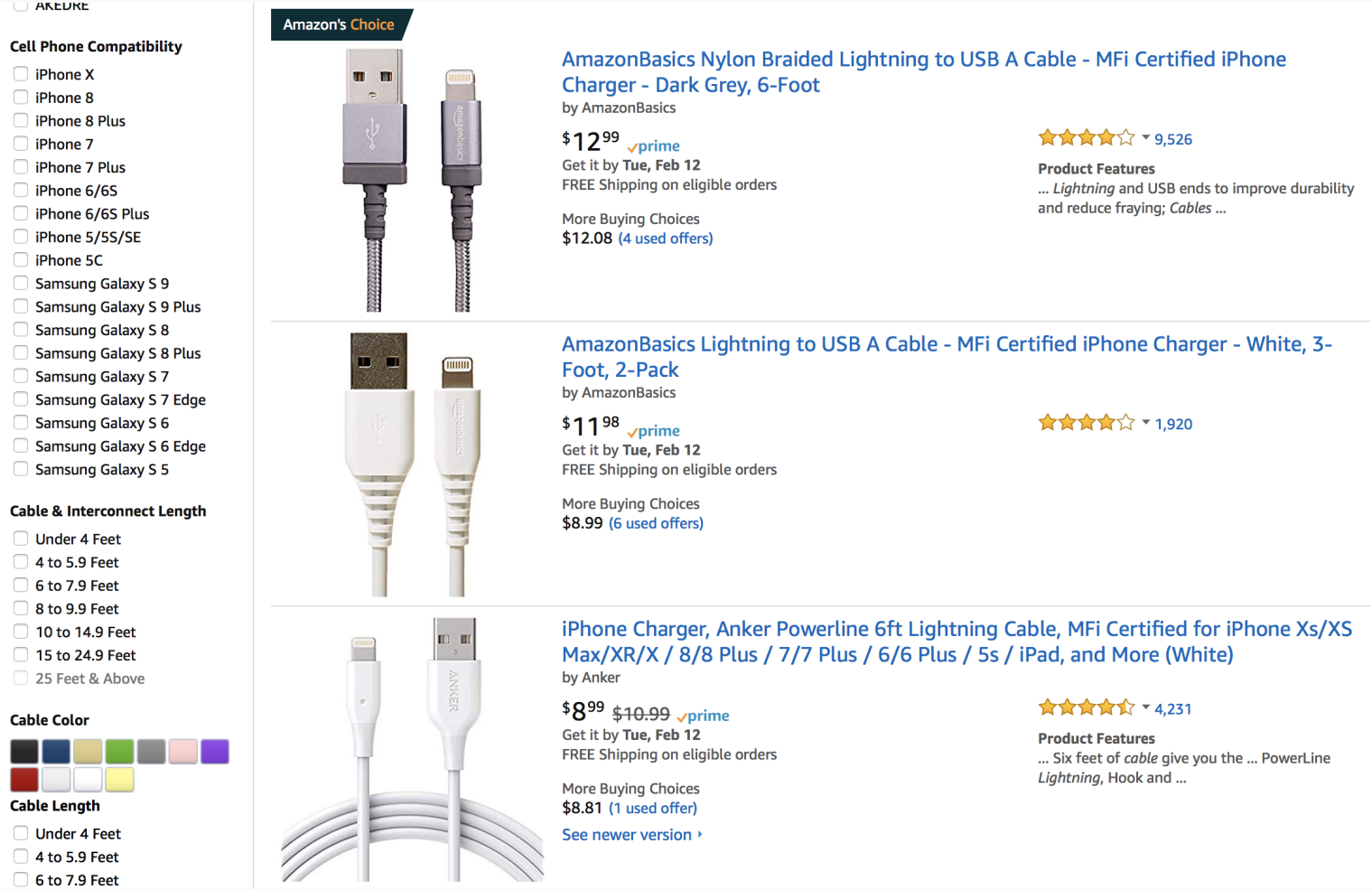


Figure. Example of Amazon search for "lightning cable" (3/3).

Figure: Amazon.

Price discrimination

- Product steering and price discrimination are ways by which the firm tries to extract the maximum amount you are willing to pay.
- 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).

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".
- Arguments against price discrimination:
  - Transparency of online prices.
  - The fear of antagonizing customers, e.g. in 2000, Amazon was caught selling the 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."
  - Other firms can learn from your profiling (see Appendix).

Amazon effects

- 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.

Amazon effects: Price changes

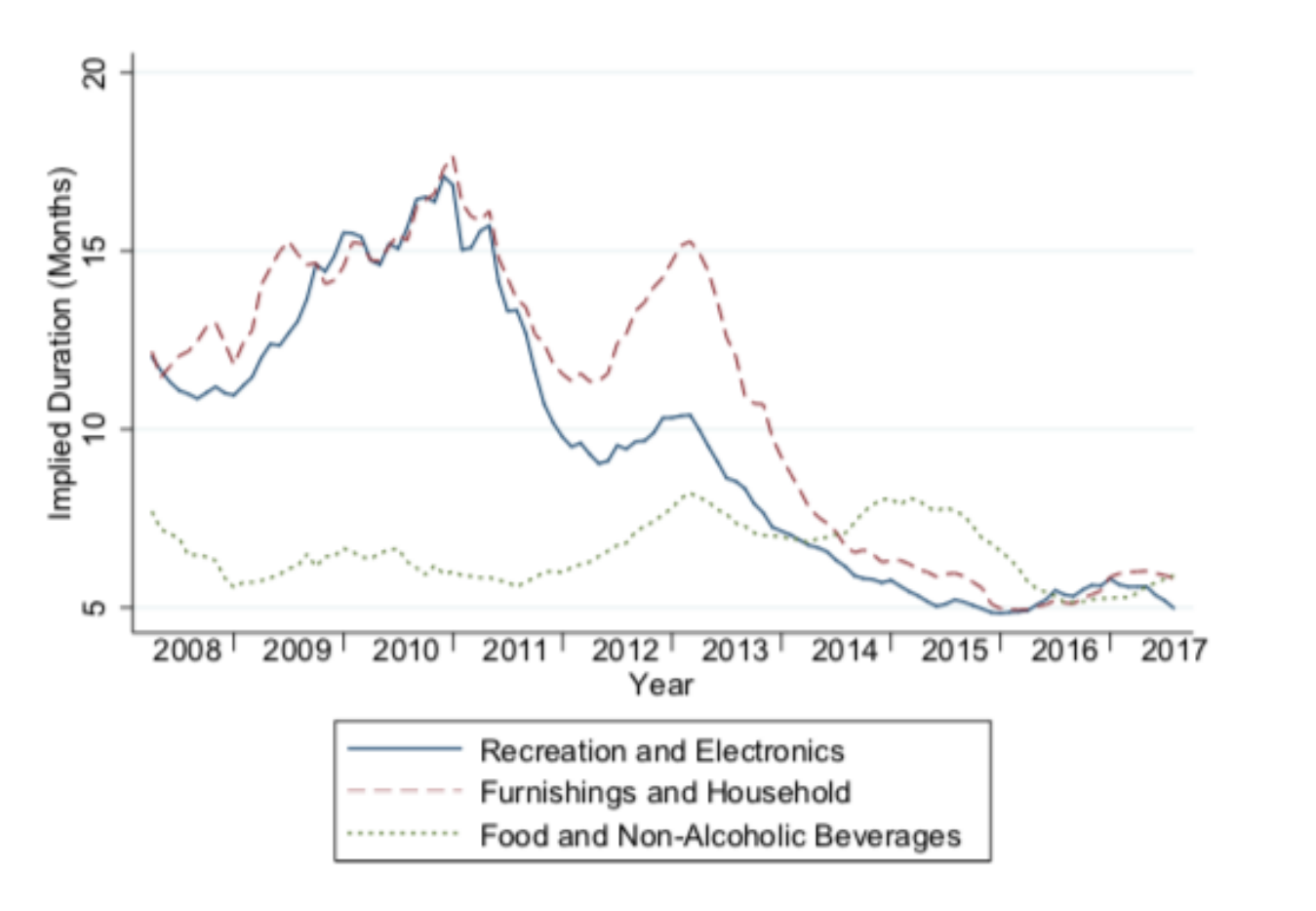


Figure. Entry of Amazon to some sector seems to increase the rate of price changes that the offline retailers make.

Source: Cavallo, (2018).

Amazon effects: Price discrimination

Table 5: Uniform Pricing for Walmart's Grocery Products Found on Amazon

	Share of Identical		Average Price Difference	
Found on Amazon	0.058	0.055	-1.979	-1.891
	(0.008)	(0.008)	(0.306)	(0.309)
Zip Codes Sampled		0.002		-0.044
		(0.000)		(0.017)
UE Rate Difference		-0.006		0.386
		(0.002)		(0.071)
Constant	0.914	0.921	2.939	1.794
	(0.004)	(0.009)	(0.152)	(0.386)
Observations	3,982	3,949	3,778	3,746
Obs. on Amazon	934	929	908	903
R-squared	0.022	0.031	0.014	0.024

Notes: The dependent variables are measured using prices collected from multiple zip codes in March 2018. The variable "Found on Amazon" is a dummy that identifies whether the product was found by a scraping robot that searched for the first 100 characters of the product description on Amazon's website. Fixed effects are computed using the product's COICOP 3-digit category. Standard errors are in parentheses.

Table. Impact of Amazon to price dispersion in Walmart's grocery products.

Source: Cavallo, (2018).

Overall gain from online shopping to consumers

- Share of online trade in the U.S. reached 10 % of in 2017.
- Variety gain (ca. 1 % of consumption):
  - 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 (ca. 0.4 % of consumption):
  - Consumers can purchase the same product online that they may have previously purchased at a brick-and-mortar store without making a physical trip.

Source: Dolfen et al. 2019.

Implications of online markets

- Increase in competition between online and offline retailers can lower markups, and prices.
- After the competitive channel is exhausted, more permanent change in the wider economy may result as the pricing patterns change both online and offline.
- May benefit the consumers as productivity gains are passed on to prices quicker.

Source: Cavallo, (2018).

Learnings today

- Online markets increase efficiency and result in permanent changes to the economy.
- Yet online marketplaces face a trade-off:
  - Reduce search frictions to benefit buyers.
  - Attract sellers by allowing for higher margins.
- Data collected online presents firms with new opportunities: dynamic pricing, price discrimination, and product steering.

Materials for this week

Reading assignment 3:

- **Ad auctions**. Easley, David and Jon Kleinberg (2010), Chapter 15 from "Networks, Crowds, and Markets: Reasoning about a Highly Connected World". Read at least Sections 15.1, 15.5, and 15.7.
- **Online markets**. Levin, Jonathan (2011) "The Economics of Internet Markets", NBER Working Papers 16852. Read Section 4 (you are not expected to memorize who wrote what, focus on the economics and empirical evidence given).
- **Macro impacts**. Cavallo, Alberto (2018) "More Amazon effects: Online competition and pricing behaviors", NBER Working Paper 25138. Sections I Introduction and VI Conclusions enough.

Next time

- Networks
- Network effects
- Model of fulfilled expectations

Appendix

Online marketplaces: Competition and selection

- Marketplaces will be competing with each other.
  - Direct price (transaction costs) competition would eat all the margins.
  - Would seem to make sense to compete in other dimensions.
- Both buyers and sellers will select to the marketplace that fits their preferences best.
- Enough to recognise the issues for now: We'll return to these questions later in the course.

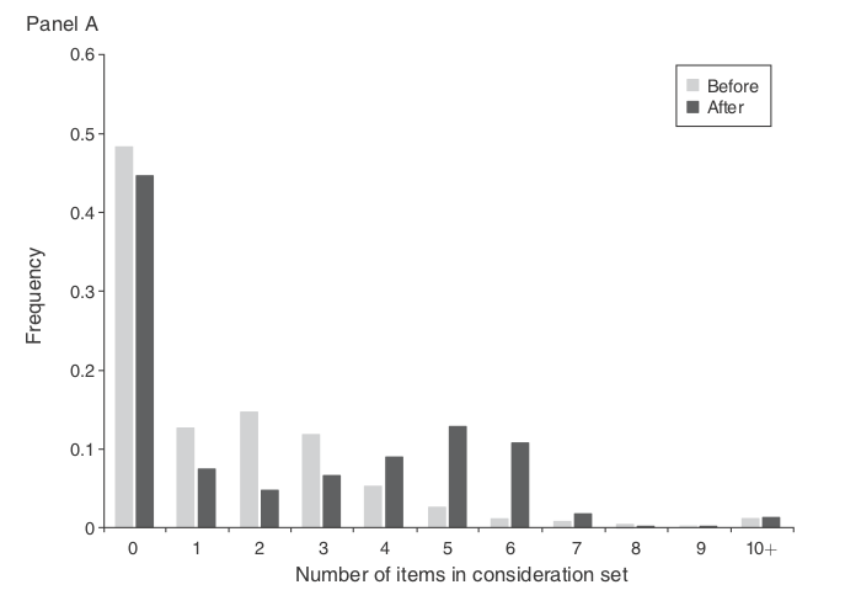
Online marketplace: Effect of market design on search

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 below.

Experiment with eBay market design



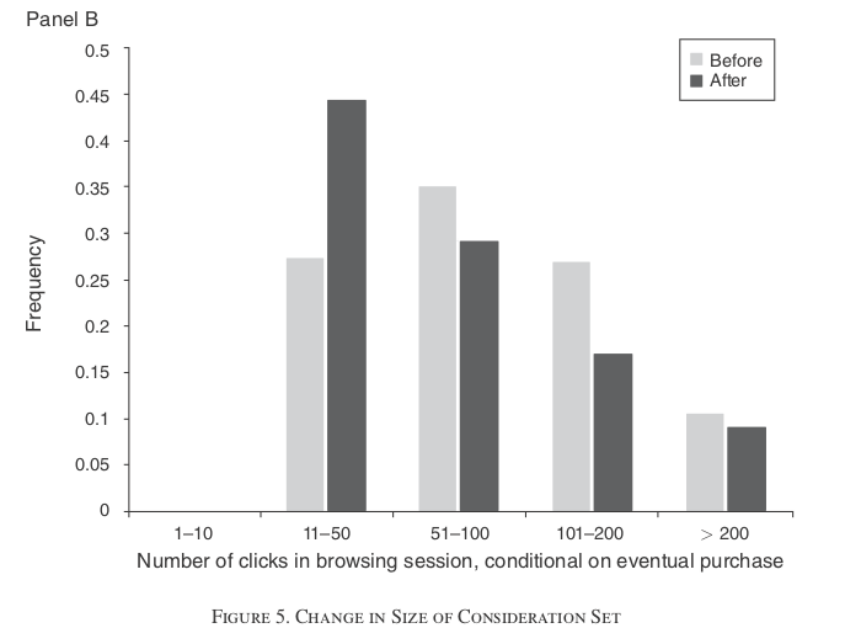


Figure. Impact of the design change to choices people see (left) and number of clicks they need to make (right).

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.

Price discrimination

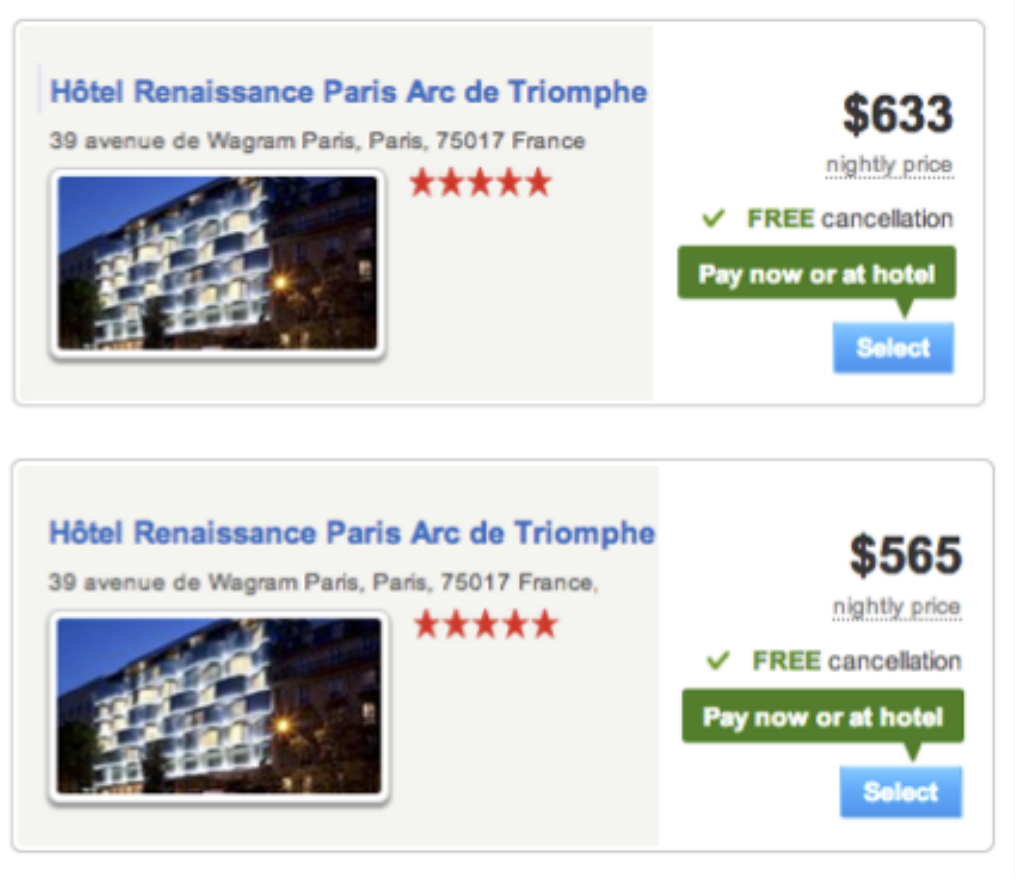


Figure. Example of price discrimination. Two identical searches with different online fingerprint.

Figure: Hannak et al. 2014.

Use of data in price discrimination

- The effects of data to competition can be surprising, as the following result from duopoly competition demonstrates:
  - 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.
- We'll continue to discuss the role of data in connection with privacy issues later.

Source: Belleflamme et al., 2019.

Lecture 7: Networks

Agenda

Last week

- Designing markets, the case of ad auctions
- Online markets

This week

- Networks
- Platforms

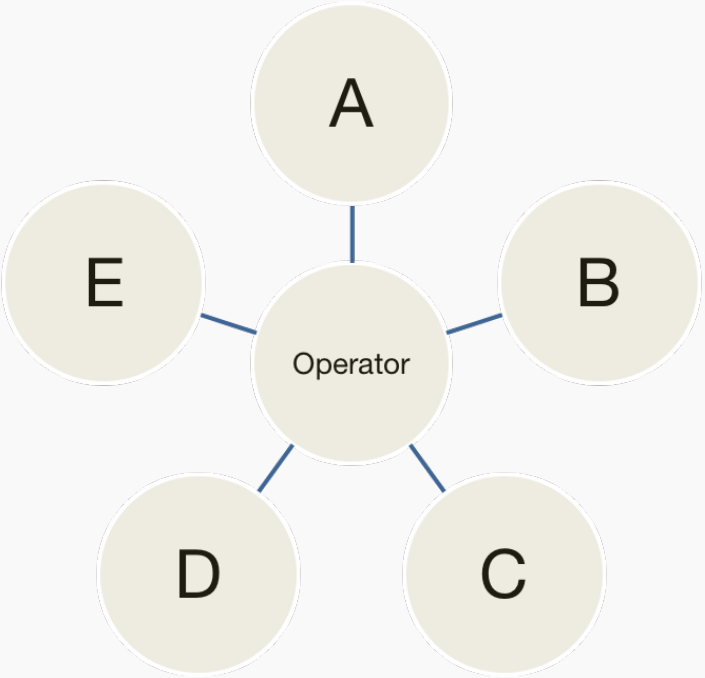
Network business – it's the 1990s

- 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.

Source: Evans and Schmalensee, 2017.

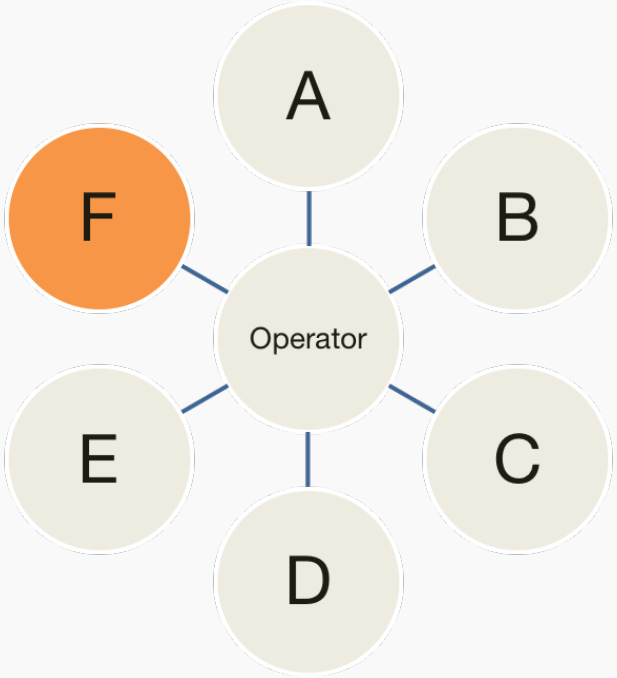
Traditional networks

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



Traditional networks

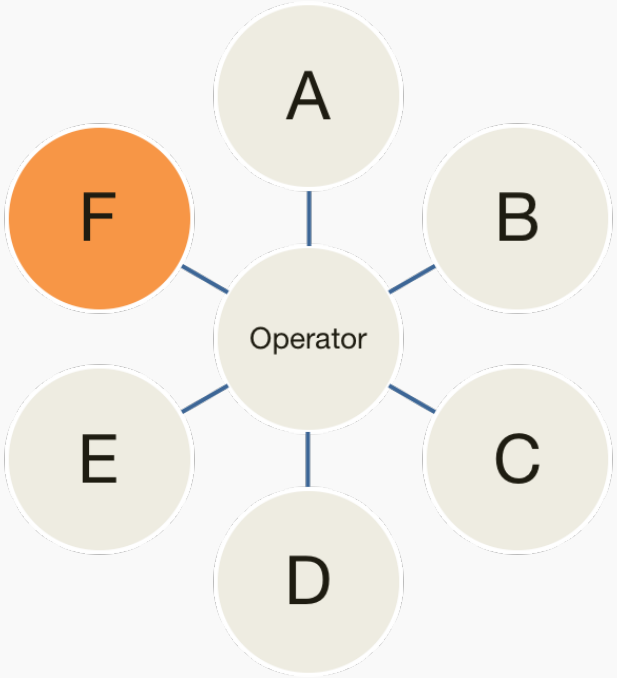
- The number of potential transactions increases with network size.
- If every new transaction has positive value, a larger network gives higher value to a subscriber.



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.



Reminder: The law of demand with traditional goods

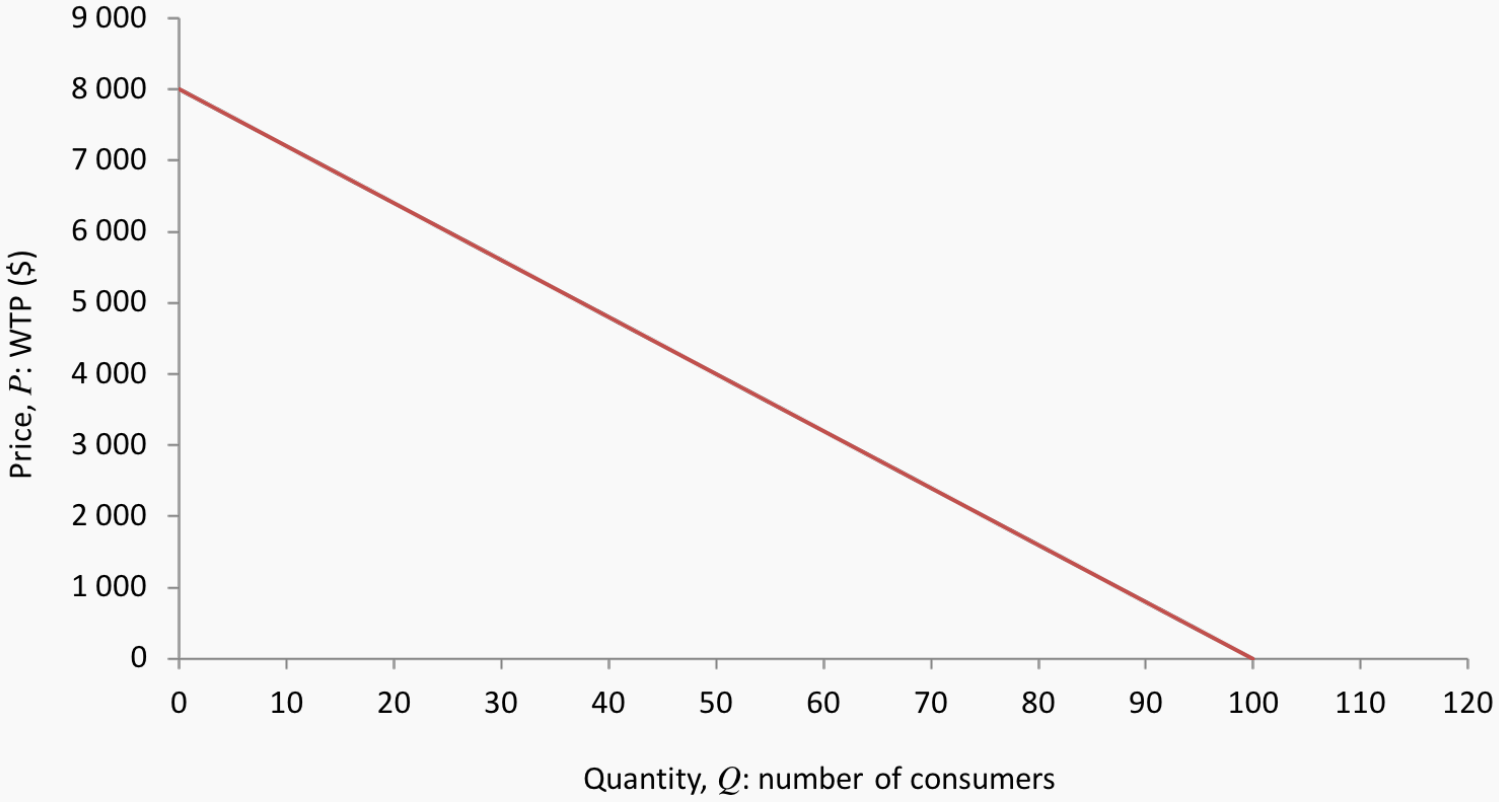


Figure. In traditional non-network industries, the willingness to pay for the last unit of a good decreases with the number of units sold.

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.
- The network effects may be direct or indirect, e.g.
  - Direct effects: You value Instagram because others use it.
  - Indirect effects: You don't directly gain if someone else has the same OS on their phone. But the larger user base makes the system attractive for developers, and you value the apps.
- *Different* from pure economics of scale:
  - E.g. a larger phone manufacturer has more resources to develop their phone.

Network effects

- Take 100 people who are in a market for a network good.
- Index the people from $v = 1, \ldots, 100$.
- Now assume that the value of the good the 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 $n = 100 - \hat{v}$. Combining these we get the following equilibrium prices:

$$p = (100 - n)n$$

Network effects

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

In-class exercise: Network effects

- We will play several rounds.
- In each round, you will have to decide whether or not to join an exclusive club.

In-class exercise: Network effects

- The price of membership for everyone is $p_0 = 1,000$ € throughout the exercise.
- The value of the membership to you in a given round is determined by two things: your type and the number of people who join.
- Your private value for the item is as before:
  - Take the last two digits of your student number
  - As an example, I'd have 96 (IIRC)

In-class exercise: Network effects

- Your valuation (or willingness-to-pay or reservation price) is equal to your type times the number of other people that buy it.
- The valuation is zero if no one else buys the commodity.
- As an example
  - If 10 other people buy the commodity, then the valuation for livo is $96 * 10 = 960$ €, less than the price of 1,000 €.
  - If 20 other people buy the commodity, then the valuation for livo is $96 * 20 = 1,920$ €, more than the price of 1,000 €.

In-class exercise: Network effects

- At the start of each round, you either *Join* or *Do Not Join*.
  - Use the poll in Presemo presemo.aalto.fi/digimar.
- After everyone has decided, you will be told the number of people who joined.
- You can then calculate your valuation.
- And your payoff is as follows:
  - If your decision is *Join*, your payoff is equal to the valuation of the club to you, minus its price.
  - If your decision is *Do Not Join*, your payoff is zero.
- Keep track of your scores.

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

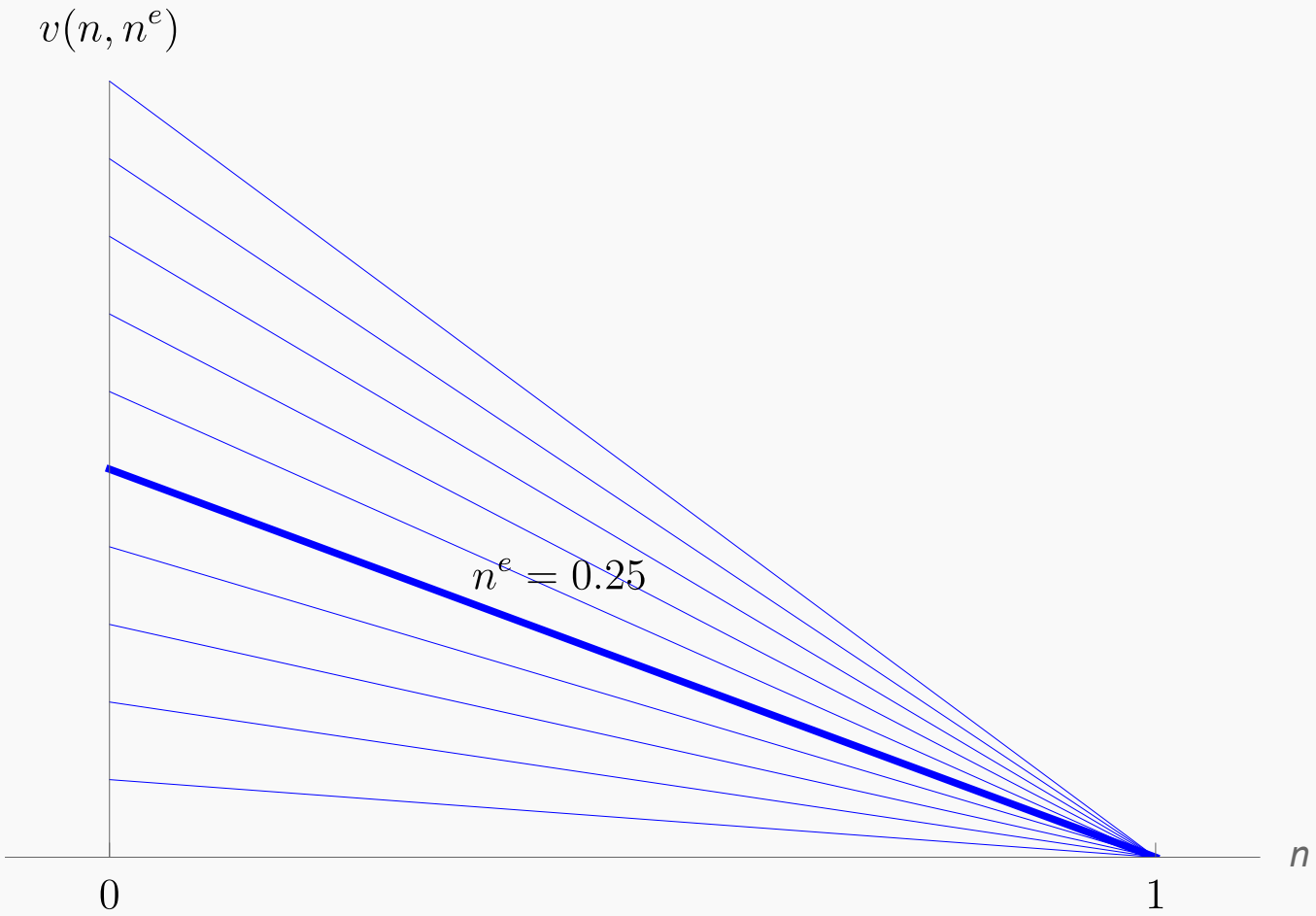


Figure. Value as a function of n when n^e is fixed to different levels, e.g. if $n^e = 0.25$ then $v(n; 0.25) = 0.25(1 - n)$.

Model of fulfilled expectations

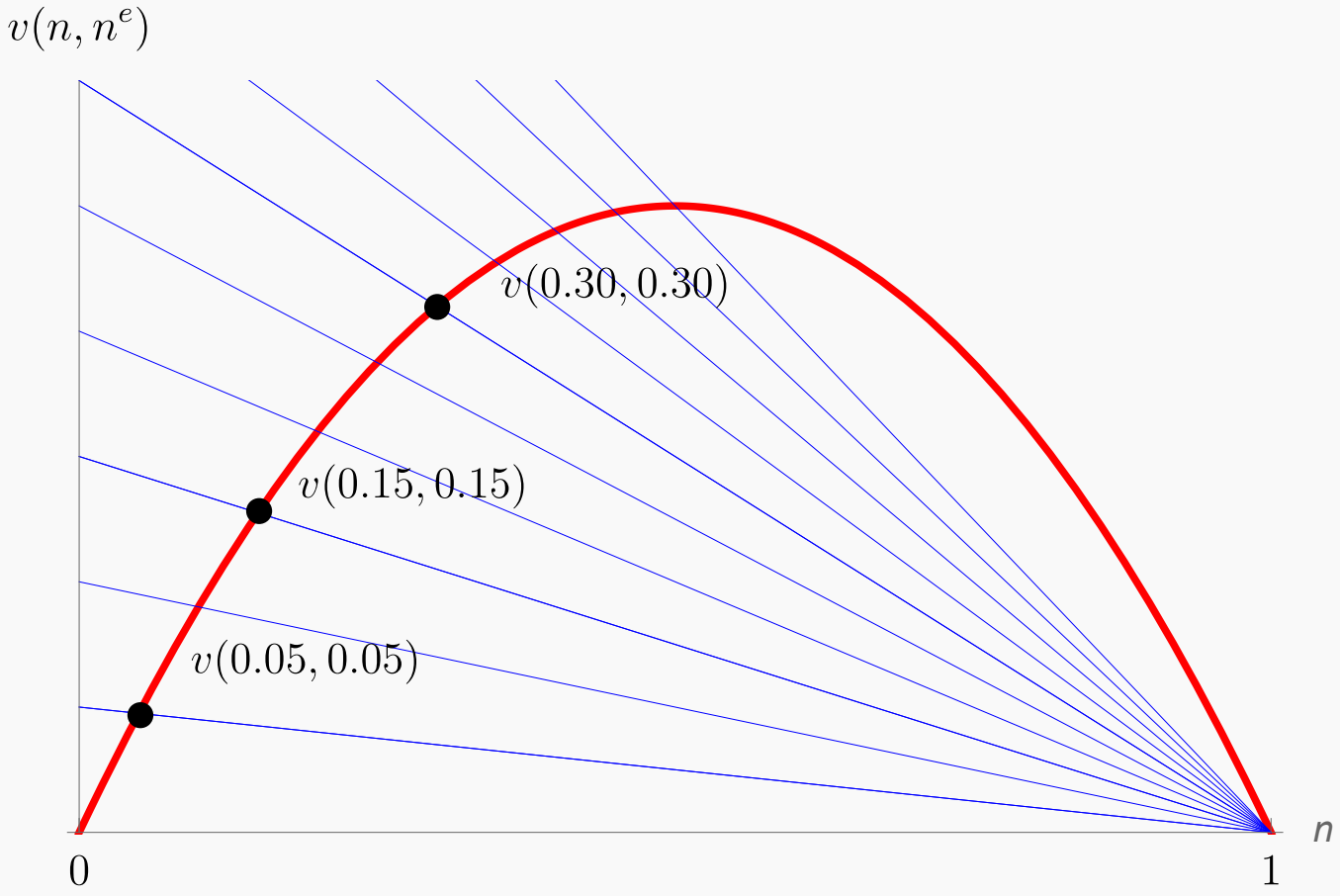


Figure. Three examples where n^e is fixed to 0.05, 0.15, 0.30 and the value is plotted as a function of n. The equilibrium points are at $n = n^e$.

Model of fulfilled expectations and prices

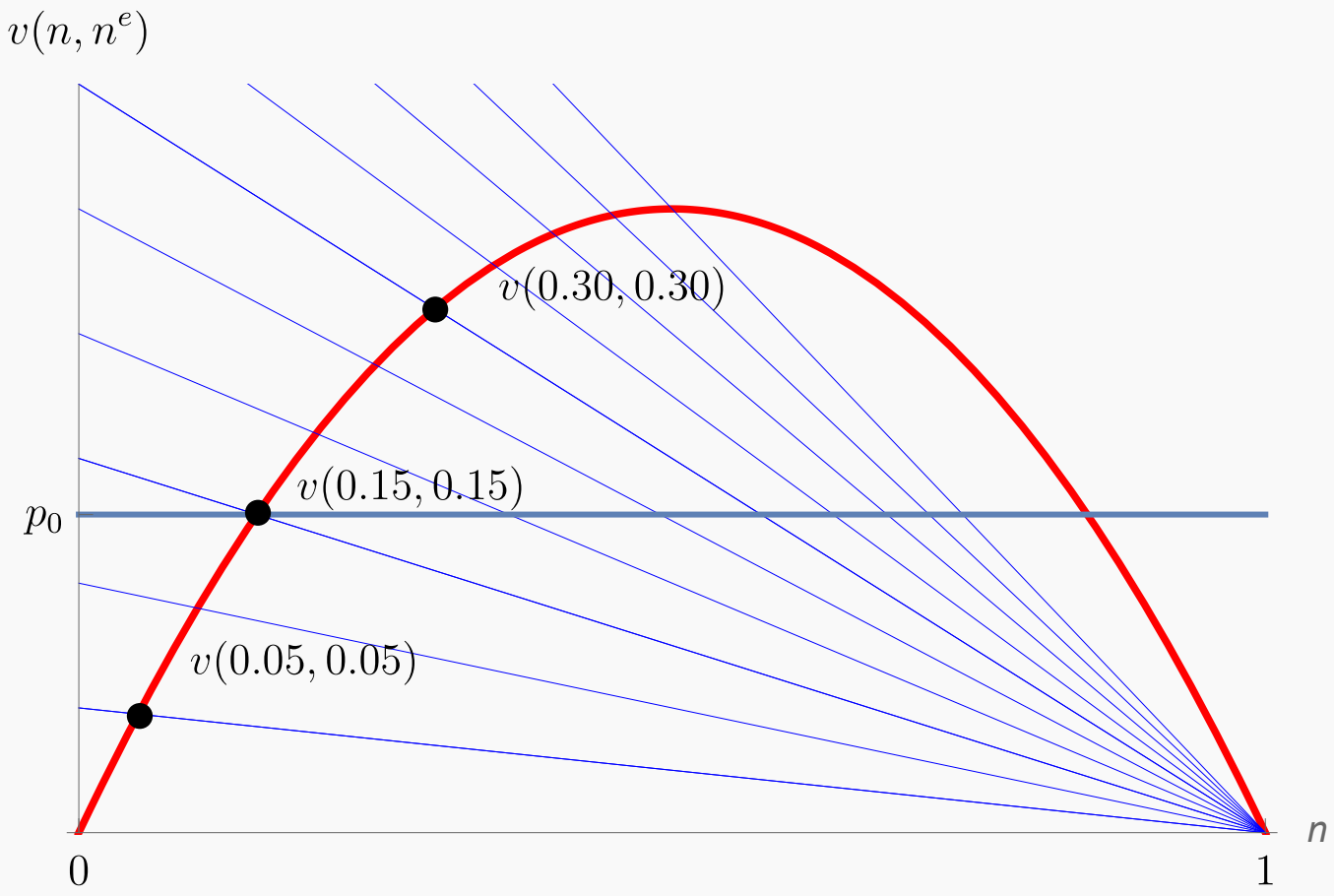


Figure. If price is set at $p_0 = (1 - 0.15) * 0.15$, then the marginal subscriber in equilibrium has a value of p_0.

Market clearing quantities and prices

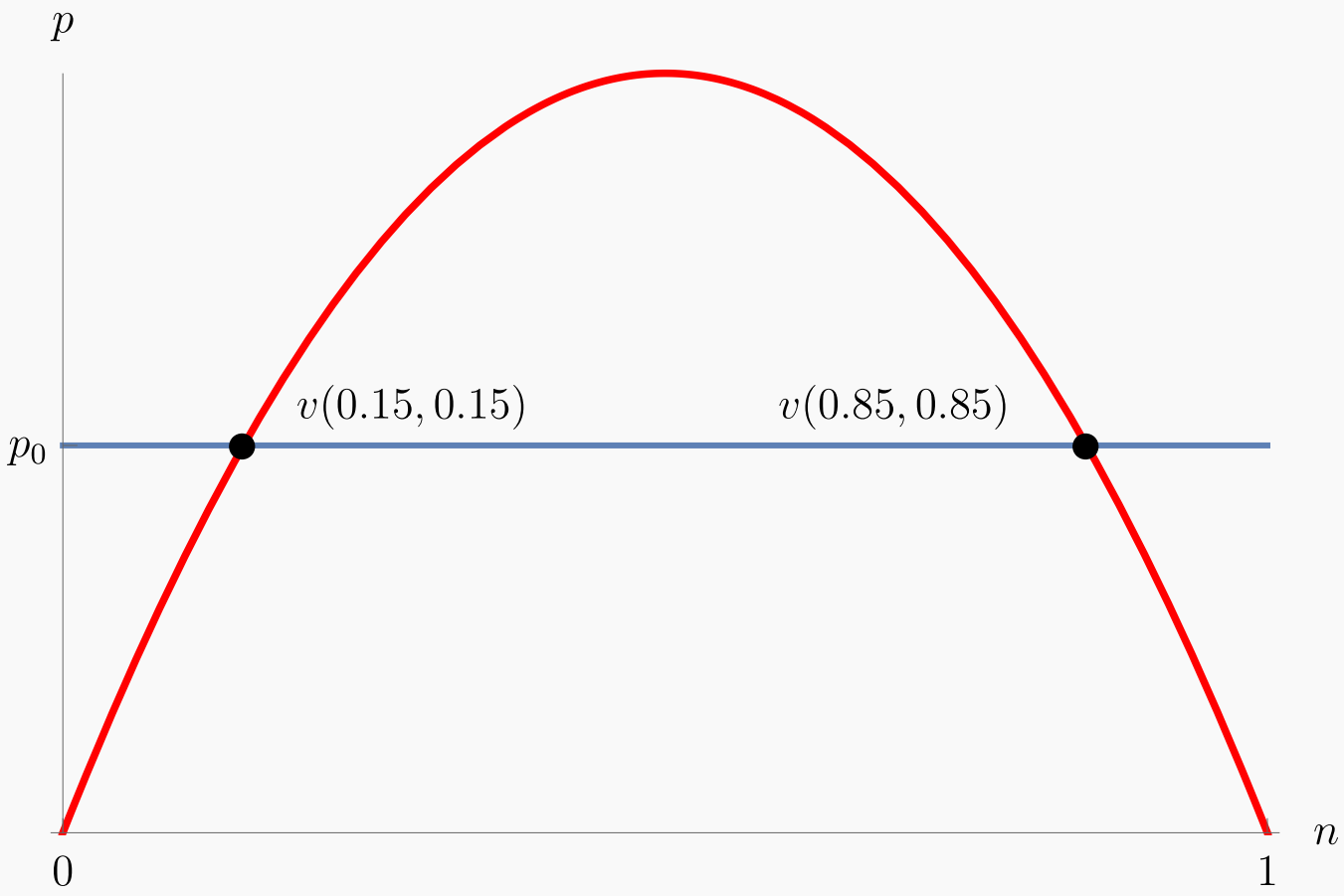


Figure. But also $(1 - 0.85) * 0.85$ is an equilibrium at the same price p_0.

Multiplicity of equilibria

- Above, the first equilibrium $(0.15, 0.15)$ is unstable:
  - A small reduction in n leads to the collapse of the network.
  - A small increase in n leads to the rapid growth of the network.
- 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.

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 Telegram group.

(iii) many of the high-willingness-to-pay consumers 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.

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, similar to price discrimination in the typical goods case.

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.

Materials for this week

Online resources (for Lecture 7):

- **Externalities**. Remind yourself of the economics of positive externalities mru.org: Positive Externality.
- **Network externalities**. www.core-econ.org 21.3 and 21.4.

Reading assignment 4:

- Katz, M. and C. Shapiro (1994) "Systems Competition and Network Effects", The Journal of Economic Perspectives. Read at least until top of p. 103 and Conclusions.
- Evans, D. and R. Schmalensee (2007) "The Industrial Organization of Markets with Two-Sided Platforms", Competition Policy International. Feel free to skip V and VI. Also, Section III A. Pricing, will be discussed more in depth in Lecture 10.

Next time

- Platforms
- Equilibria in platforms
- Identifying externalities

Appendix

Figure: Smithsonian.

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 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.

Impact of costs

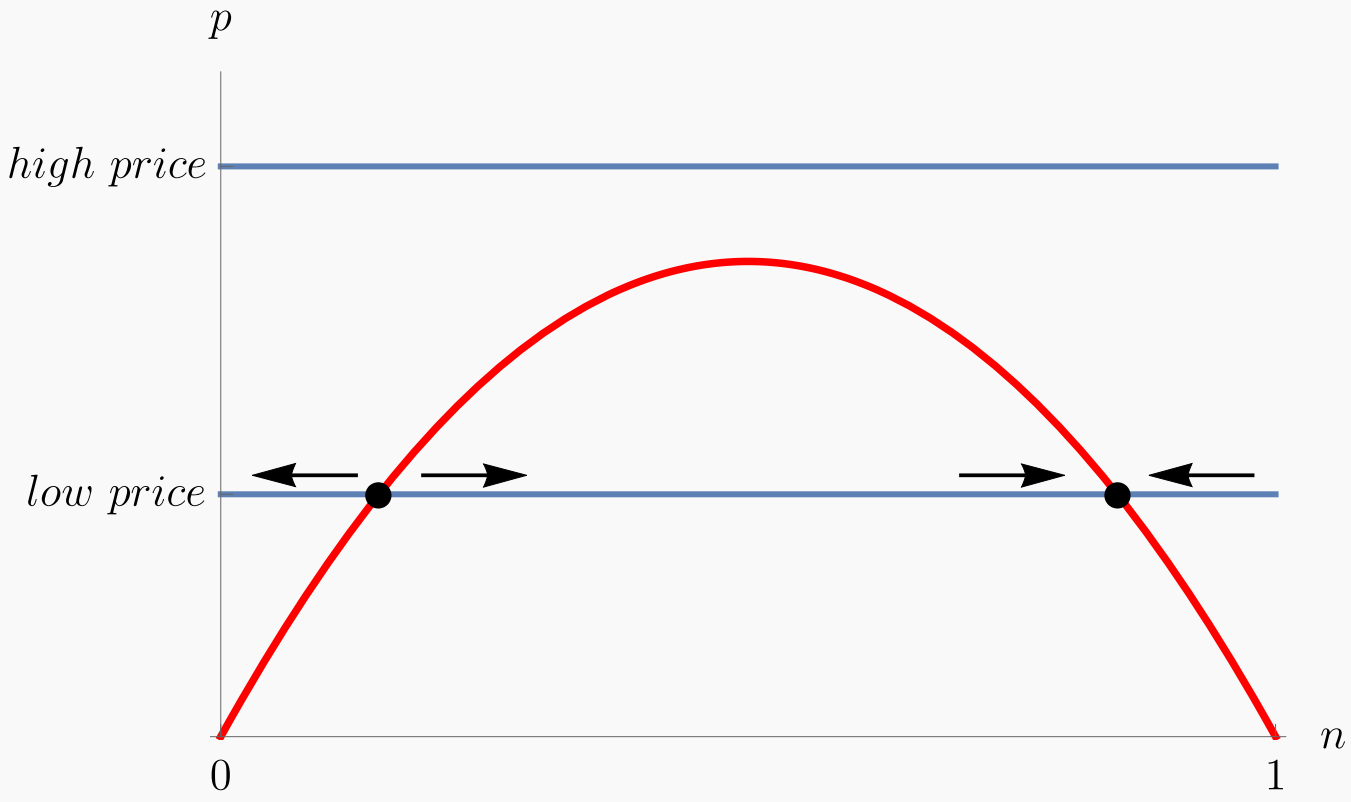
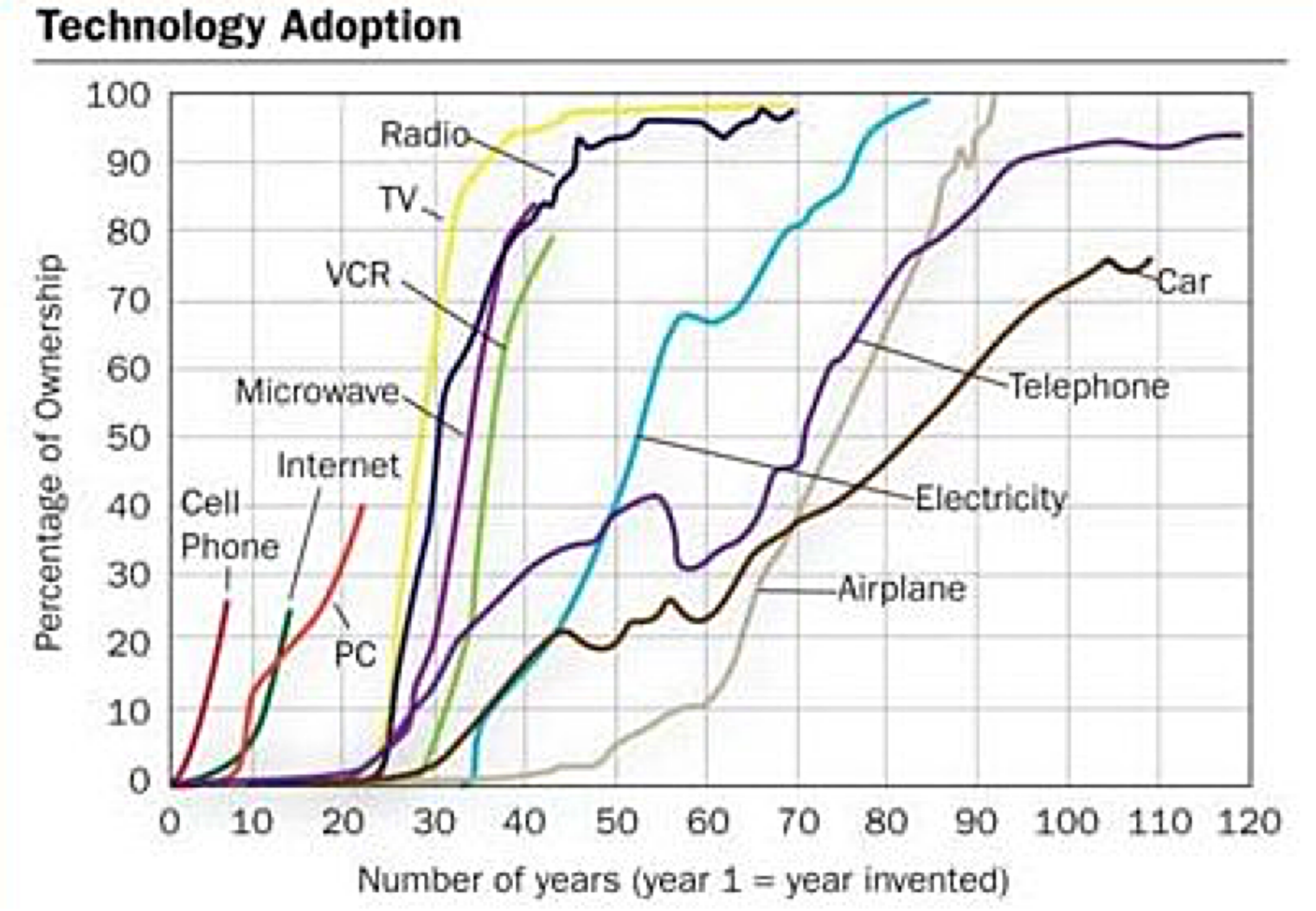


Figure. In competitive markets, the price will be set on the basis of cost. When costs are high, equilibrium is at zero. If costs come down, other equilibria become possible.

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 (relatively) small size and then expand significantly.
- It is possible that the industry starts with low expectations initially as e.g. costs are high, and later on advances quickly to the right equilibrium.

Adoption – Examples



Source: Forbes Magazine.

ECON-C5100 Digital Markets

Iivo Vehviläinen

February 2, 2022

Aalto University
iivo.vehvilainen@aalto.fi

Lecture 8: Platforms

Outline

- Platforms
- Equilibria in platforms
- Identifying externalities

Reminder: Network effects

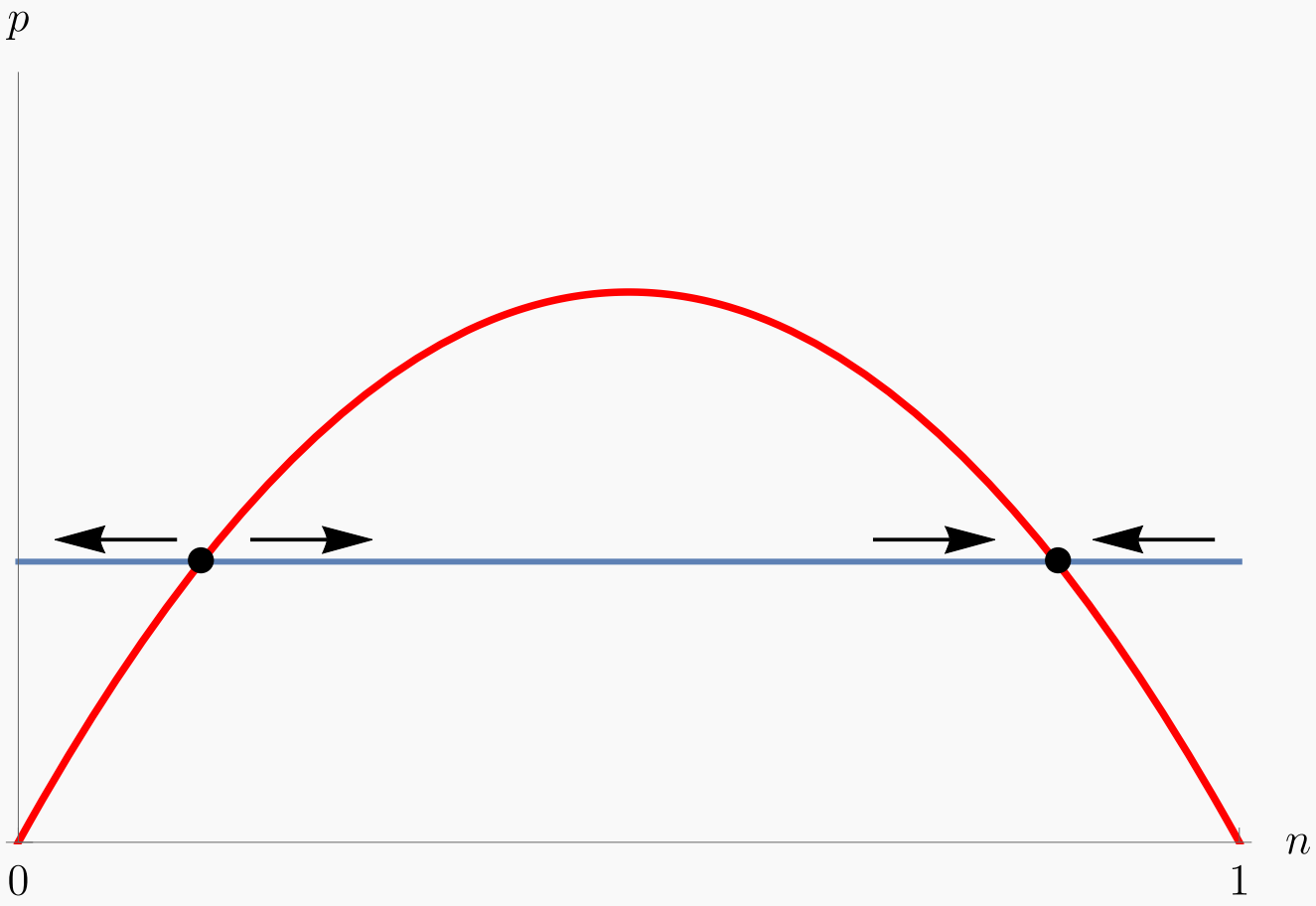


Figure. Positive network effects: Beyond tipping point (on the left) there is a high stable equilibrium (on the right).

What could go wrong?

- Not all the users are the same
  - Instead of pure scale, quality matters.
- Network effects are often indirect
  - Need to take into account separate user groups.
- Network effects can work in reverse
  - Shifts in customer base may occur rapidly.

Source: Evans and Schmalensee, 2017.

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.

> 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 – Example: Google

Q4 2021 supplemental information (in millions, except for number of employees; unaudited)

Revenues, Traffic Acquisition Costs (TAC) and number of employees

	Quarter Ended December 31,	
	2020	**2021**
Google Search & other	$ 31,903	$ 43,301
YouTube ads	6,885	8,633
Google Network	7,411	9,305
Google advertising	46,199	61,239
Google other	6,674	8,161
Google Services total	52,873	69,400
Google Cloud	3,831	5,541
Other Bets	196	181
Hedging gains (losses)	(2)	203
Total revenues	$ 56,898	$ 75,325
Total TAC	$ 10,466	$ 13,427

Figure. Create content to attract users, then sell ads. Q4/2021 earnings of Alphabet. Total revenue for the year $257 billion (cf. expected GDP of Finland in 2021: $255 billion).

Source: Alphabet.

Exchanges – Example: Andela

Figure. Match buyers with sellers. Andela matches African developers with global clients.

Figure: Tom Saater for The New York Times.

Software – Example: R

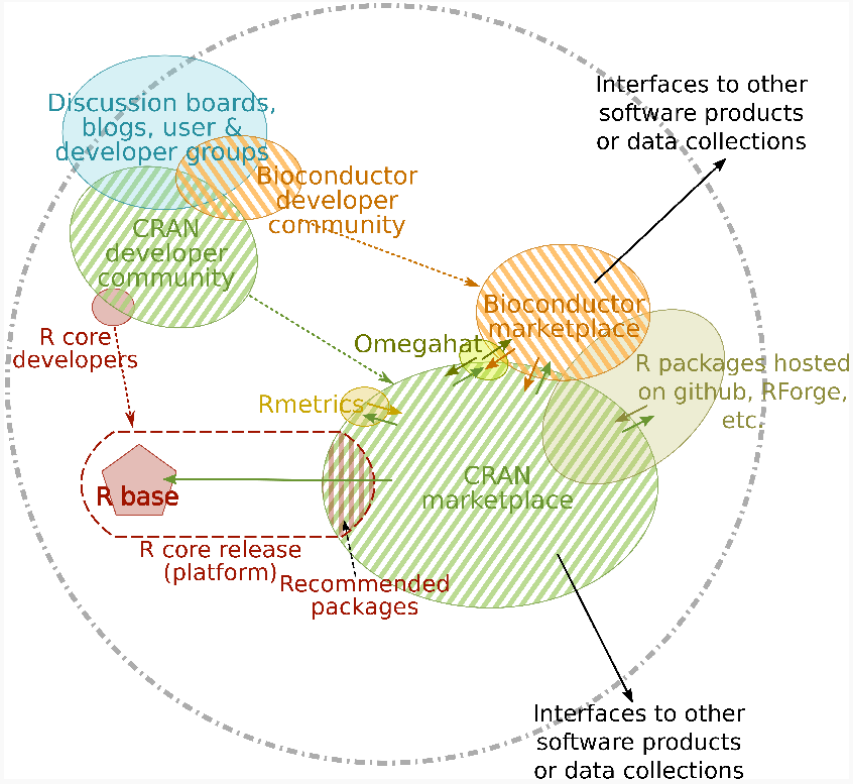


Figure. Environment to create apps that users like. Example of R development community.

Figure: Plakadis et al. 2017.

Transaction services – Example: MobilePay

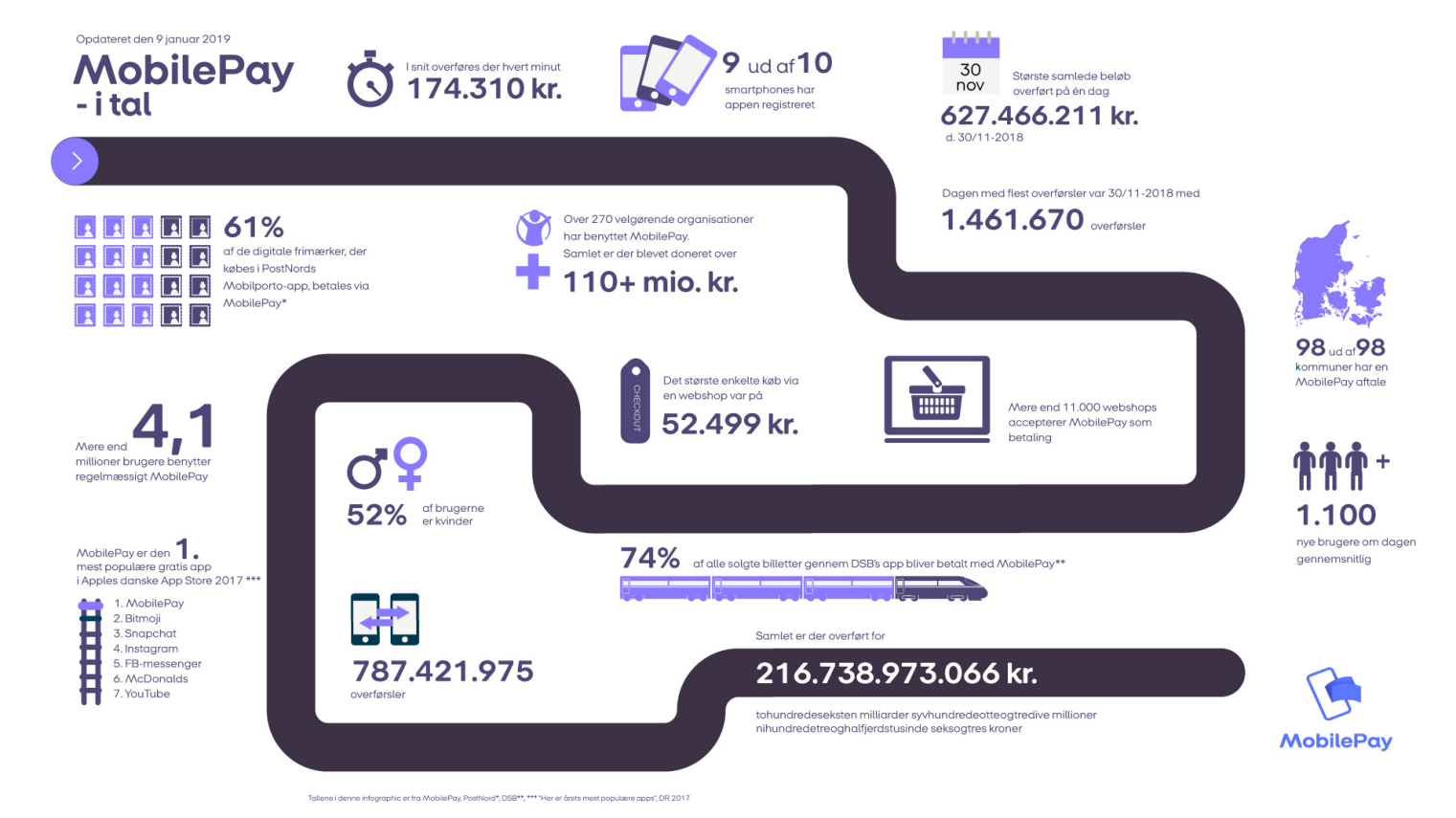


Figure. Moving money to move stuff. MobilePay is a mobile transaction payment system.

Figure: MobilePay.

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.

In-class exercise: Platform or not?

Come up with a business/website that you think operates as a platform.

Use the text field in the Presemo presemo.aalto.fi/digimar vote to add the site and the link.

Vote for the ones you think are platforms.

Reminder: Network effects

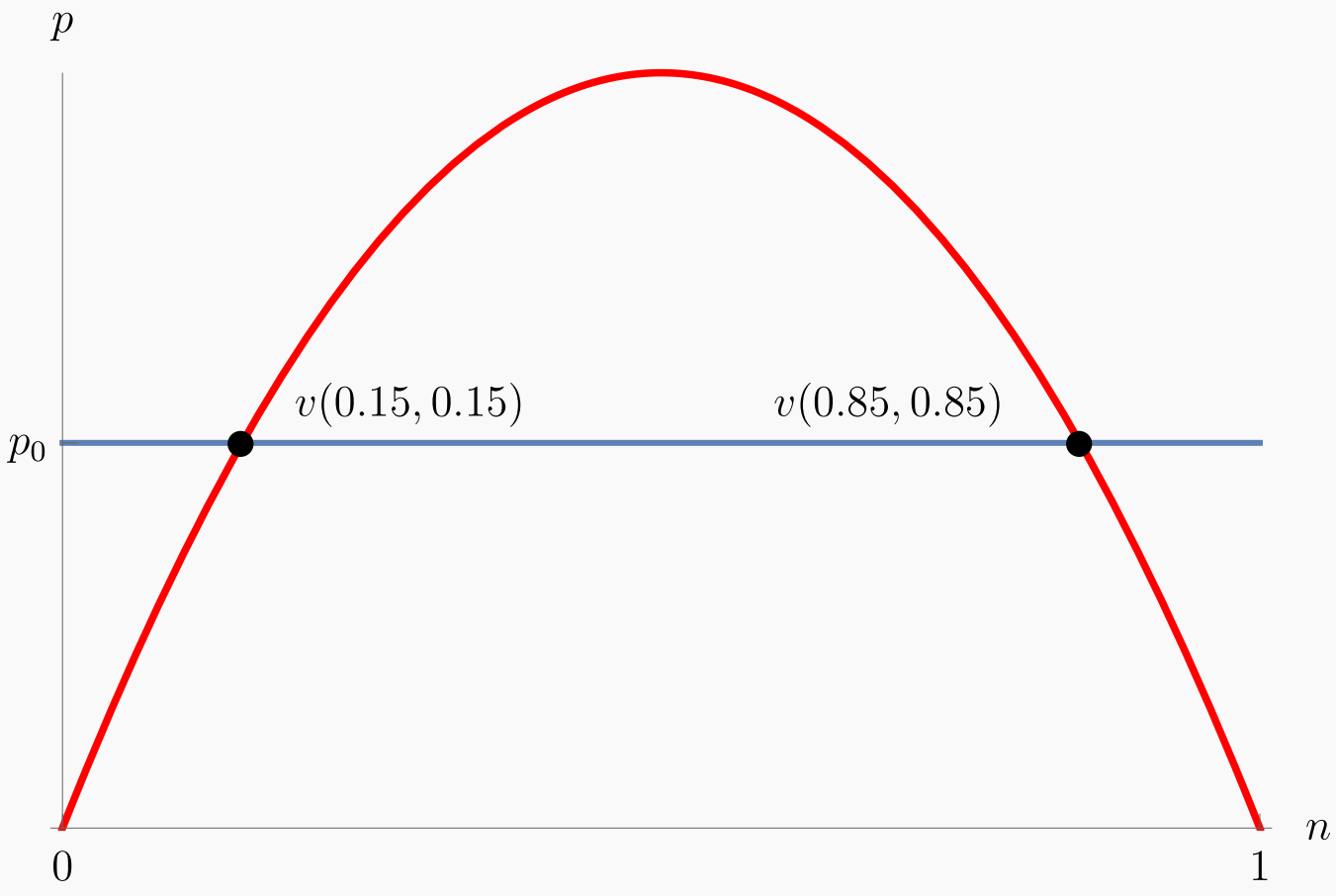


Figure. Equilibrium prices with $p = vn$. A given price p_0 determines how many participants the network will end up having.

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

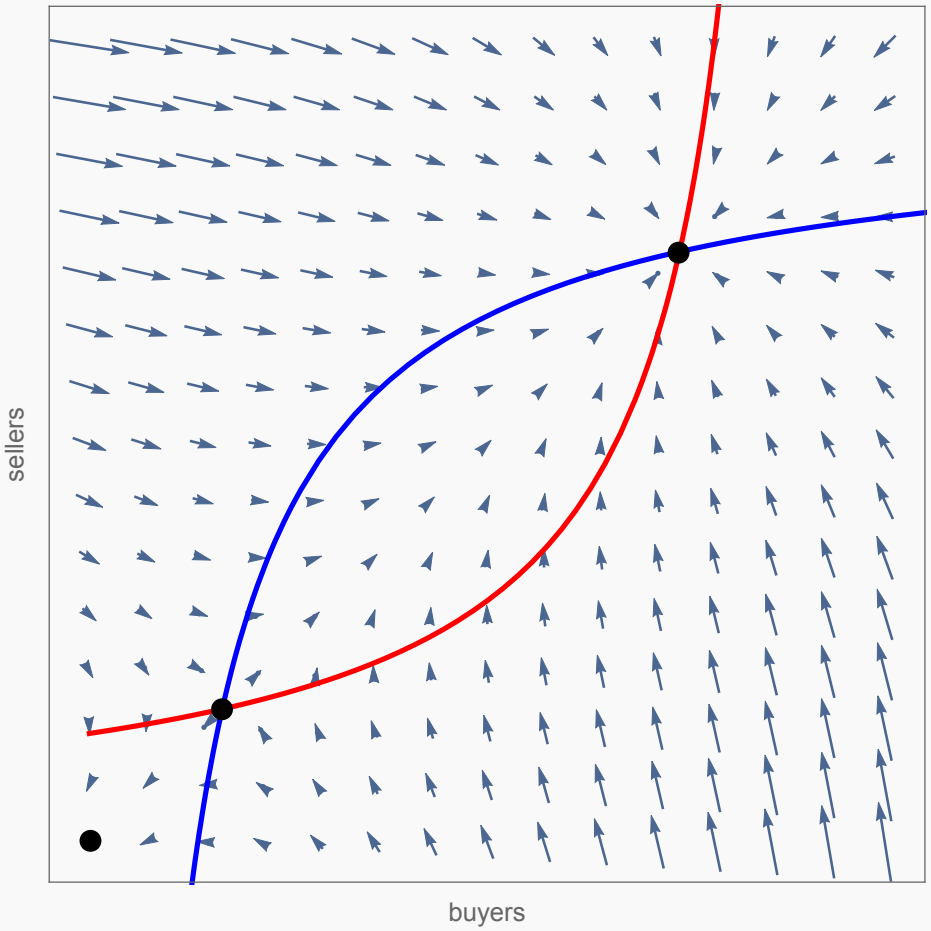


Figure. Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

Examples

Demonstration of the platform effects.

Identifying externalities

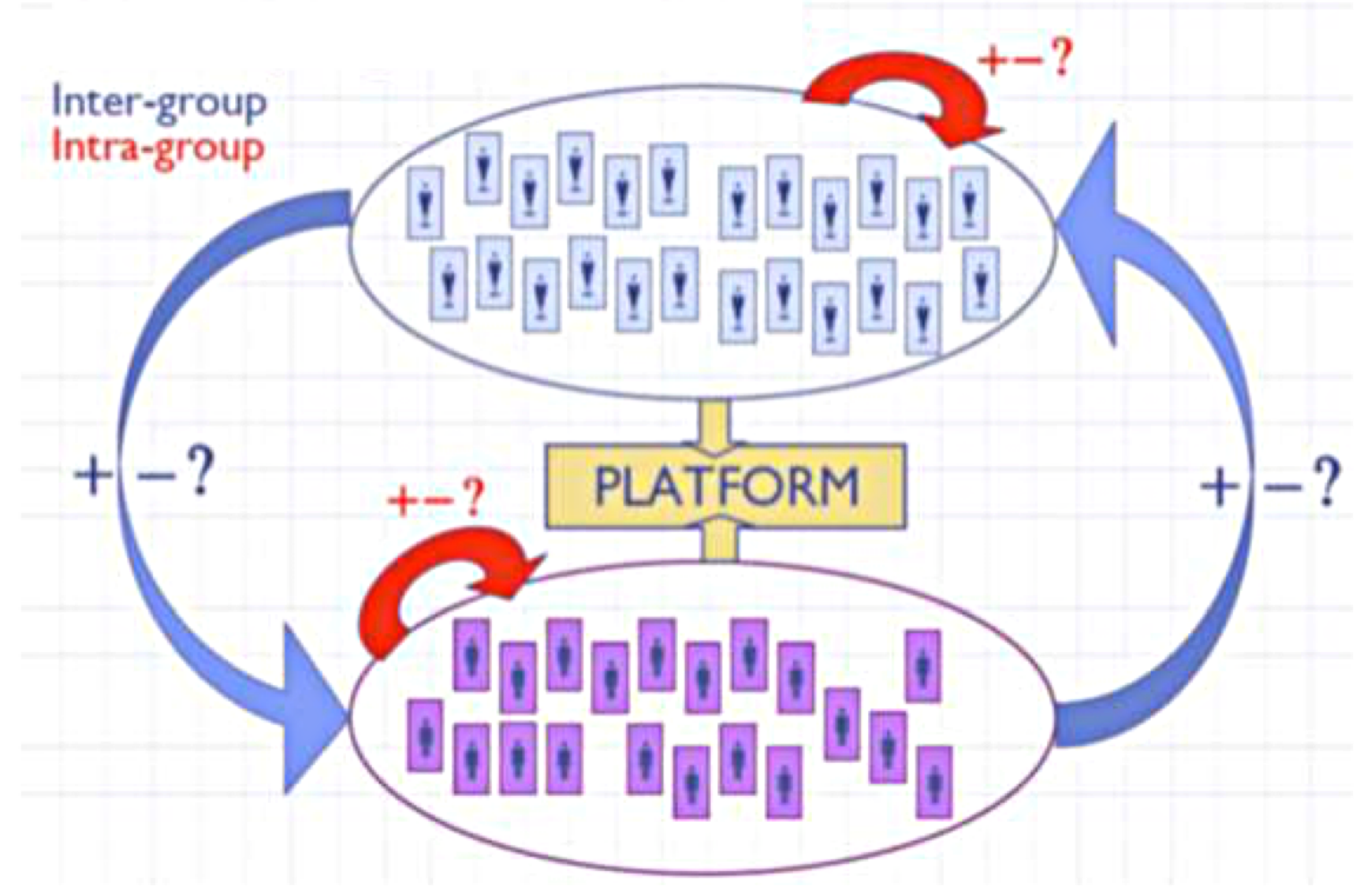


Figure. Externalities within a group and between groups.

Source: P. Belleflamme.

Identifying externalities

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

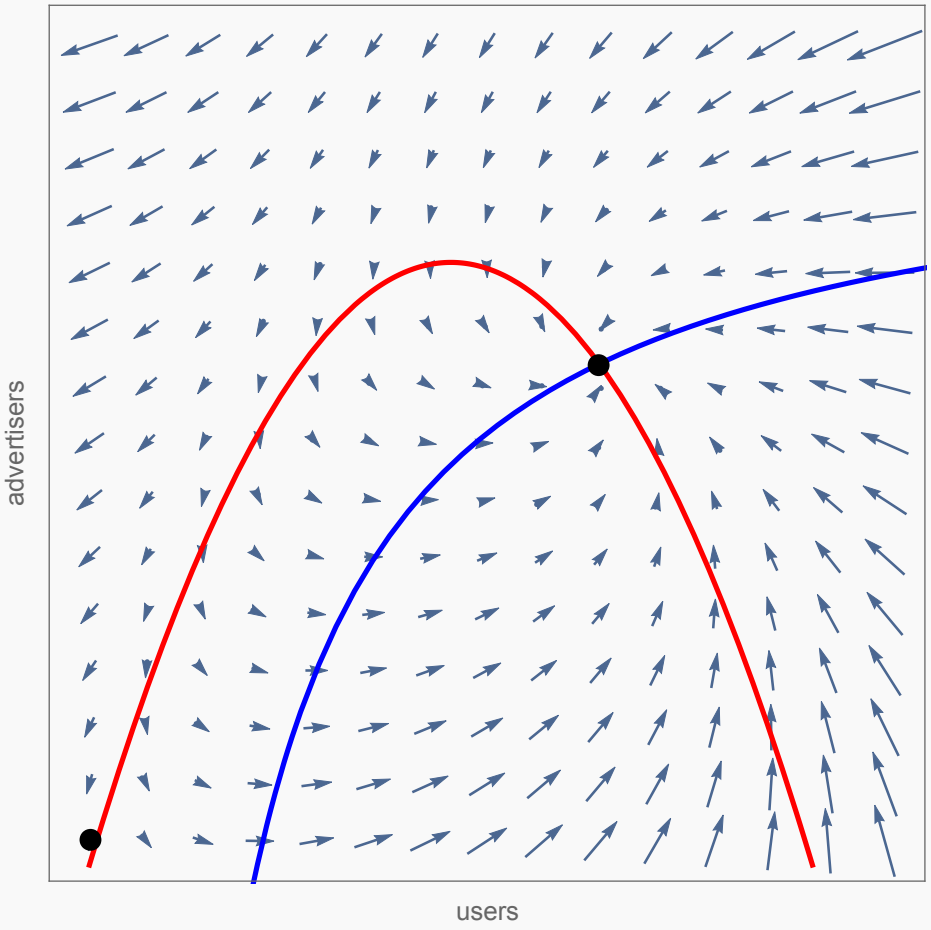


Figure. Simple ad model: Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

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.

Materials for this week

Online resources (for Lecture 7):

- **Externalities**. Remind yourself of the economics of positive externalities mru.org: Positive Externality.
- **Network externalities**. www.core-econ.org 21.3 and 21.4.
- **Platforms**. www.core-econ.org 21.5.

Reading assignment 4:

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- Evans, D. and R. Schmalensee (2007) "The Industrial Organization of Markets with Two-Sided Platforms", Competition Policy International. Feel free to skip V and VI. Also, Section III A. Pricing, will be discussed more in depth in Lecture 10.

Next time

Strategies of platforms

- Openness
- Pricing

Appendix

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.

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

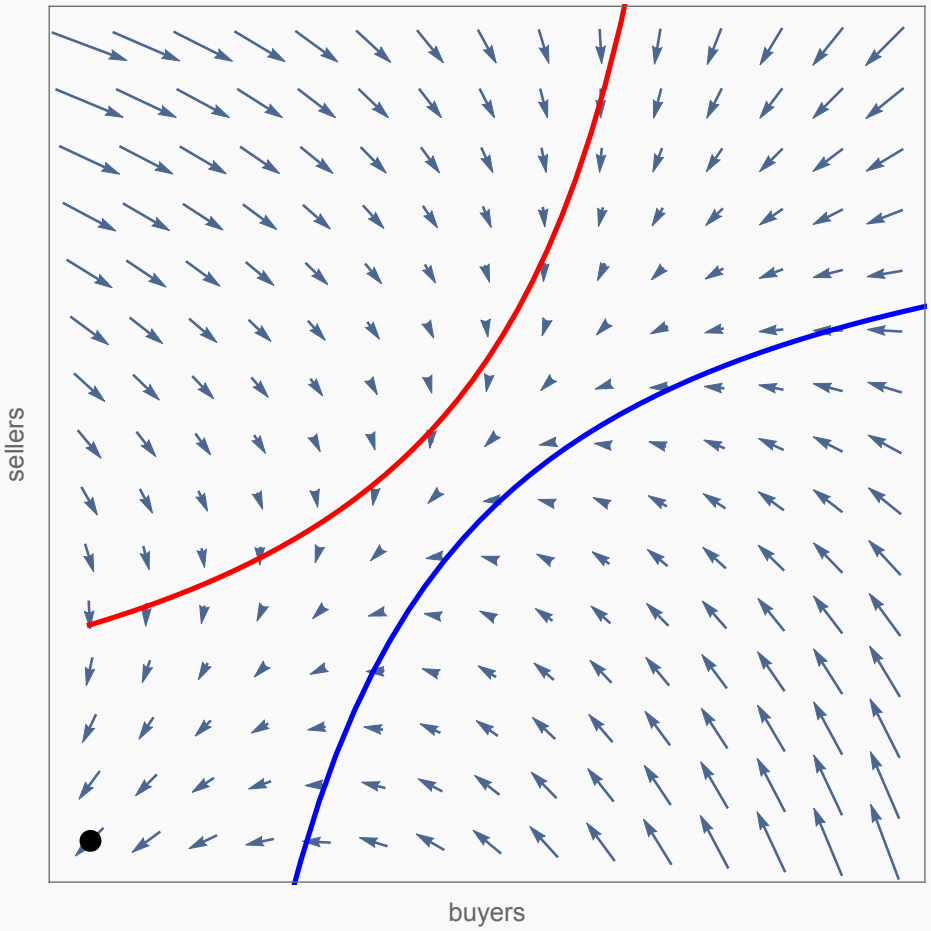


Figure. $\kappa_b = \kappa_s = 0.5$: Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

ECON-C5100 Digital Markets

Iivo Vehviläinen

February 7, 2022

Aalto University
iivo.vehvilainen@aalto.fi

Lecture 9: Platform stragegies

Last week

- Network effects
- Platforms aka two-sided markets

Outline

- Platform pricing
- Openness

Reminder: Illustrative exchange platform

- As before, the payoffs 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.

- To fix ideas, you can think of the payoff for the platform as

$$\pi_p(n_b, n_s; p_b, p_s; c_b, c_s) = n_b(p_b - c_b) + n_s(p_s - c_s)$$

  where c_b is the fixed cost of serving a buyer and c_s a seller.

Reminder: Platform equilibria

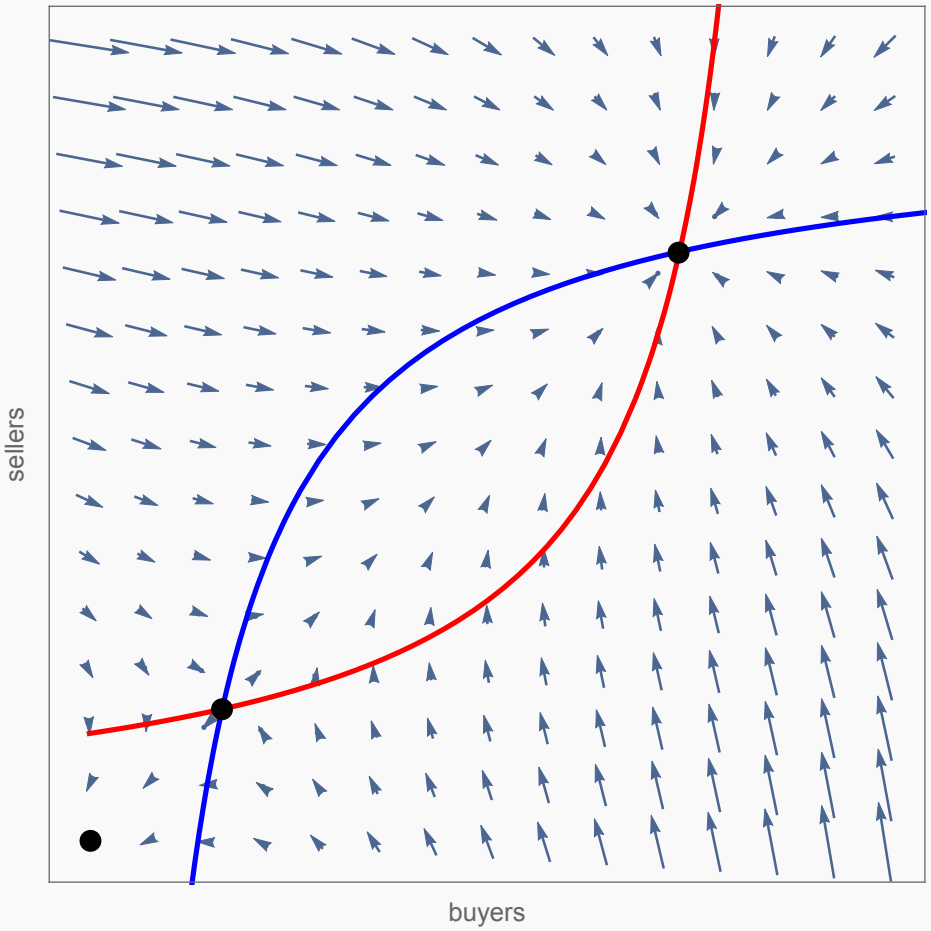


Figure. Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

Change in buyers' prices

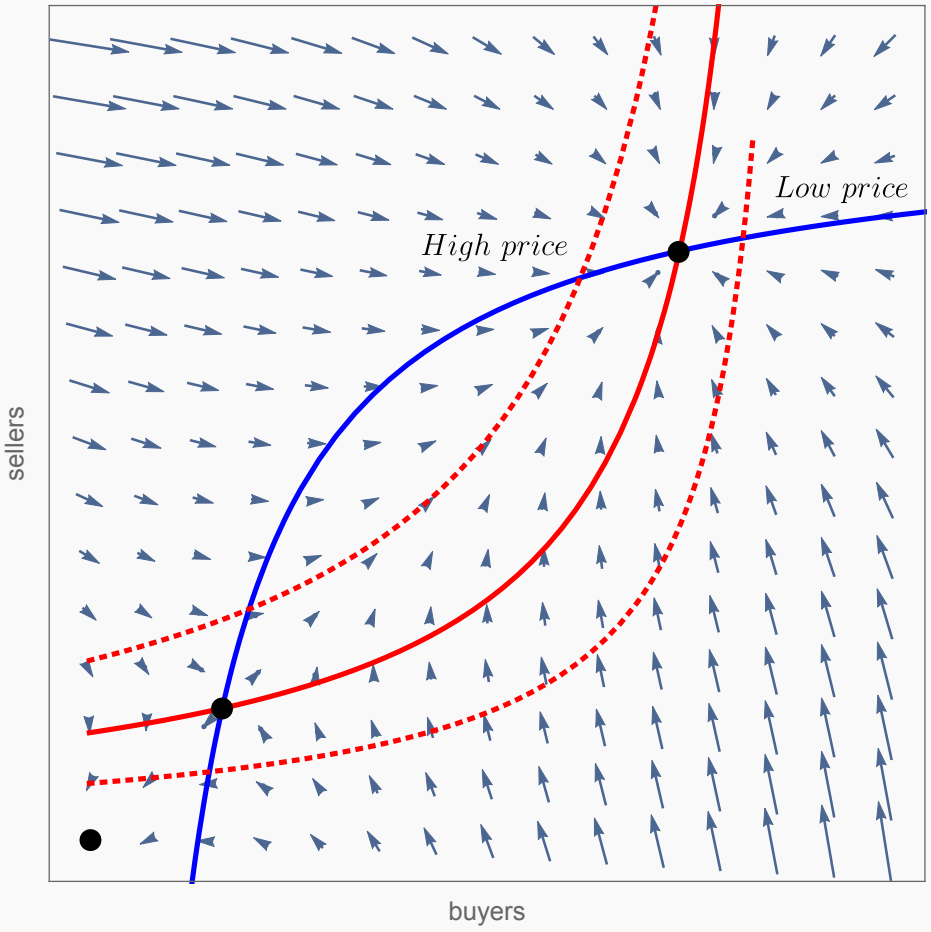


Figure. Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Dashed lines represent changes in prices for buyers.

Change in sellers' prices

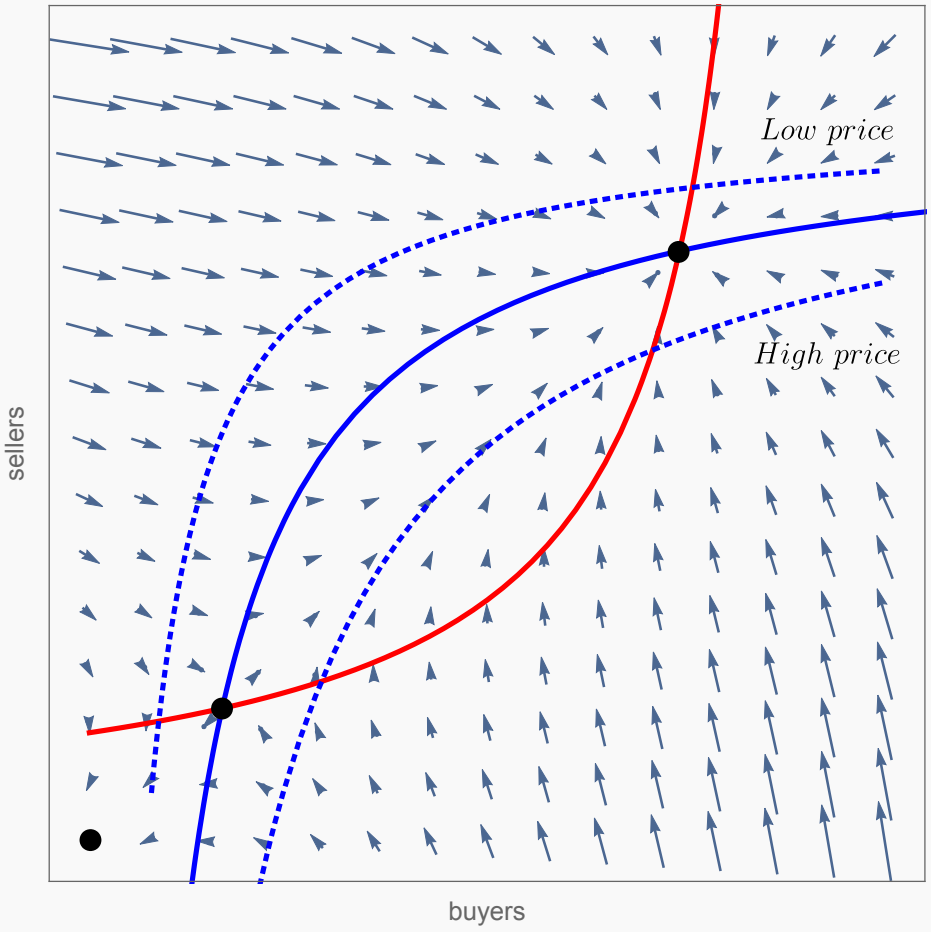
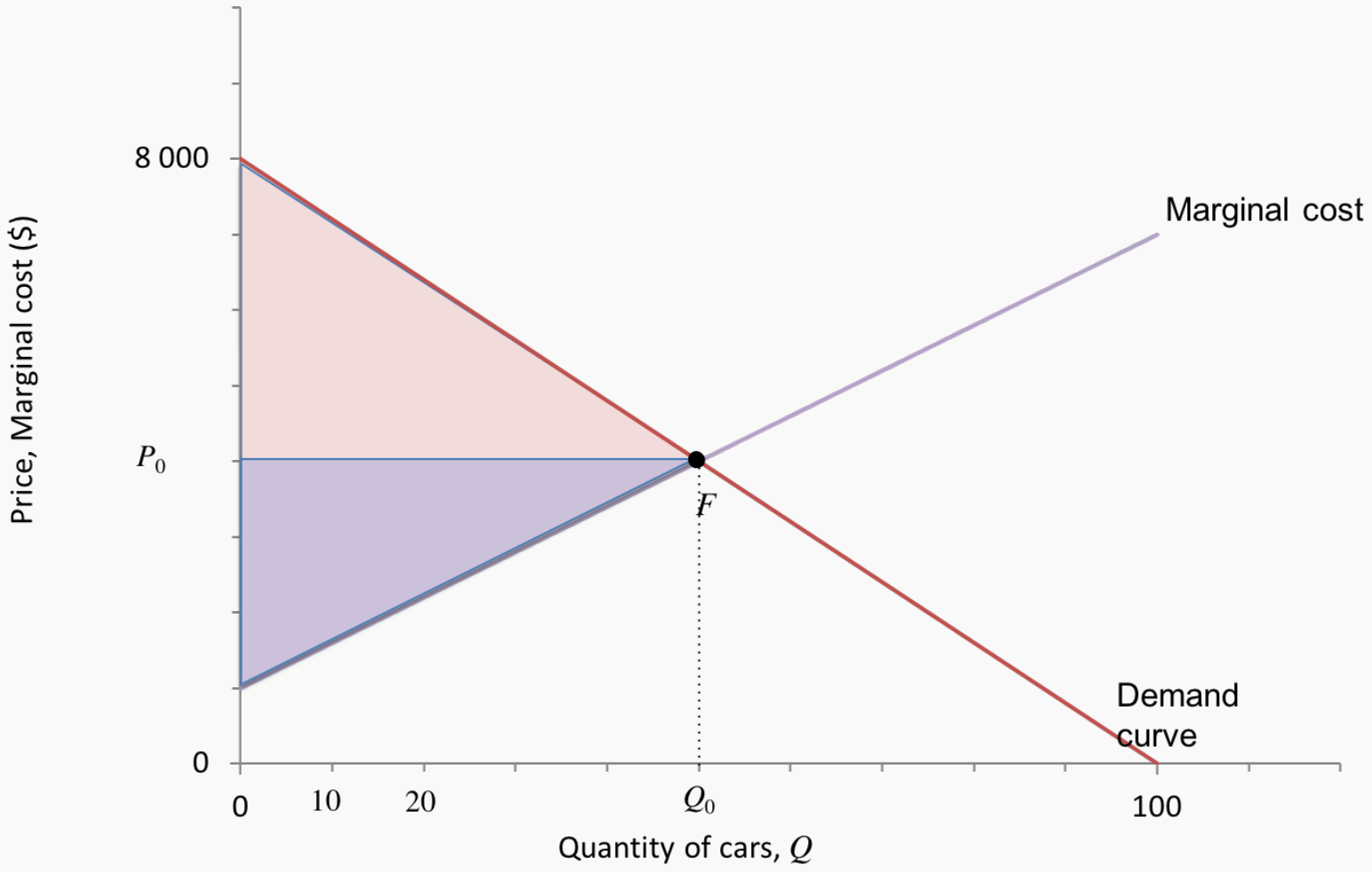


Figure. Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Dashed lines represent changes in prices for sellers.

But how to set prices on a platform

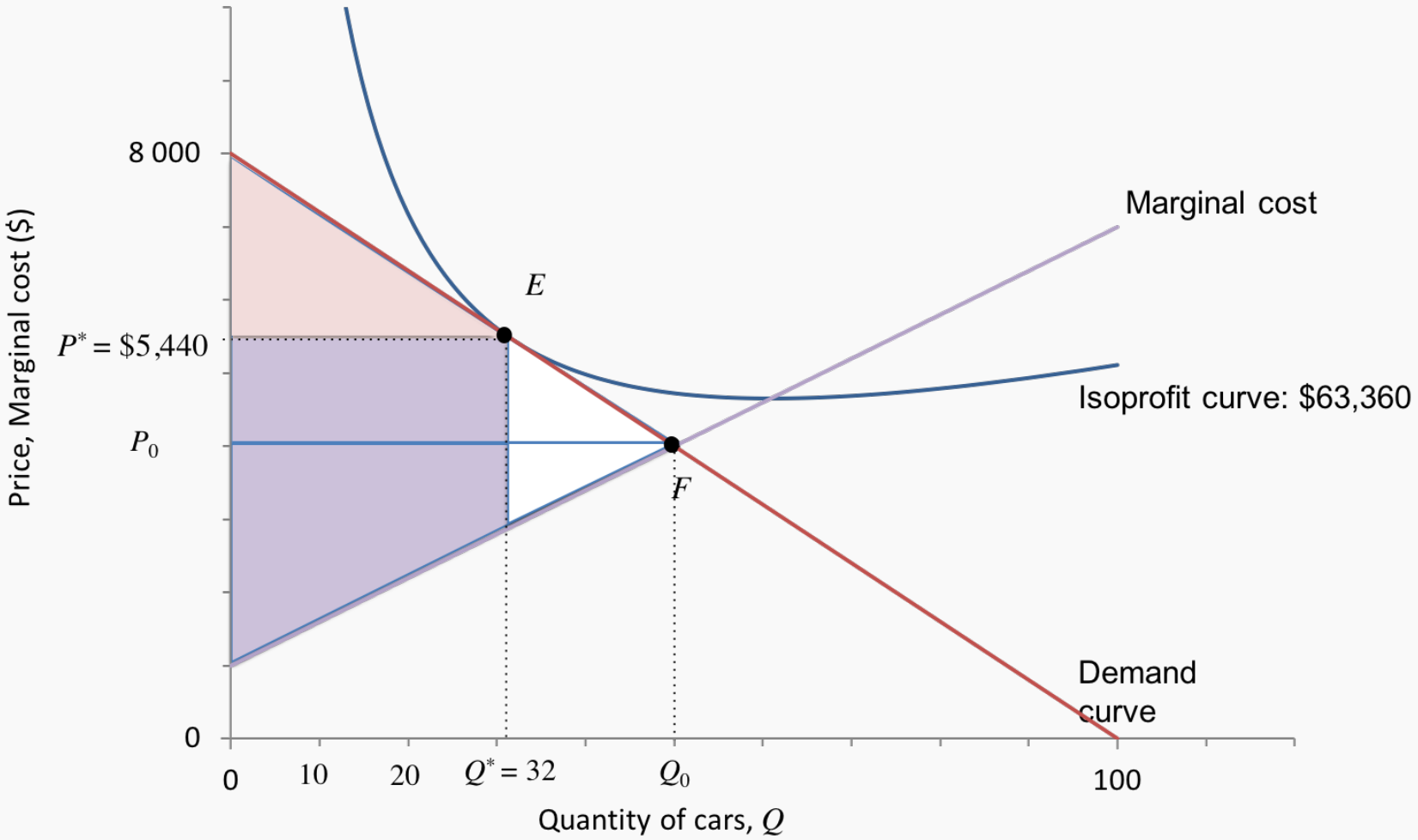
- Impact of prices
  - Choice of price affects how many users will use the platform
  - Number of users on one side will affect the interest on other sides through externalities
  - Platform pricing affects which side, or the platform operator, enjoys the benefits of complementarities
- We will go through the intuition for these key questions:
  1. How do socially optimal (=efficient) prices look like?
  2. How does monopoly pricing differ from the social optimum?
  3. What role does competition between platforms have?
- First, some preliminaries

Reminder: Pricing of a traditional good with competition



Source: CORE.

Reminder: Monopoly pricing of a traditional good



Source: CORE.

Price discrimination: Three archetypes

1st degree price discrimination: everyone pays a different price based on valuation.

3rd degree price discrimination: different prices based on some observable characteristics.

2nd degree price discrimination: consumers choose what to pay, one way is to discriminate with quality, e.g.

- Create a high and a low quality product
- Ones who have high values need to be made to purchase high quality, i.e. meet *incentive compatibility*
- Ones with low values need to meet participation constraint, i.e. buying the low quality product must be *individually rational*

Efficient prices

Social pricing of a network good

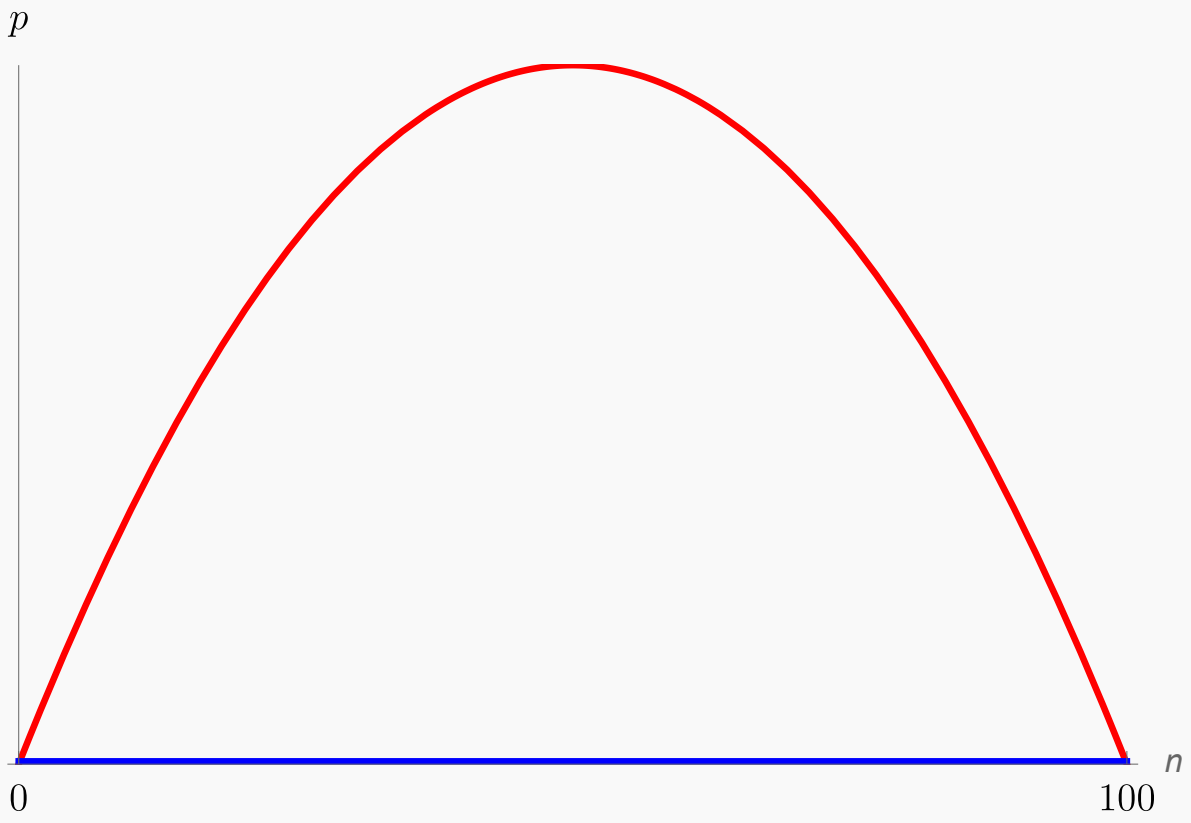


Figure. Network with an equilibrium price: $p = (100 - n)n$. If costs are 0 then socially optimal to let everyone use the network $\rightarrow$ set price at 0.

Platform pricing – Social optimum

- Platform different from a network: several sides
- In general, socially optimal prices will be different from marginal costs of providing the services to different sides
- Socially optimal pricing aims at maximizing the total surplus generated by the platform
  - 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
  - In theory, optimal prices are set in a Pigouvian manner: the prices include the positive or negative externality that the user has on the other sides (mru.org: Positive Externality)

Rochet and Tirole, 2006; Weyl, 2010.

Platform pricing – Social optimum

- Note! The value of the platform comes through the surplus to the users on each side + what the platform gets:

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

- The value of a platform comes mostly through its size
  - Splitting the platform would reduce the network benefits

Monopoly prices

Monopoly pricing of a network good

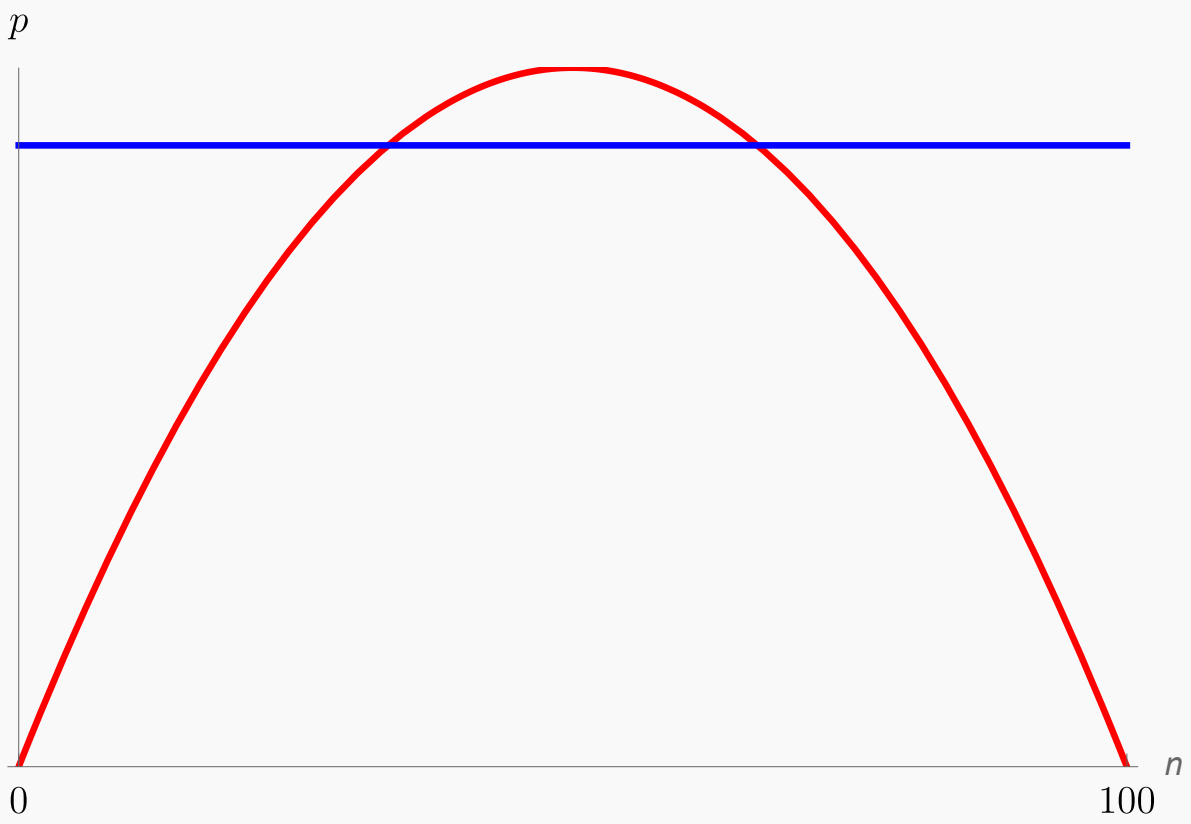


Figure. Monopoly sets the price to maximize profits: $\pi = pn = (100 - n)n^2$ and the optimal network size is $n = 200/3$ with price $p = 20000/9$ (solve for the 1st order condition, also see the Excel-file).

Platform pricing – Monopoly

- Platform pricing again different.
- Monopoly prices will differ from socially optimal prices:
  1. Classical distortion: Monopoly withholds output with higher (total) prices to increase profits.
  2. "Spence distortion": Monopoly can only choose one "quality" in any given side of the platform that it can offer to other sides.
  3. "Displacement distortion": Interaction benefits to users will differ from socially optimal.
  4. "Scale distortion": Participation rates will differ from socially optimal.

Tan & Wright, 2021.

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

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

- Other distortions consists of Spence distortions, displacement distortions, and scale distortions.
- Combined these effects mean that prices can be above or below efficient ones on some side.

Tan & Wright, 2021.

Platform pricing – Example: Ad market

- Consider the case of 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.

Example: Newpaper, very illustrative

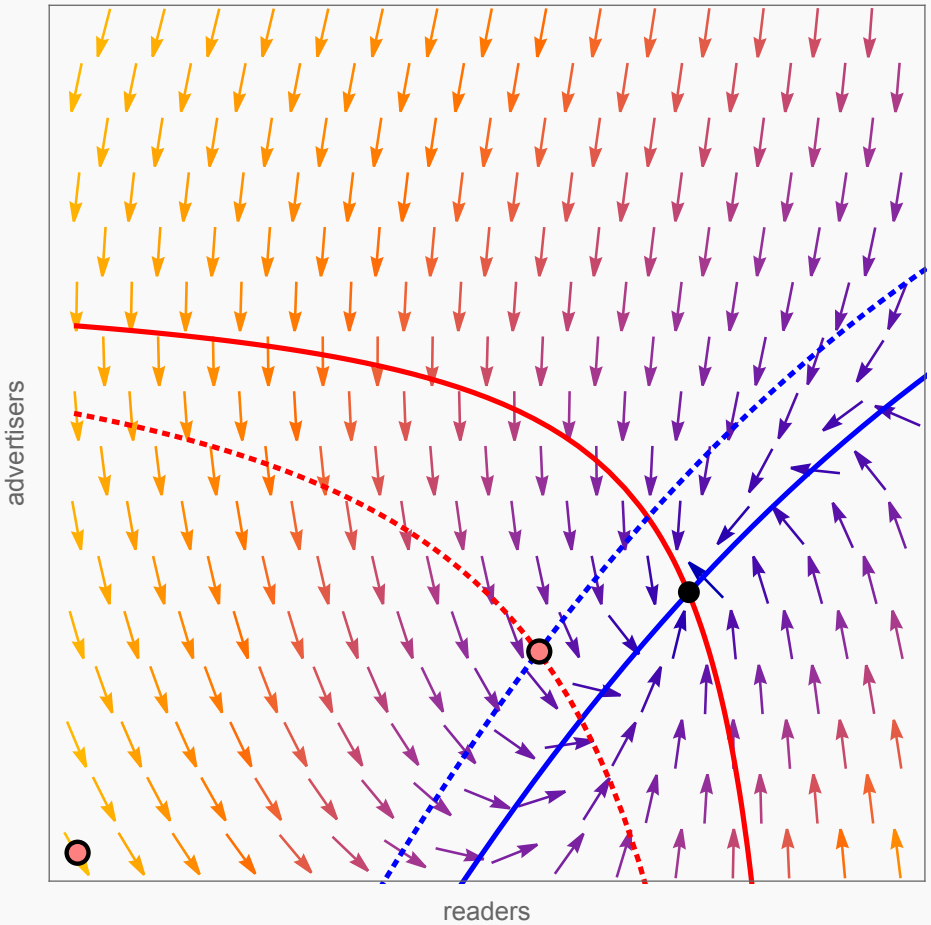


Figure. Increase in cost shifts demand (from solid red to dashed red), reducing interest to advertisers. Optimal to reduce advertiser prices (move from solid blue to dashed blue) to find new equilibrium (red dot).

Platform pricing – Monopoly

- A profit-maximizing platform may subsidize some side of the market because this generates a higher volume of trade and, thereby, higher profits on the other side of the market
  - E.g. free search at Google, no buyer fees at Amazon
- Pricing below cost on that side may be socially desirable, but the subsidy chosen by a profit-maximizing intermediary may be too low or even too high from a social point of view

Competition

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.
- Also: small firms easy target for the bigger ones

Platform pricing strategies – Predatory pricing

- 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. Red Cross donuts, early transition attempts of traditional media to internet, Alibaba Tmall

Figure 1: Donuts served for free in WWII.

Figure: Delaware Historical & Cultural Affairs.

Platform pricing strategies – How to capitalize

- Divide and conquer
  - Low fee for one group, high for the other
- Additional services with extra costs are a way to price-discriminate:
  - Same idea as with the free-to-play games
  - Capitalization e.g. through payment services (Alipay, PayPal before split from eBay), premium services (Tmall, Amazon Prime) or logistics
- Or introduce other sides to the platform, e.g. Youtube ads
- Or capitalize user data
  - Platforms can choose what information to reveal to the users, e.g. buyer data to other sellers at Amazon

Platform pricing – Competition

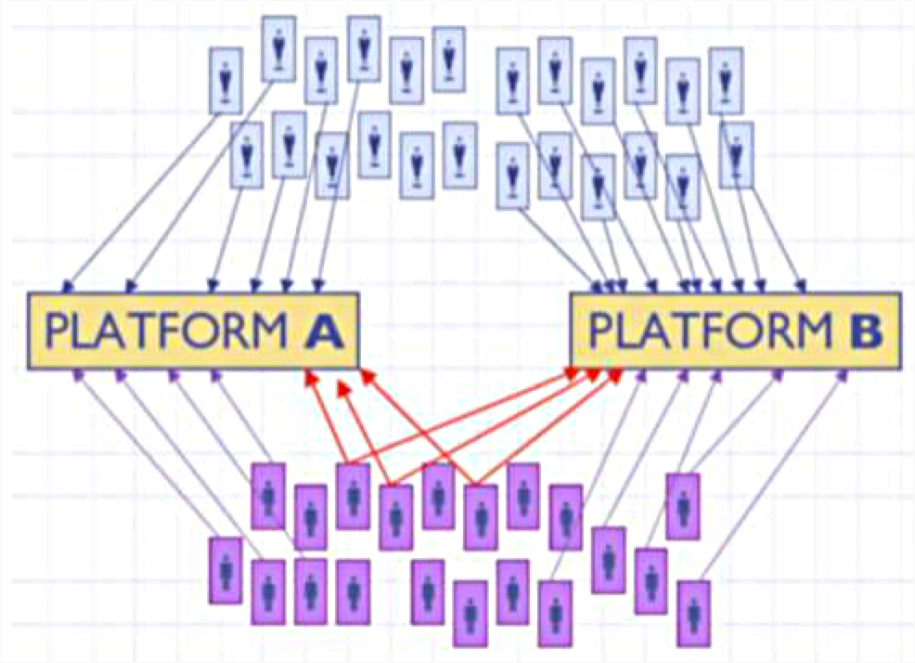
- Like in monopoly, competing platforms design their price structures so as to maximize their profits
- Tremendous multiplicity of equilibria are possible in competition between platforms depending on the pricing
- Price competition is intensified when consumers place a higher value on the size of the network. This leads firms to reduce prices in order enlarge their network size
- Usage prices are usually lower on the market side which exerts a stronger externality on the other side

Source: Rochet and Tirole 2003, P. Belleflamme.

One more definition: 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.

Platform pricing – Multihoming

- 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
- Also, 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

Source: Rochet and Tirole 2003.

Platform competition – Example

- 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
- 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

Source: White and Weyl, 2016.

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 Android and Apple.
- eBay
  - Amazon taken over in the U.S. Alibaba in China etc.
- Apple iTunes
  - Lost to streaming services, e.g. Spotify.
  - Now transitioned to Apple Music.
- MySpace
  - Lost to Facebook. (And Facebook . . . ?)

Openness

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
  - E.g. Amazon offering its own products

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
- For a network good this has higher value than for a traditional good 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 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, motivated on quality grounds (that are now challenged in the courts!)
  - Oftentimes in digital world compatible services are hard to envision: e.g. Google search, Instagram, 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 their data, harder to split profits compared to users paying money for compatible products to different firms (nuts and bolts)

Learnings today

- Pricing on platforms is complex. The price on one side affects demand on that side. Pricing needs to take into account the externalities that change in demand on one side causes in the other sides.
- Monopoly platform fails to fully internalize the externalities when setting the prices, leading to prices deviating from socially efficient levels.
- Because of network externalities, no easy remedy to increase competition through regulation.

Materials for this week

Online resources:

- **Moral hazard**. If need be, consult MRU on asymmetric information, moral hazard, and signalling. mru.org: Asymmetric information.

More technical sections from earlier readings

- Levin, Jonathan (2011) "The Economics of Internet Markets", NBER Working Papers 16852. Section 2.
- Evans, D. and R. Schmalensee (2007) "The Industrial Organization of Markets with Two-Sided Platforms", Competition Policy International. Section III A.

Reading assignment 5:

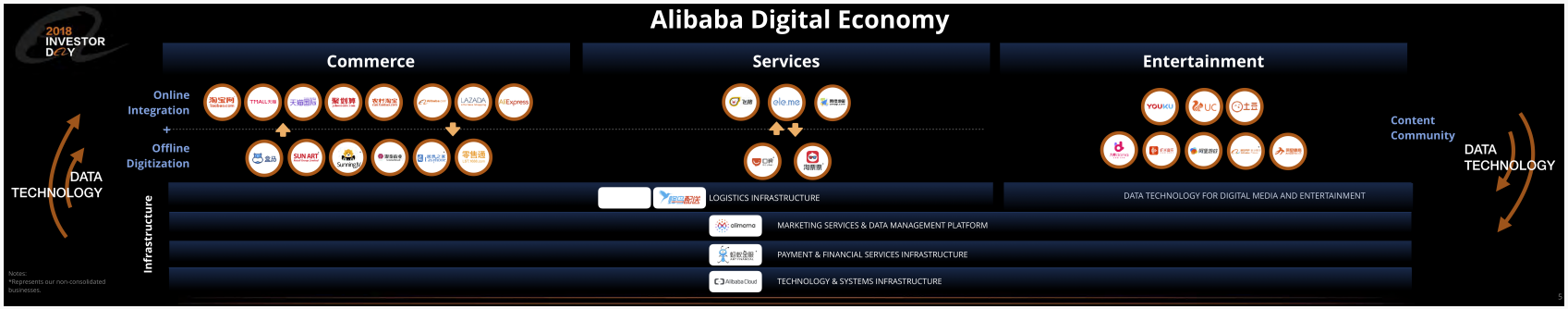
- **Platform stratgies**. Rysman, Mark (2009). "The Economics of Two-Sided Markets. Journal of Economic Perspectives", Volume 23, Number 3. Section on Public Policy will be discussed in lecture 12.
- **Sharing economy**. Luca, Michael (2017). "Designing Online Marketplaces: Trust and Reputation Mechanisms." Innovation Policy and the Economy.

Next time

- Sharing economy / peer-to-peer markets
- Reputation

Appendix

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.

Platform pricing vs. complementary products

- Though platform pricing is similar to complementary of goods, the logic with platform pricing is different:
  - For example, with tennis balls and a tennis racket the same consumer enjoys the complementary benefit.
  - With platforms, the benefits are divided to different sides.

Competing platforms

Multiple platforms are more likely to coexist, if

- Platforms are sufficiently different
  - Android and Apple iOS
  - Instagram and Twitter
- Multihoming is feasible
  - Exchanges
  - Credit cards
- It is hard to differentiate within a platform
  - Streaming services

Source: Rysman, 2009.

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)

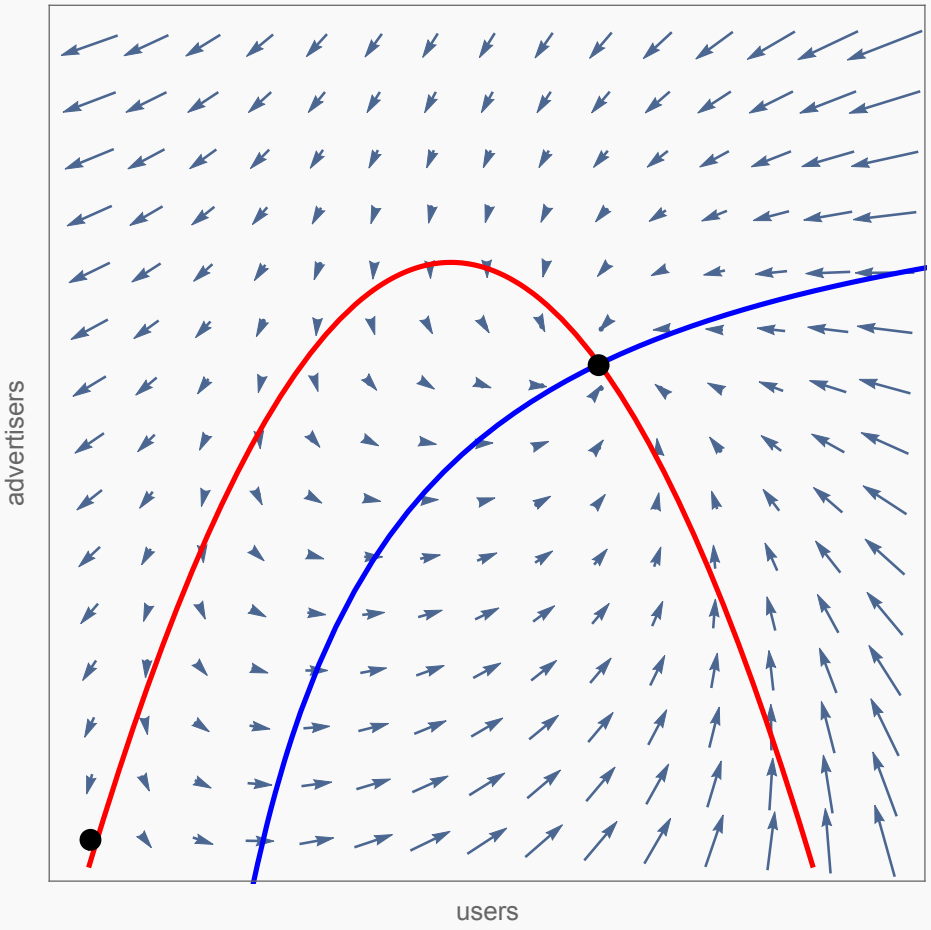


Figure. Simple ad model: Indifference curves for buyers (red line) and sellers (blue line) with fixed prices. Black dots show the equilibria, and the arrows to which equilibria a given starting position would lead.

Ad market model (illustrative)

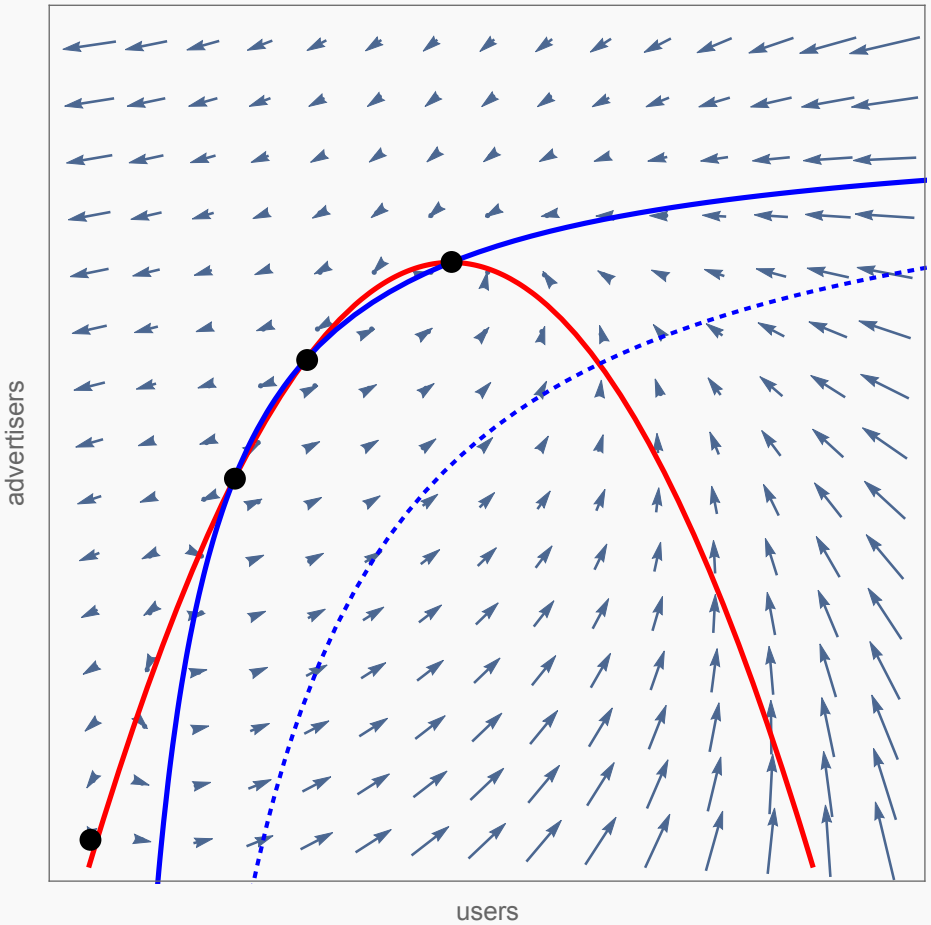


Figure. Simple ad model with lower prices for advertisers (solid blue line) vs. higher advertiser prices (dotted blue line). Number of advertisers can become higher, lower, or the same.

ECON-C5100 Digital Markets

Iivo Vehviläinen

February 9, 2022

Aalto University
iivo.vehvilainen@aalto.fi

Lecture 10: Sharing economy

Outline

- Recap: Platform strategis
- Sharing economy / peer-to-peer markets
- Reputation
- Externalities

Recap: Platform strategies

Recap: Platform pricing

- The structure and characteristics of a particular market determine how the sides of the platform affect each other.
- Pricing for users on one side of the platform needs to take into account the externality that the users create on the other side(s) of the platfom.
- As a result, the price for a particular side does not need to fully reflect the cost of serving that side.

More general platform price structure

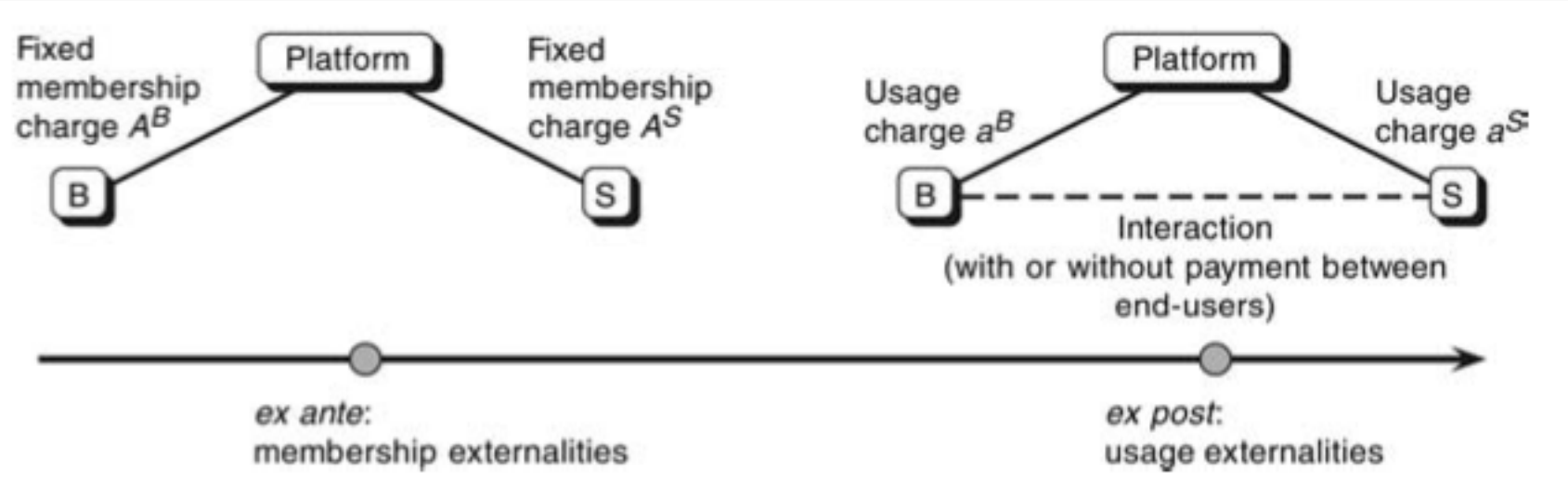


Figure. Simplified pricing structure on a platform.

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

Rochet and Tirole, 2003; Armstrong, 2006; Figure: Rochet and Tirole, 2006.

Examples of platform pricing choices

Industry	Side	Access	Usage
Ad sponsored media	Advertisers	0 ($< MC$)	✓
	Users	0	0
Clubs	Men	✓	✓
	Women	✓	✓
Mobile phone apps	Developers	✓($< MC$)	✓
	Users	Cost of device	✓
Newspapers	Advertisers	0	✓
	Readers	✓($< MC$)	0
Online market places	Buyers	0	0
	Sellers	✓	✓
Payment cards	Cardholders	✓($< MC$)	0
	Merchants	0	✓
Shopping malls	Shoppers	0	0
	Stores	✓	0

Adapted from Evans and Schmalensee 2007.

Recap: Platform pricing

Some general guidelines can be given:

- A social planner would set the prices based on cost plus the externality to the average user on the other side of the platform.
- Monopoly prices would be different from social optimum:
  - the monopoly would withhold production
  - monopoly is only interested in the externality to the marginal user on the other side of the platform
  - pricing account for the distortions in the number of users
- Prices are usually lower on the market side where users are more price responsive and which exerts a stronger externality on the other side.

Sharing economy

Sharing economy

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

Figure: BlaBlaCar.

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.

Examples of P2P markets

What are the P2P markets you have been using or providing services with?

Use the text field in the Presemo presemo.aalto.fi/digimar vote to add the site and the link.

Sharing economy provides flexibility

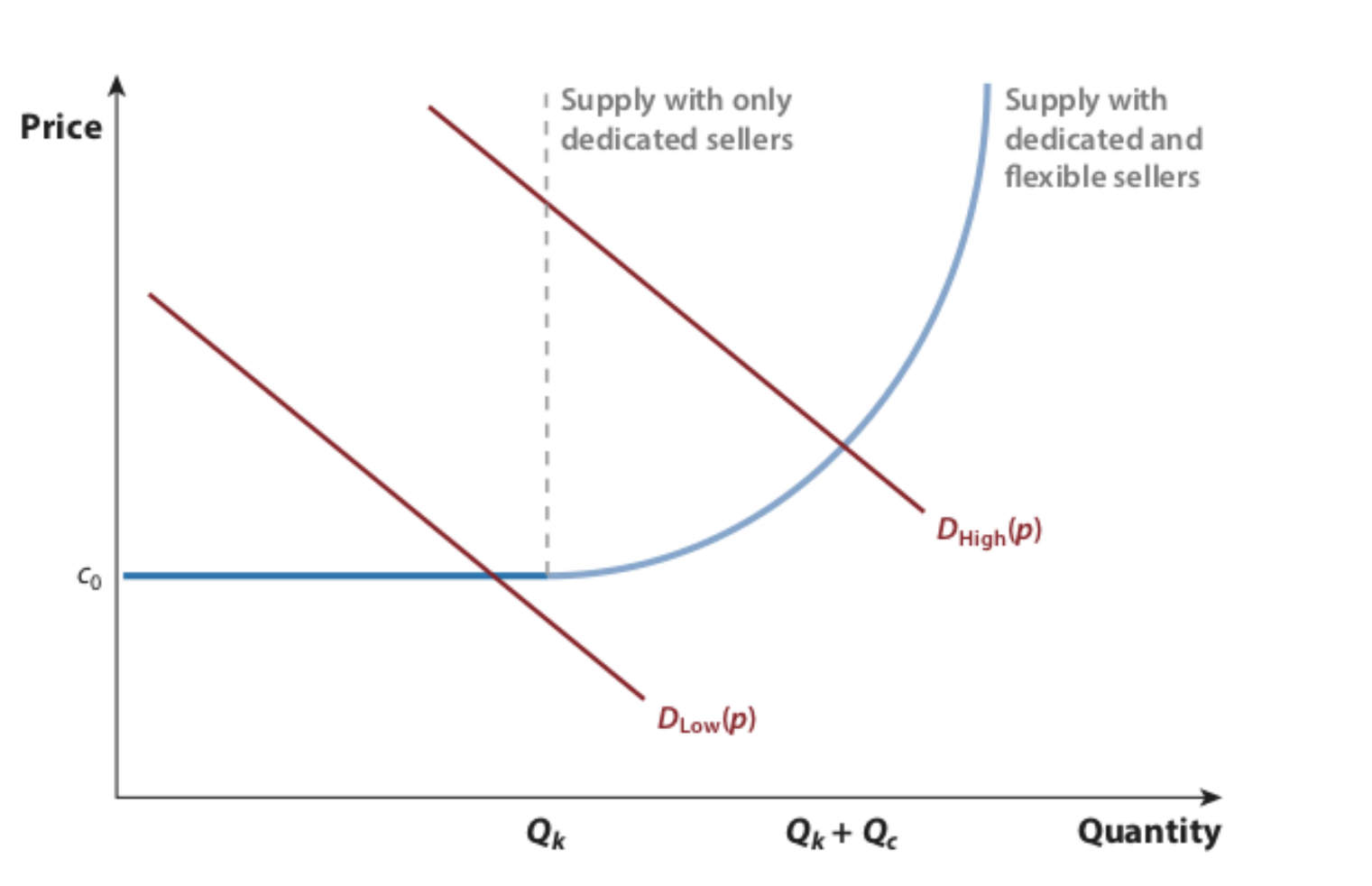


Figure. Sharing economy can increase capacity in traditional businesses.

Source: Einav et al. 2016.

P2P market design

- P2P markets require efficient search and matching algorithms and proper platform pricing strategies.
  - cf. 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".

Features of building trust at AirBnB

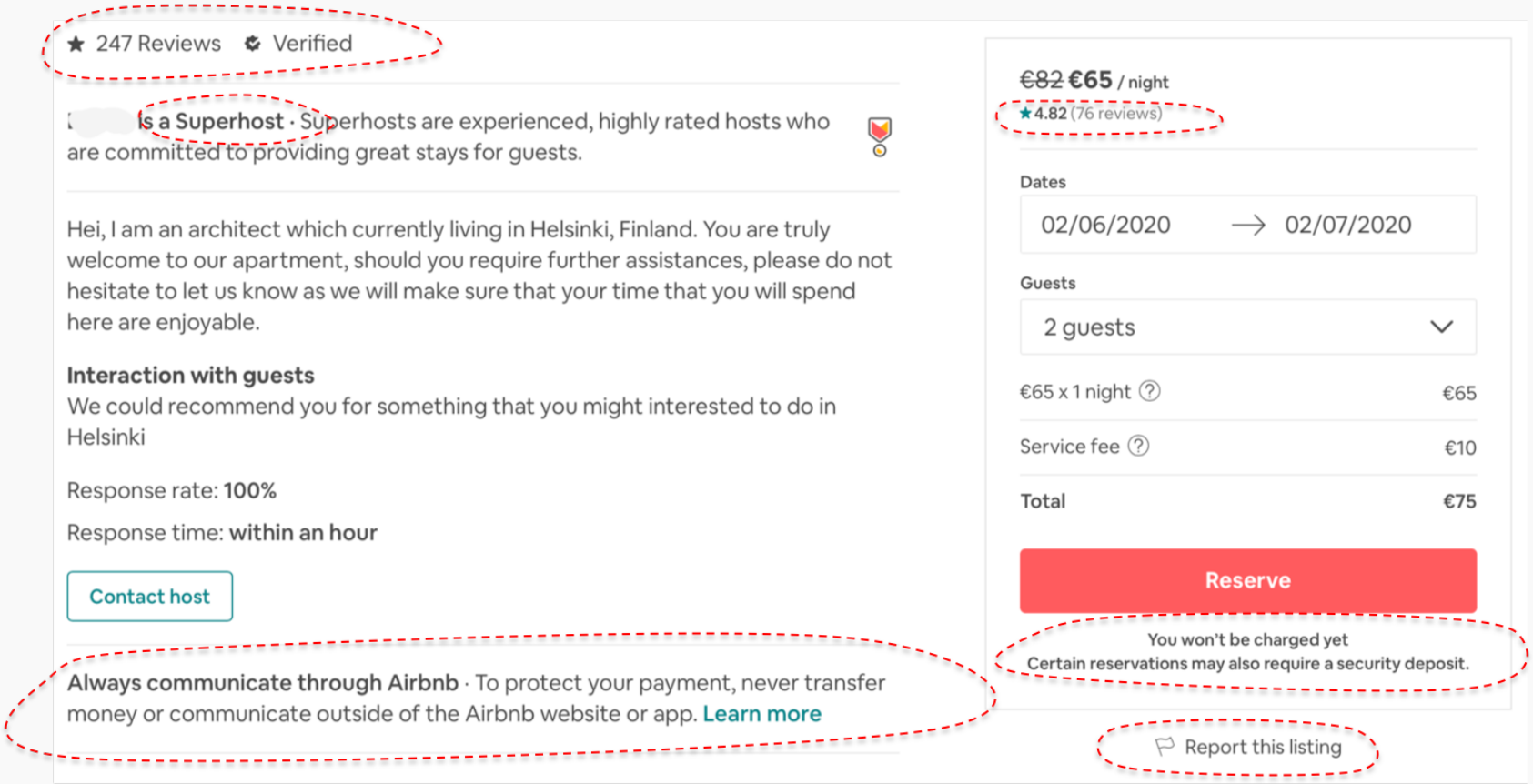


Figure. Example of the interface of AirBnB with several design elements that try to make you comfortable in making the booking.

Figure: AirBnB.

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.

Reminder: The square and the tower

Market square in Siena, Italy. Source: Tuscany, Beautiful Everywhere.

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? (market for 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.
- Indirect measures also possible, e.g. use AI to follow messaging between the buyers and sellers post-trade.

E.g. Milgrom and Tadelis (2019).

Asymmetric information

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.

Source: Edelman 2017.

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

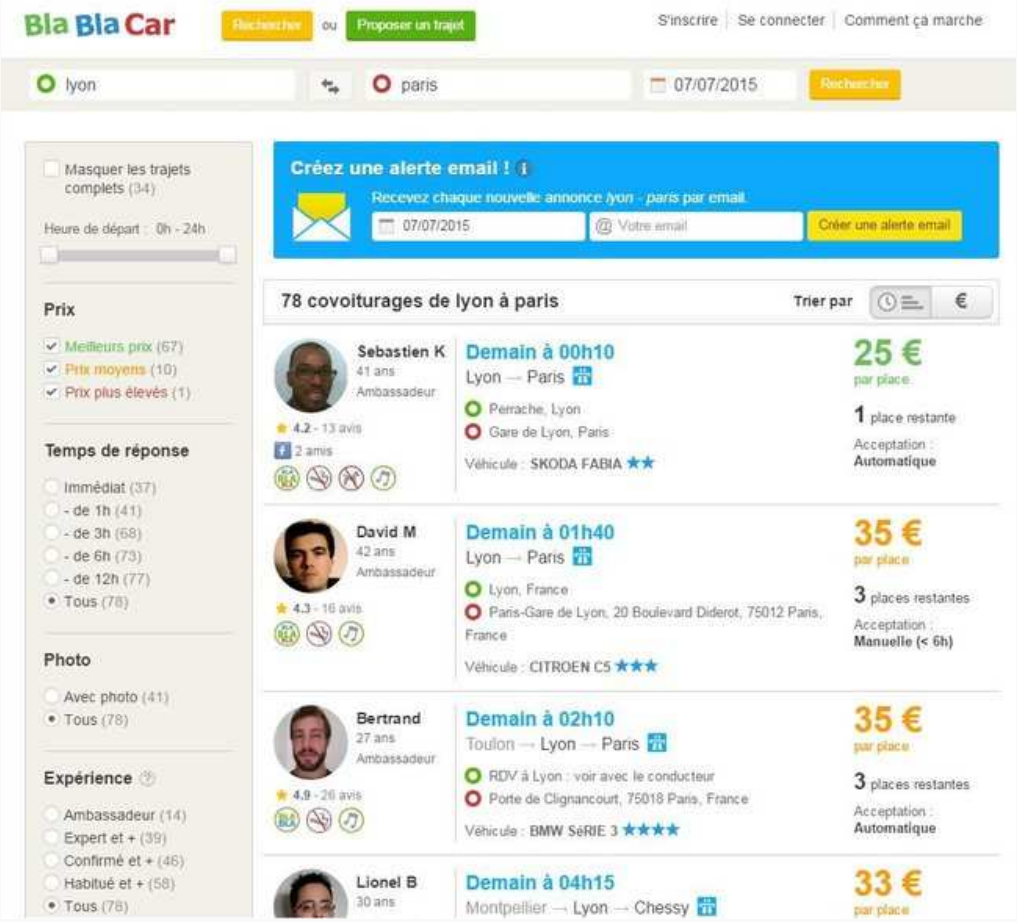


Figure. Example of pricing on BlaBlaCar.

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.
  - The reason?
- In the digital world, easier to set curtains that manage the flow of information, but design still going to be tricky.

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.

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
  - Consumer protection, market power, externalities.
  - More on regulating these in lecture 12.

Learnings today

- Platform competition and pricing in the digital domain are complex; the outcomes are dependent on the specific market.
- Also other dimensions of platform design 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.

Materials for this week

Online resources:

- **Moral hazard**. If need be, consult MRU on asymmetric information, moral hazard, and signalling. mru.org: Asymmetric information.

More technical sections from earlier readings

- Levin, Jonathan (2011) "The Economics of Internet Markets", NBER Working Papers 16852. Section 2.
- Evans, D. and R. Schmalensee (2007) "The Industrial Organization of Markets with Two-Sided Platforms", Competition Policy International. Section III A.

Reading assignment 5:

- **Platform stratgies**. Rysman, Mark (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.
- **Sharing economy**. Luca, Michael (2017). "Designing Online Marketplaces: Trust and Reputation Mechanisms." Innovation Policy and the Economy 2017.

Last week

- Digital goods
- Regulation

Appendix

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.

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.

Examples of P2P markets

- Accommodations (Airbnb, Fairbnb.coop, Uniplaces)
- Computer programming (Andela, Freelancer, Upwork)
- Consumer loans (Lending Club, Prosper)
- Crafts (Etsy)
- Currency exchange (CurrencyFair, Wise)
- Dating (Tinder)
- Deliveries (Foodora, Wolt)
- Household tasks (Handy, TaskRabbit)
- Local goods and services (Craigslist)
- Marketplaces (eBay, Huuto.net, Tori.fi)
- Rides (BlaBlaCar, Grab, Uber)
- Start-up financing (Kickstarter)
- User generated content (Twitch, YouTube)

Adapted from Einav et al. 2016.

ECON-C5100 Digital Markets

Iivo Vehviläinen

February 14, 2022

Aalto University
iivo.vehvilainen@aalto.fi

Lecture 11: Digital goods

Outline

- Digital goods
- Cyber security

A definition

> Economics is the study of how society allocates scarce resources and goods.

Digital goods

- What changes if the scarcity is relaxed?
- The replication costs of digital goods is (nearly) zero.
- Digital goods are non-rival
  - Consumption of a movie from Netflix does not affect the possibility of others to consumer the same movie.
- In comparison to traditional goods
  - Going to a movie theater: the seat that you take takes away the possibility to see the same movie from someone else.
  - Renting a DVD: the disc can only be in one place at a time.
- The cost of delivering the movie from Netflix server to a consumer is also nearly zero.

Digital goods industry

So producing digital goods is (nearly) free, but how can the goods be priced profitably?

1. Selling eyeballs
2. Selling data
3. Selling the service

Source: Lambrecht et al. 2014.

Reminder: Auctions as a tool for selling stuff

How to choose price for thousands of ads sold to billions of consumers?

- 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.

Reminder: Selling eyeballs

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.

Reminder: Selling eyeballs

- Ad auctions in Google search
  - Advertisers send their bids in cents per click by search term.
  - Auctions are used to clear the market.
- Advertisements seen on a normal webpage or within an app are auctioned in a similar fashion.
  - Can be also cost per impression rather than cost per click.
  - Exact auction form varies.

Value of digital goods?

How much is Google search worth to you?

Use the chat in Presemo presemo.aalto.fi/digimar to report your price and the link.

Importance of digital services to well being

Table 1. Median WTA estimates for most popular digital goods categories

Category	WTA per year 2016, $	WTA per year 2017, $	95% CI WTA per year 2016, $		95% CI WTA per year 2017, $		n
			Lower	Upper	Lower	Upper	
All search engines	14,760	17,530	11,211	19,332	13,947	22,080	8,074
All email	6,139	8,414	4,844	7,898	6,886	10,218	9,102
All maps	2,693	3,648	1,897	3,930	2,687	5,051	7,515
All video	991	1,173	813	1,203	940	1,490	11,092
All e-commerce	634	842	540	751	700	1,020	11,051
All social media	205	322	156	272	240	432	6,023
All messaging	135	155	98	186	114	210	6,076
All music	140	168	112	173	129	217	6,007

Figure. How much money a median user would have to get (WTA, willingness-to-accept) in order to not have access to digital services.

Source: Brynjolfsson et al., 2019.

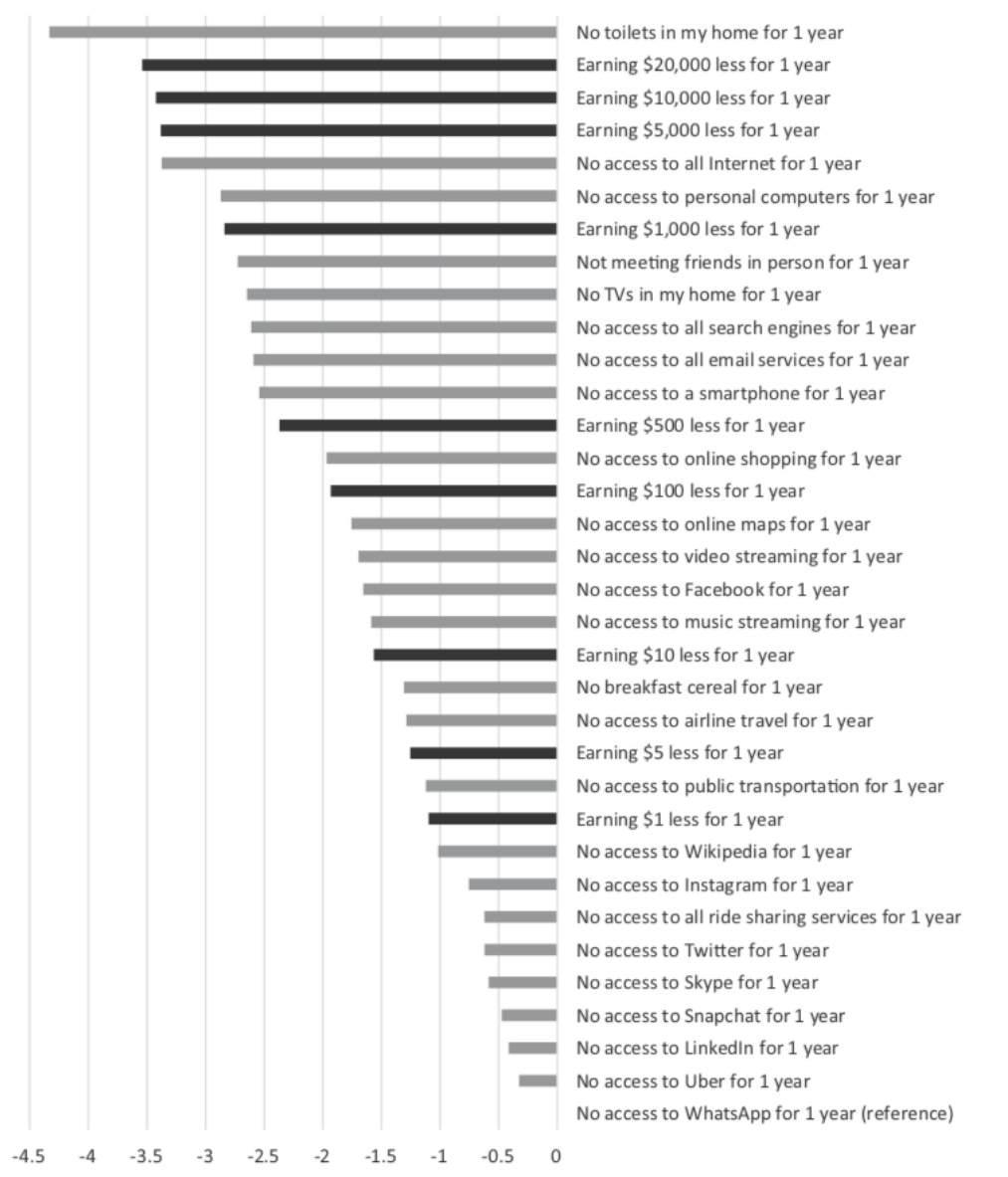


Figure. Relative disutilities from not having access.

Source: Brynjolfsson et al., 2019.

Selling eyeballs

- Many of the online services provide utility to the users
  - Search, maps, email, e-commerce, social media, messaging, entertainment, etc.
- Companies that can provide such utility can attract users to their pages.
- Repeated opportunities to sell ad space.
- Free access to a webpage maximizes the number of users.

Impacts of zero prices

- Reduction of transaction costs
  - No need for billing
  - Sometimes no need for accounts etc.
- Consumers like zero-price products.
  - Seems to go beyond simple utility maximization.

Shampanier et al., 2007.

Unwanted consequences of free pricing: E-mail

Cost of Spam Advertising Relative to Other Advertising Media
(cost per thousand impressions (CPM))

		Breakeven conversion with marginal profit = $50.00	
Advertising vector	*CPM*	*Percent*	*Per 100,000 deliveries*
Postal direct mail	$250–1,000	2–10%[a]	2000
Super Bowl advertising	$20	0.04%	40
Online display advertising	$1–5	0.002–0.006%	2
Retail spam	$0.10–0.50	0.001–.0002%	0.3
Botnet wholesale spam	$0.03	0.00006%	0.06
Botnet via webmail	$0.05[b]	0.0001%	0.1

Figure. Spammers were responsible of roughly half of the 300 billion emails send every day in 2018. Their annual private gain was estimated to be $200 million in 2012 with a social cost that was 100 times greater.

Source: Rao and Reiley, 2012.

Selling eyeballs

Firms use tracking to collect data that is used

- To target the ads more precisely
- To develop services
- To keep people coming back
- For sale

Selling data – Benefits

- Advertising revenues support new services on the Internet.
- Targeted advertising gives consumers useful information.
  - User see ads that should more precisely reflect their "needs".
  - Reduces the showing of unwanted ads.
  - Improves efficiency of advertisement.
- Information can be "reused", increasing its value.

Lenard and Rubin, 2009.

Selling data – Incentives

- Trade-off in the incentives for consumers to reveal data
  - Sharing information may increase benefits.
  - Equally rational to not share too much information.
  - Possibility for resale of data leads to more caution.
- Implications to market efficiency and competition ambiguous.
- We'll return to privacy questions in the lecture about regulation.

Acquisti et al., 2016.

Selling data – Institutions

- Who has the property rights for data?
  - Consumers waiver a lot of their rights in the terms of services.
  - Granting access to data not always made knowingly.
- Birth of data intermediaries
  - Collecting data from various sources for resale.
- Also possibility for data breaches.
- Solution proposed by Tim Berners-Lee: "Pods," personal online data stores.

Data breaches: Hacking

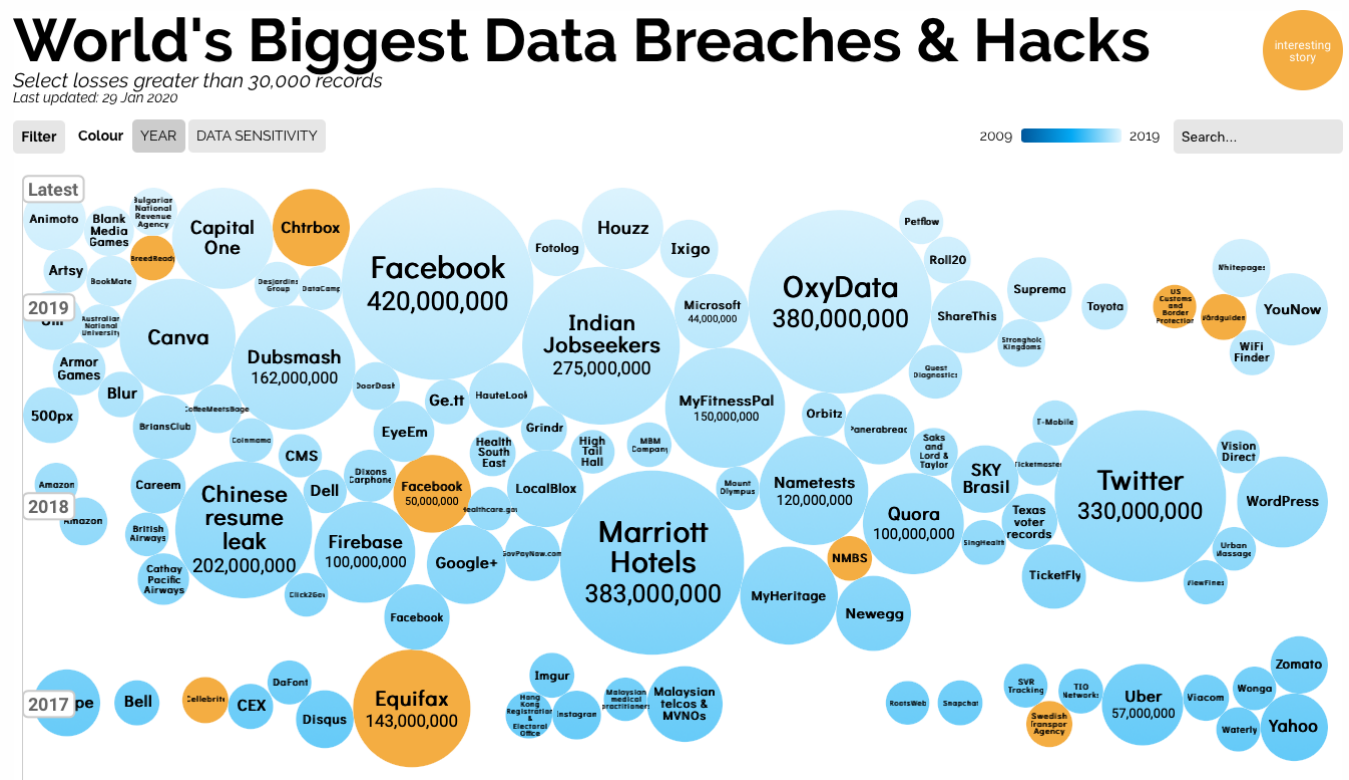


Figure. Data breaches of various sorts seem to be an increasing problem, with total global cost of $2–3 trillion in 2019.

Figure: https://www.informationisbeautiful.net/visualizations/worlds-biggest-data-breaches-hacks/

Data breaches: Hacking

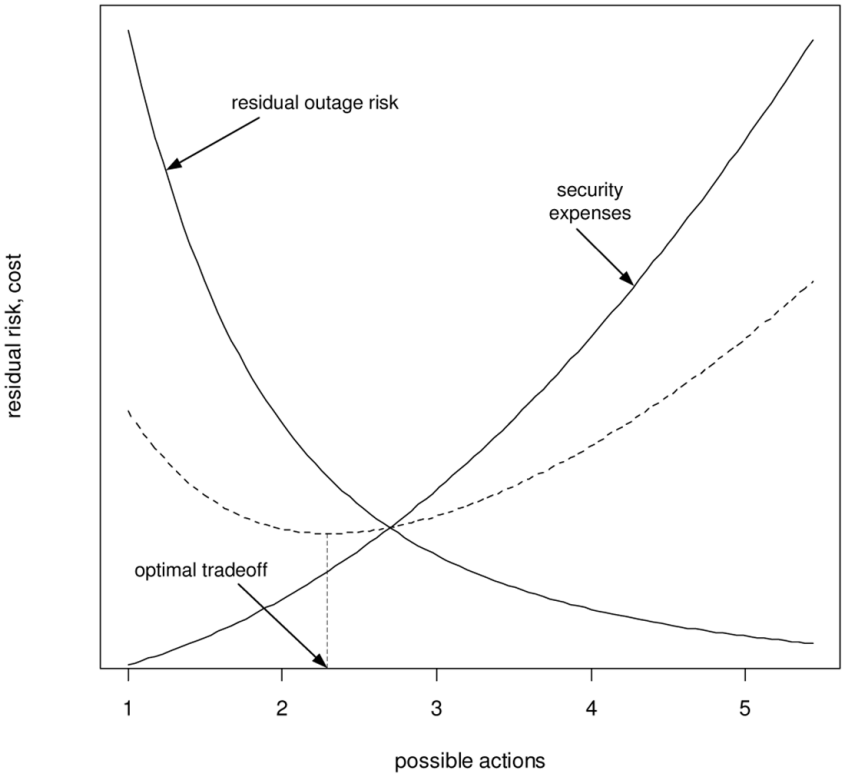


Figure. Investment to security reduces the risk of security breach. While initially effective, security investments have diminishing marginal returns that make it unprofitable to protect against all eventualities. The level of security is set where the total cost ($\sim$ dashed line) is minimized.

Figure: Rass et al. 2017.

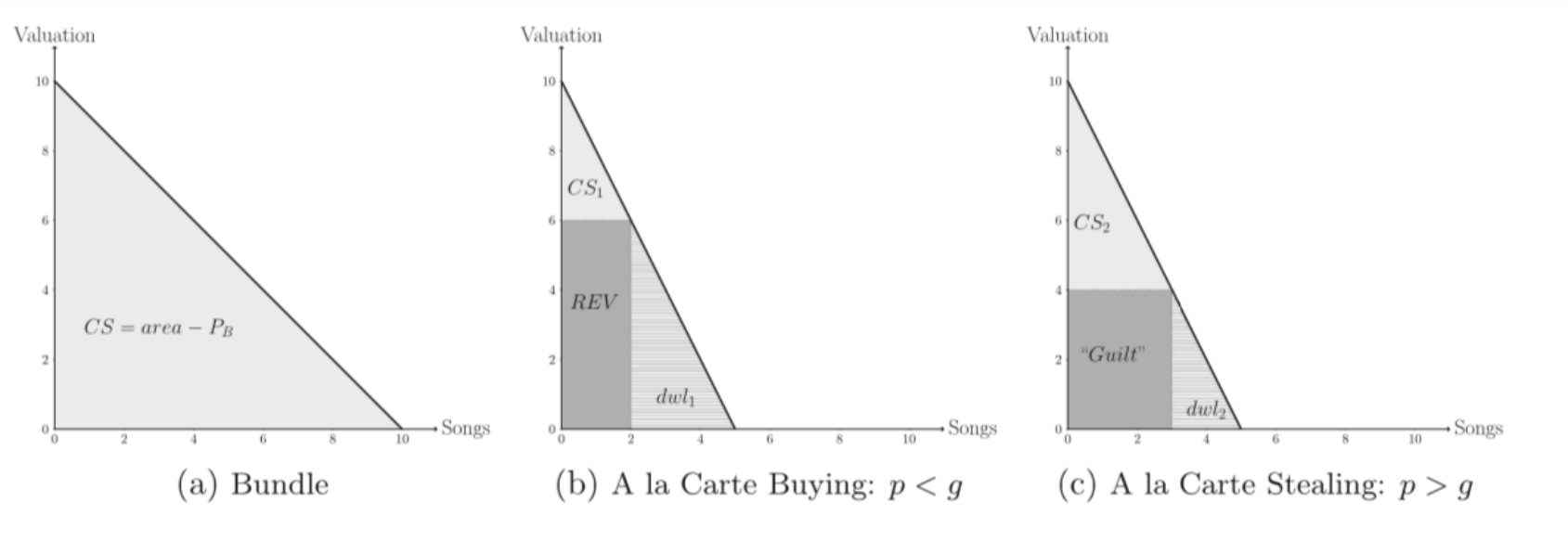
Selling the service

- If marginal costs are near zero, why are not all digital services prices near zero?
- In many services network effects play a role and give the network operators pricing power, for example:
  - Marketplaces that can offer a large number of buyers and sellers (e.g. Alibaba, Amazon).
  - Software platforms that have a large number of users (Android, Apple iOS, Windows).
- Notice though that the profits are due to innovation and investments.

New ways to price goods

- The non-rival nature of digital goods makes it possible to bundle products.
- Bundling so far particularly popular in entertainment in the form of streaming
  - Exemplified by Spotify that took over Apple iTunes.
  - Development in technology has allowed the spread of streaming to video, here Netflix was an early pioneer.

Why streaming won?



(a) Bundle (b) A la Carte Buying: $p < g$ (c) A la Carte Stealing: $p > g$

Figure. Alternatives for a consumer to enjoy music.

Source: Aguiar and Waldfogel, 2018.

Bundling

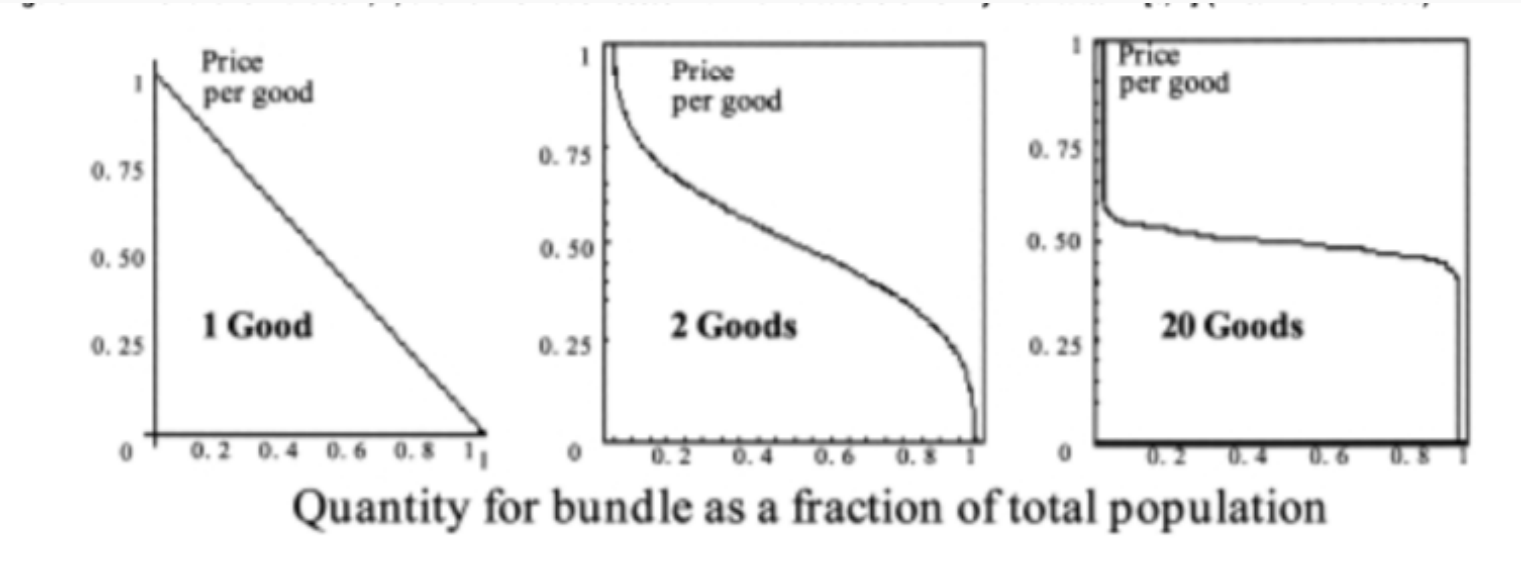


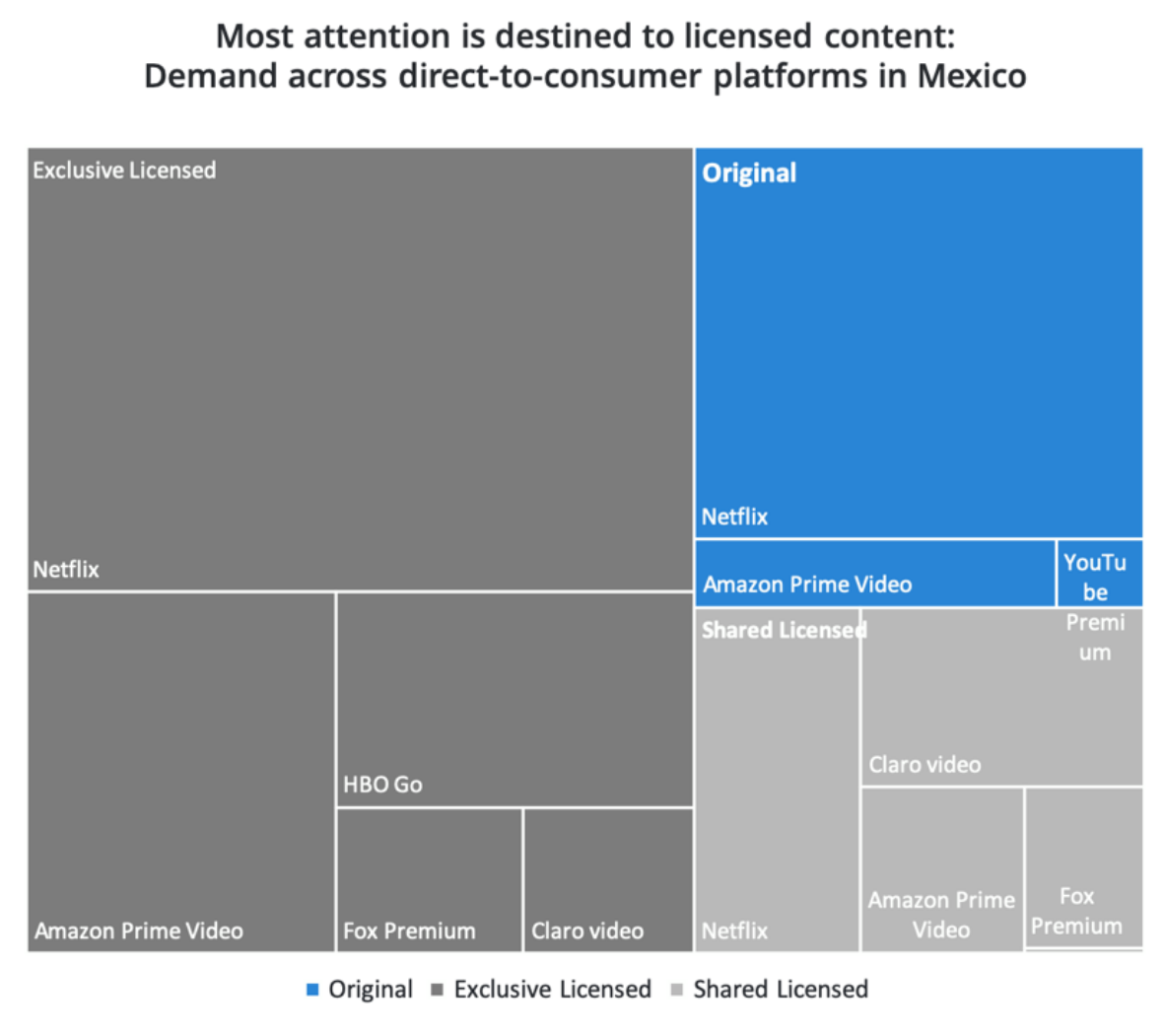
Figure. Bundling several non-rival goods to heterogeneous consumers will extract higher rents from consumers than pricing the products individually.

Source: Bakos and Brynjolfsson, 1999.

Exclusive content – A "must have"?

> At trial, much time was spent debating the "must have" status of Turner's programming content. According to the Government, distributors literally "must have" Turner's content in order "to compete effectively".... Defendants countered that the term "must have" simply a marketing phrase used to mean "popular" and, similarly, that Turner content is not actually necessary to allow distributors to operate their business successfully.
>
> –Judge Richard Leon in USA v. AT&T et al. (2018)

Reminder: Exclusive content vs. bulk

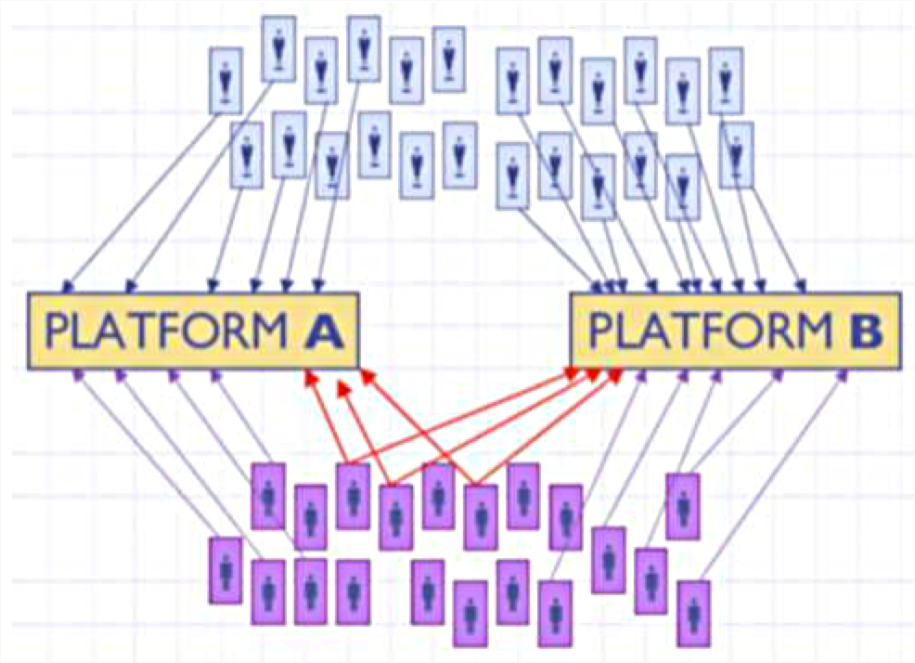


Source: PARROT analytics, 17 Oct 2019.

Reminder: multihoming

Intuition:

- Platforms have a monopoly access for singlehomers.
- Singlehomers are courted: once captured are monopoly subjects.
- Multihomers are exploited: they want to have access to the singlehomers.



Source: P. Belleflamme.

Must-have items

- Consider two items on sale: A and B and two service providers $R1$ and $R2$.
- Product A has no substitutes, product B has several.
- Some consumers like A, some B, and yet others both.
- If there are enough singlehomers, then product A can become a "must-have":
  - Say that initially both service providers carry both items.
  - Now consider the removal of item A from $R2$. Then $R1$ has better selection to consumers who like both A and B.
  - Singlehomers that like both will then converge to $R1$, and this will affect the sales of also item B at $R2$.

Opinion

AN OP-ED FROM THE FUTURE

We Should Have Bought the DVDs

It's 2022. I don't know if I'll ever own a house, but I can own my favorite television shows in their entirety.

By Veronica Walsingham

Ms. Walsingham is a writer.

Figure. Result of "streaming wars"?

New York Times, 20 Jan 2020.

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.
- 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.

Digital public goods

- Information creators can decide to share their goods for free.
  - Open source software.
  - Wikipedia and the like.
- A puzzle, why do they choose to do so?
  - Altruistic behavior: want to do good.
  - For a developer, a possibility to signal your value.
  - For a company, possibility to sell complementary services.
- Many digital public goods have network good characteristics
  - More people working with the same project help in development.
  - Can reach a dominant position.
  - Can reduce incentives to innovate.

Learnings today

- Digital goods are different from traditional goods: they are non-rival and not affected by some of the scarcity constraints and costs of traditional goods.
- Monetization of digital goods and services has three main routes: selling eyeballs, selling the service, or selling the data.
- Digitalization creates new opportunities (open source, blockchain) but also puts pressure to the established institutions (IPR, privacy).

Materials for this week

Reading assignment 6:

- **Digital markets**. Lambrecht, Anja, Avi Goldfarb, Alessandro Bonatti, Anindya Ghose, Daniel G. Goldstein, Randall Lewis, Anita Rao, Navdeep Sahni, and Song Yao (2014) "How Do Firms Make Money Selling Digital Goods Online?" Marketing Letters.
  - References to literature, the models that do get sometimes slightly complicated can be freely skipped.
- **Regulation**. Demange, G. (2018) "Mechanisms in a Digitalized World", CESifo Working papers. Should be relatively easy read.

Next time

- Consumer protection
- Market power
- Externalities

Appendix

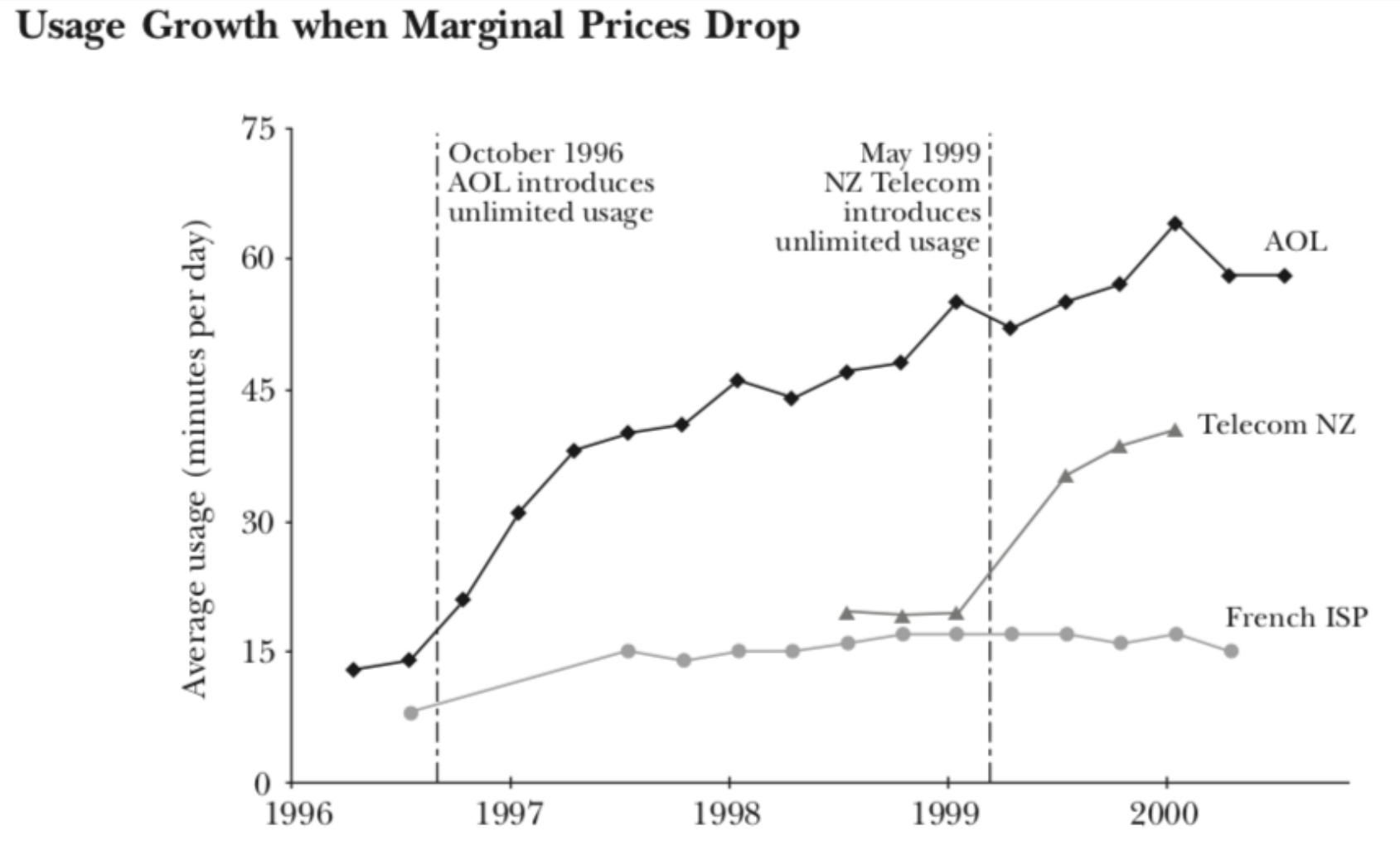


Figure. Change in usage when pricing moved from usage to access.

Source: Odlyzko, 2001.

Property rights and liability laws – Example

- Publishers and record labels less important as digitalization opens new avenues for distribution of work, for example
  - Video, e.g. Vimeo and YouTube.
  - Inexpensive publishing and distribution services Smashwords for books, Soundcloud and Jamendo for music.
- It may be optimal to share some of the content for free to increase consumer awareness
  - Publishers less eager to enforce their rights.
- Revenues collected from various sources.

Mustonen, 2019

ECON-C5100 Digital Markets

Iivo Vehviläinen

February 16, 2022

Aalto University
iivo.vehvilainen@aalto.fi

Lecture 12: Regulation

> 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.*

Outline – Why regulate?

Typical concerns are

- Consumer protection
- Market power
- Externalities

Consumer protection

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

Consumer protection: What are the concerns on data?

- Privacy
  - Considered to be a human right on its own.
  - Privacy paradox: Consumers do not seem to act rationally.
- Illegal uses of data
  - Firms do something else with the data than they say they do.
  - Data can be compromised.

Big data and privacy – Example

Target by custom data feeds

Trainline used Dynamic's SmartContent platform to integrate a custom data feed containing the latest train journey offers and availabilities at various train stations. Different digital screens displayed customised creatives showing passengers the most relevant availabilities at their train station, and helping them to make the most of the offers at a given time and place.

Figure: JCDecaux.

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 know 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).
- . . . or care if they know that data is being colleced.
  - Privacy paradox: When asked, users say that they care about privacy, but in real life they seem to accept data collection.

Big data and privacy – Data misuse

App	Google Play downloads	Clear information that they share data with non-service provider third parties in the consent flow?	Clear information in the consent flow that shared data is used for targeted ads?	In-app options to reduce data sharing with third parties?
Clue	10,000,000+	✗	✗	✗
Grindr	10,000,000+	✗	✗	✗
Happn	50,000,000+	✓	✗	✗
Muslim: Qibla Finder	10,000,000+	✗	✗	✗
My days	5,000,000+	✗	✗	✗
My Talking Tom 2	100,000,000+	✓*	✓*	✓*
OkCupid	10,000,000+	✗	✗	✗
Perfect365	50,000,000+	✓	✓	✗
Tinder	100,000,000+	✗	✗	✗
Wave Keyboard	10,000,000+	✗	✗	✗

*Only provided information and options when the user said they were born in 2002 or earlier.

Figure. Popular dating services like Grindr, OkCupid and Tinder are spreading user information like dating choices and precise location to advertising and marketing companies in ways that may violate privacy laws.

Figure: Norwegian Consumer Council.

Reminder: 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).
- Information can be "reused", increasing its value.

Big data and algorithms

- Algorithmic use of data leads to high level of selection:
  - Aim is to offer user specific content that increases sales.
  - This can be a purchase decision, click on an ad or more time spent on the platform.
- Algorithmic externalities
  - Discrimination of some users.
  - 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.
- Limited transparency on the how the algorithms operate.

Algorithmic discrimination – Examples

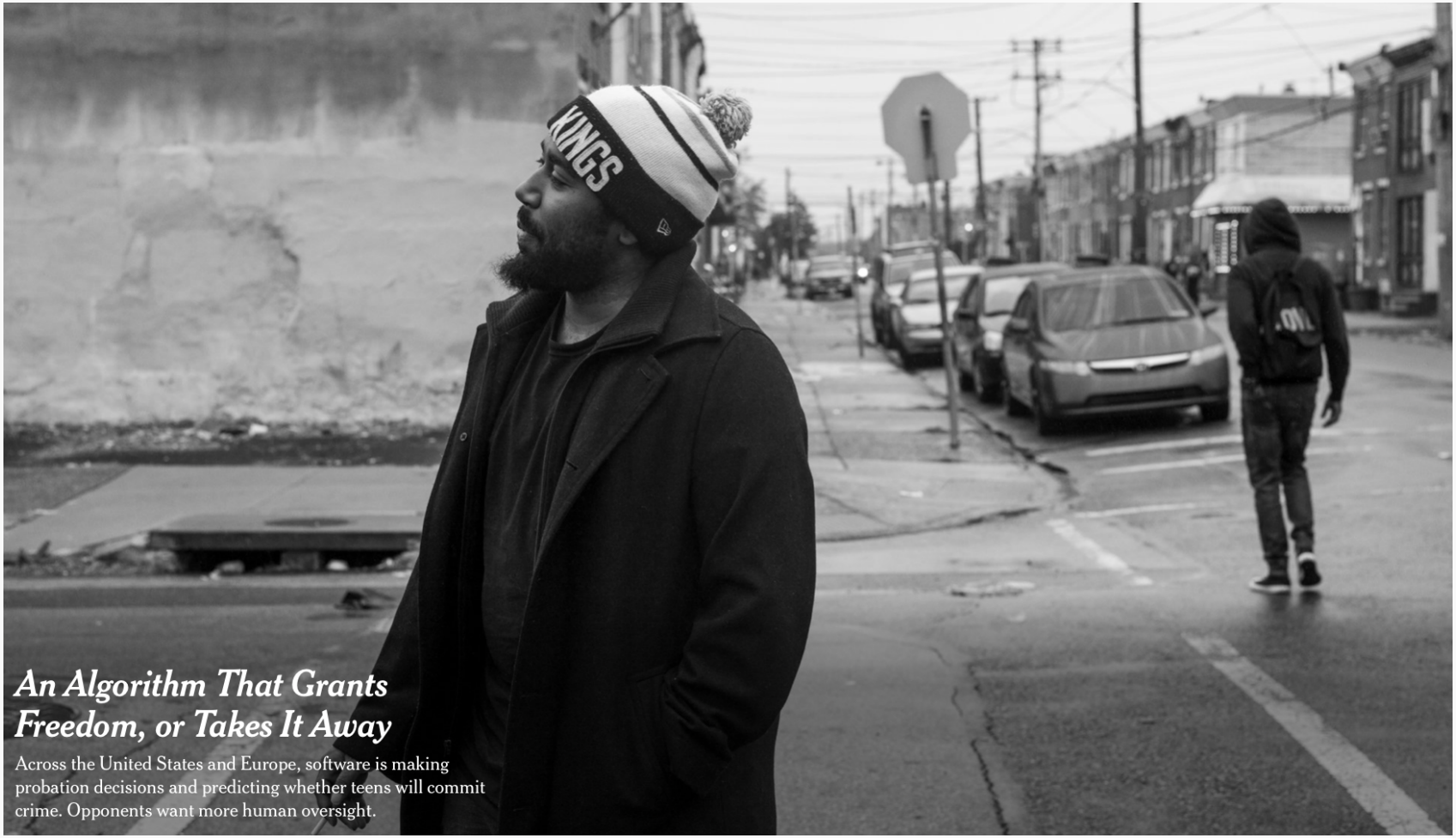


Figure. Profiling is used in deciding probation risk in the U.S., detecting welfare abuses in Holland, and predicting teen crime risk in the U.K.

New York Times, 6 Feb 2020.

Algorithmic discrimination – Trade-off

Trade-off in the use of data in decision making:

- To avoid disparate treatment, *protected category* attributes cannot be considered.
  - For example, cannot give probation to whites and not black.
- To avoid disparate impact, protected category must be considered.
  - For example, need to set different cutoffs to different races to ensure an equal balance of false positives and false negatives.
- Anti-discrimination laws leave balancing to the decision maker.
- But what if the decisions are made by an algorithm?

Cofone, 2019.

Regulatory responses – Privacy

- 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."
- 2020 privacy laws in California a step forward in the U.S.
- But global firms often operate beyond the reach of national regulators, leading to calls on global regulation.

Market power

Market power – What are the concerns?

- Firms use market power so that the market deviates from an efficient allocation
  - Consumers "pay" too much for the service.
  - Consumers don't receive the good they'd mostly value.
- Worry about long-term dynamism of the digital markets
  - Firms with more data have a competitive advantage and grow. Not necessarily firms that are more otherwise more efficient.
  - Impacts entry, innovation, and development.
  - Big firms can extract undue value from other markets (suppliers, other firms, labor) and policy makers.
  - Scale and scope now are unprecedented.
- How long will this last?

Joseph Stiglitz (2018) and Raghuram G. Rajan (2018).

Increasing growth?

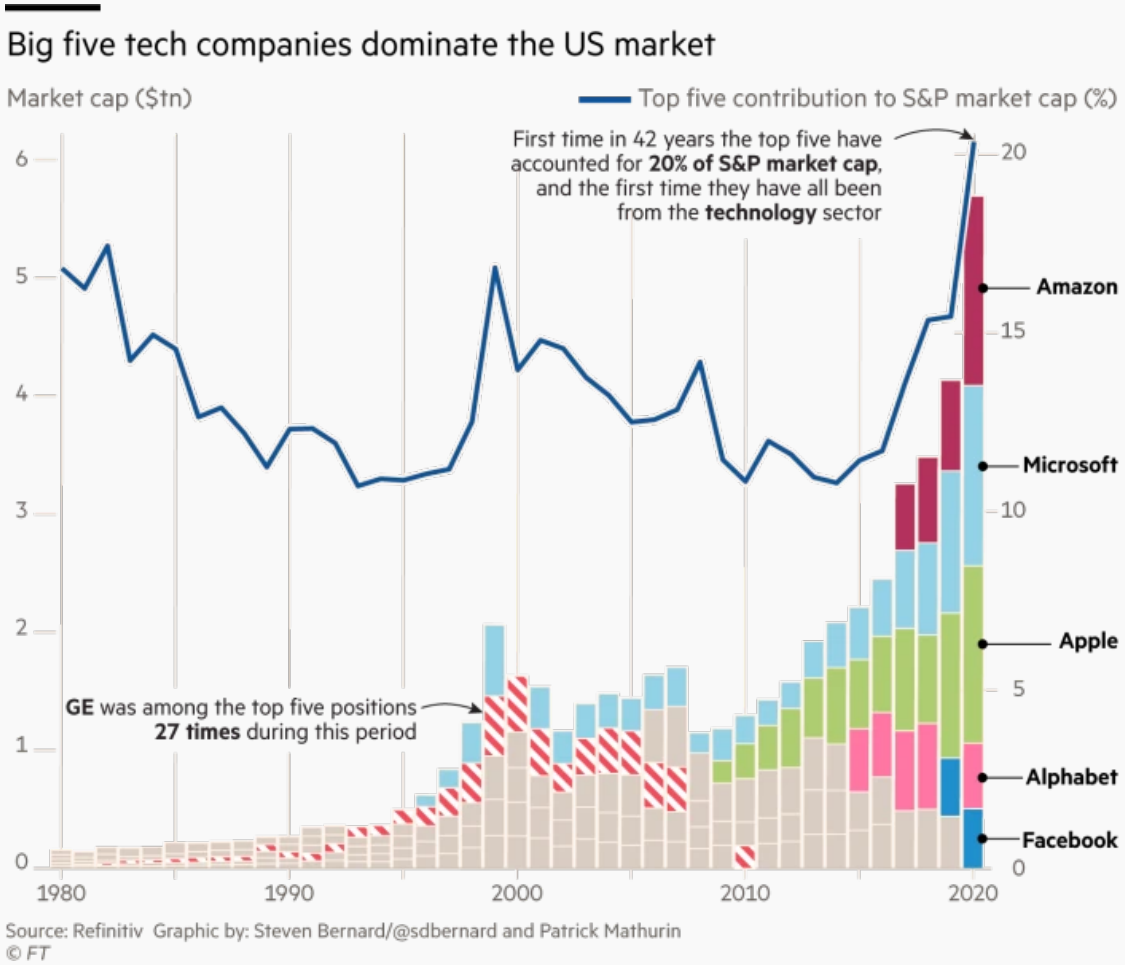


Figure. Share of the top five firms in the S&P index and the absolute market caps of the top firms. Alphabet = Google.

Source: Financial Times, 1 Aug 2020.

Falling growth?

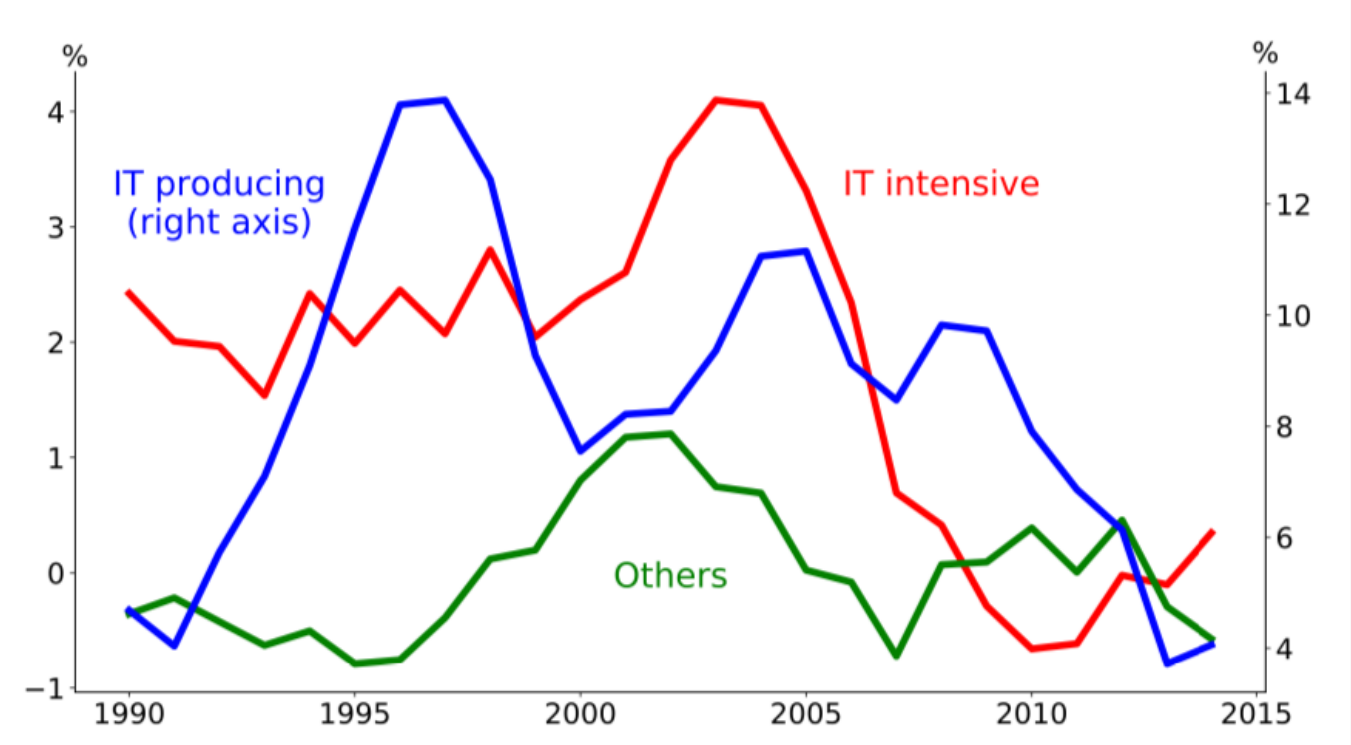


Figure. Growth bursts as most efficient firms spread to new markets. But less efficient firms find it hard to replicate success, leading to less entry and innovation. Big firms also reduce innovation because they do not want to compete with each other.

Source: Aghion et al. 2019.

Moral hazard – Search engine manipulation effect

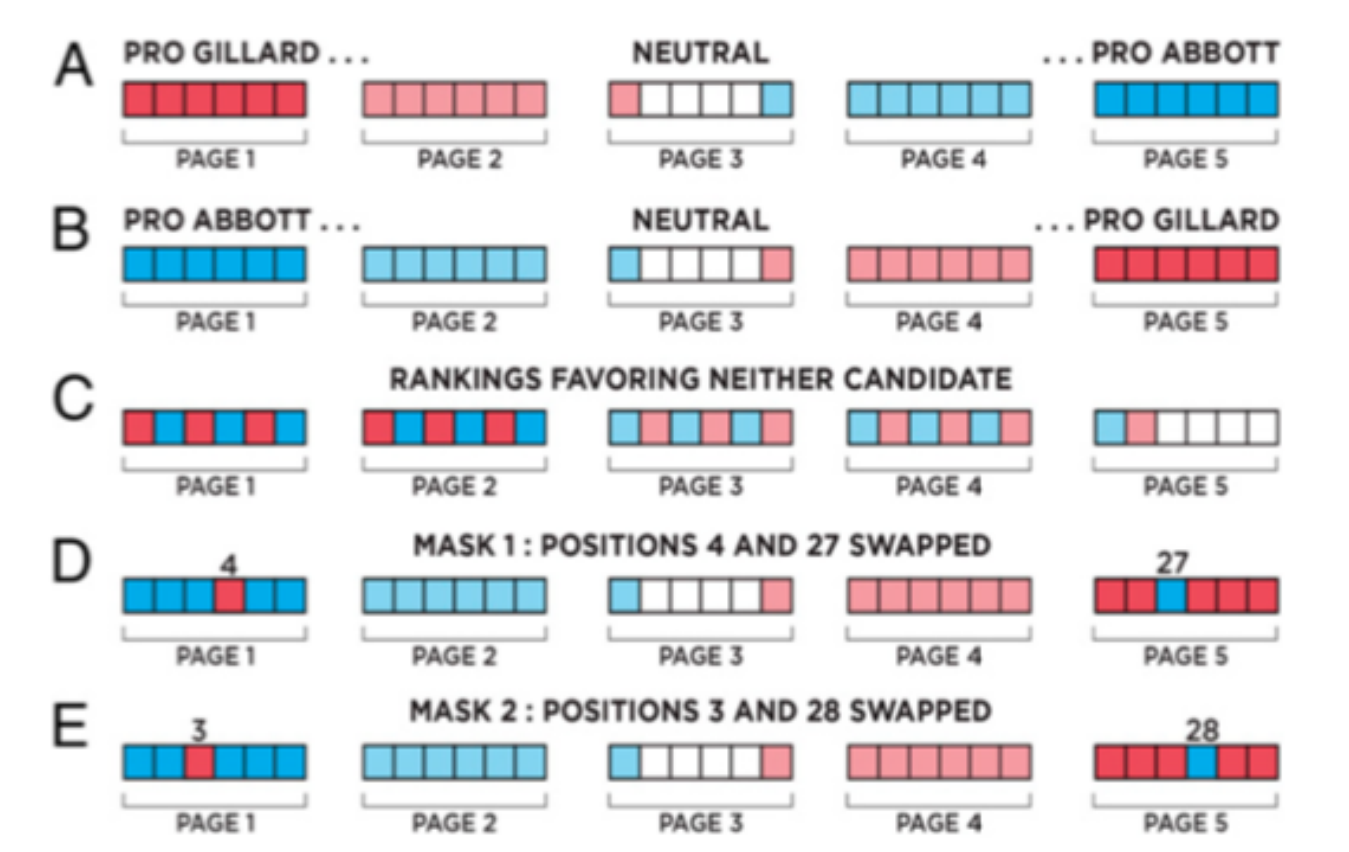


Figure. Controlled test of how changing only the order of search results can affect opinions.

Epstein and Robertson, 2015.

Moral hazard – Search engine manipulation effect

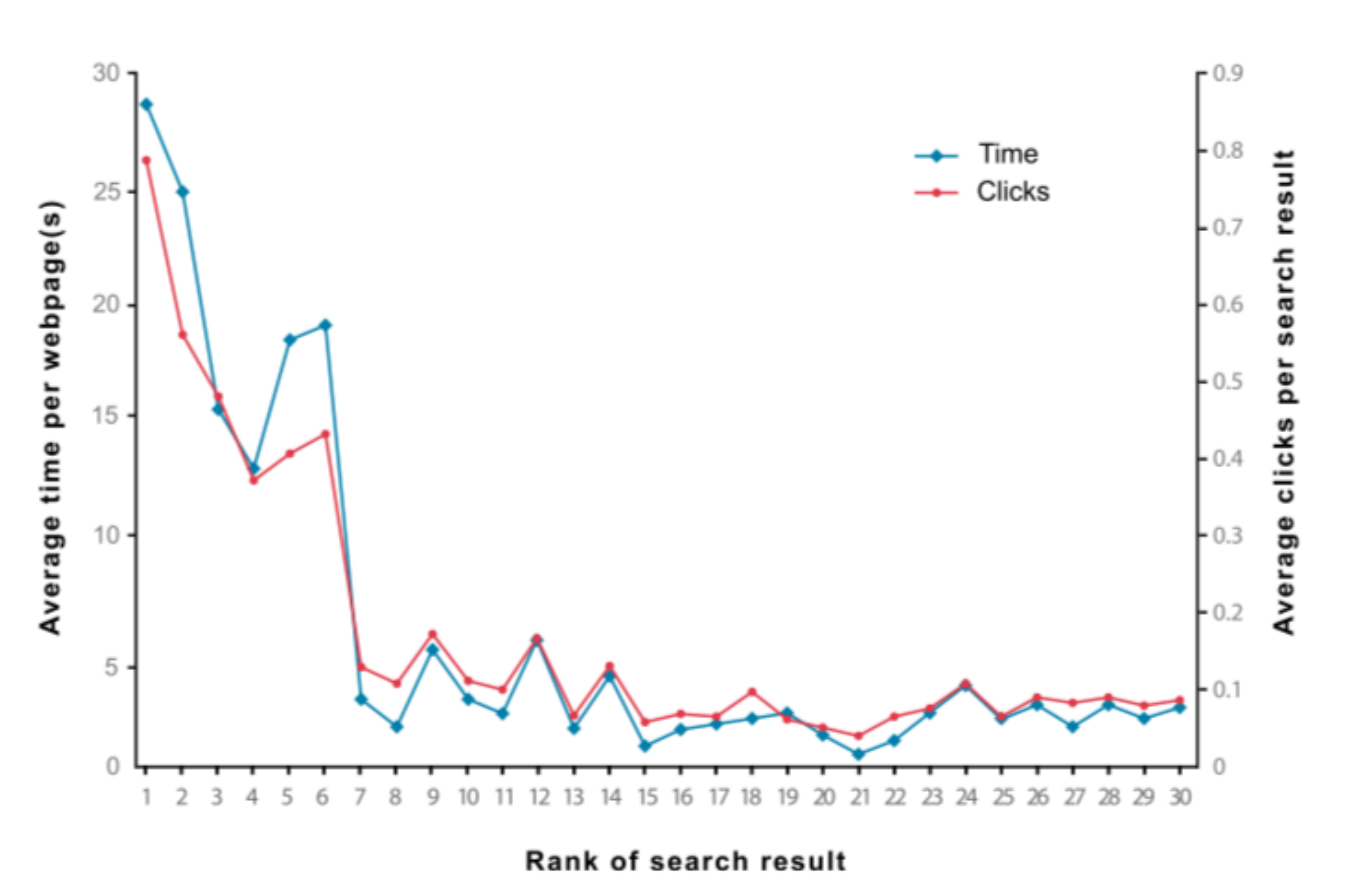


Figure. People click most the results on the top (red line) and also spend more time on those pages (blue line).

Epstein and Robertson, 2015.

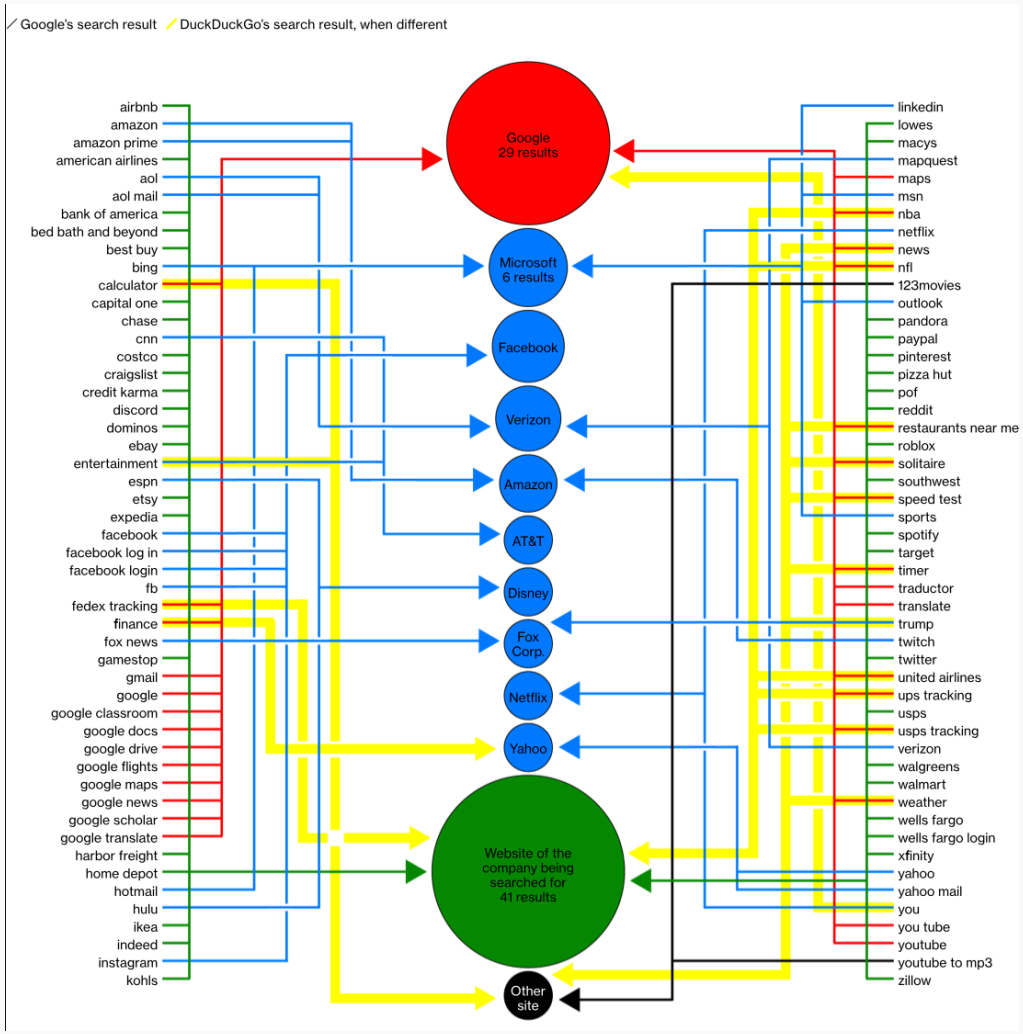
Moral hazard – Search engine manipulation effect

Results from a controlled experiment:

- Biased search rankings can shift the voting preferences of undecided voters by 20 % or more.
- The shift can be much higher in some demographic groups.
- Search ranking bias can be masked so that people show no awareness of the manipulation.
- Knowledge of the bias seems only to enforce the impact.

Epstein and Robertson, 2015.

Market power – Search engine manipulation effect



Source: Bloomberg Businessweek 23 Oct 2019.

Market power – Google

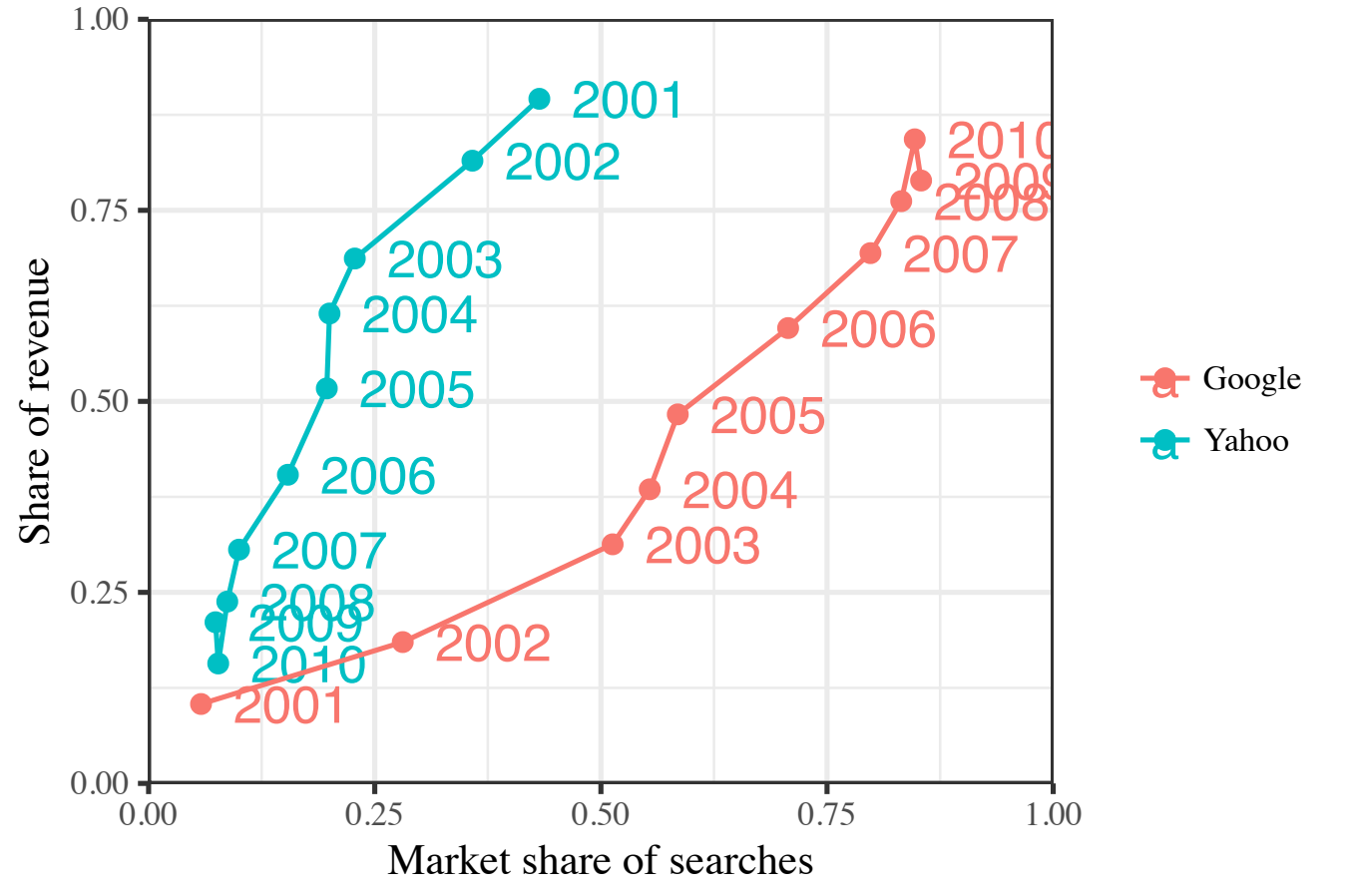


Figure. Development of the share of revenue (for the two) against the share of user searches (total market) for Google vs. Yahoo.

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.
  - Examples suggest bias at least towards Google's own services.

Reminder: Market power – Algorithmic pricing

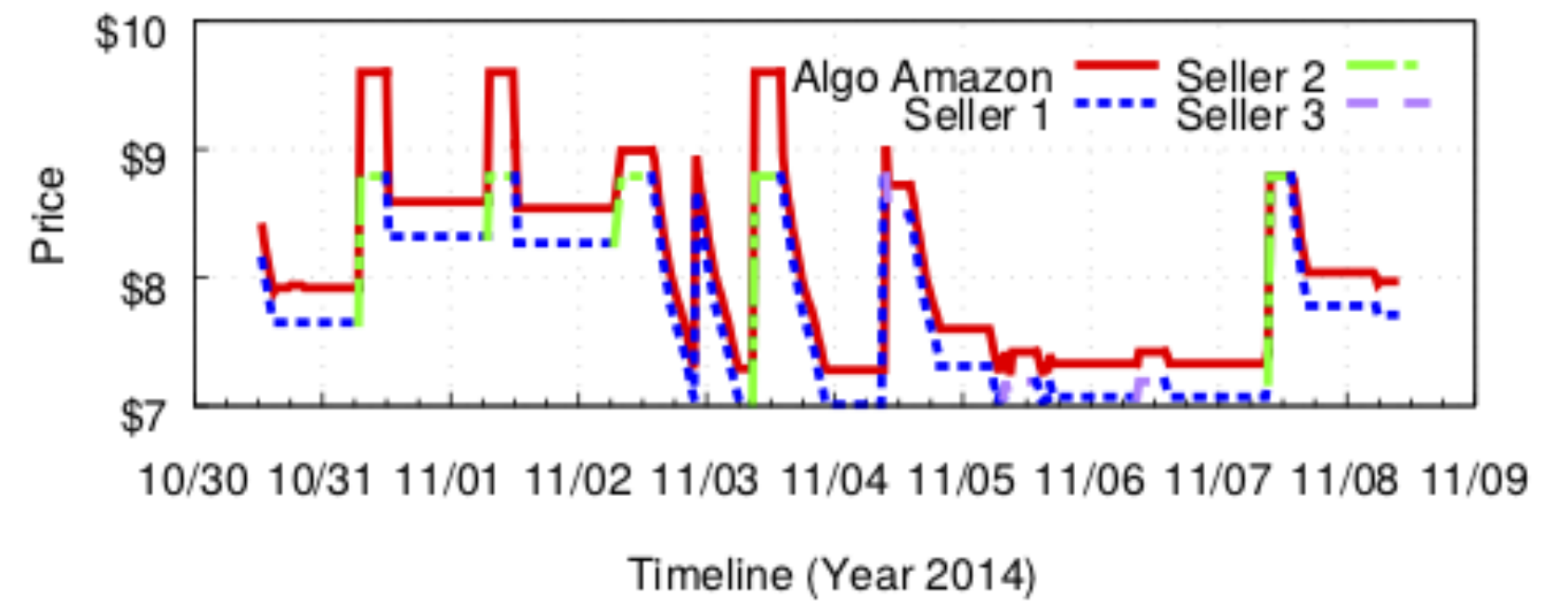


Figure. Example of Amazon keeping a premium over other sellers.

Source: Chen et al. 2016.

Reminder: Market power – Algorithmic 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.

Market power – Regulatory responses

- Are the firms too big and powerful?
- If yes, then try and regulate market structure
  - Block mergers
  - Split up companies
- For example: U.S. FTC suing Facebook:
  - "Facebook, the prosecutors said Wednesday, should break off Instagram and WhatsApp, and they said new restrictions should apply to the company on future deals. Those are some of the most severe penalties regulators can demand." N.Y. Times 9 Dec 2020.

Market power – Regulatory responses

- Are the firms misusing their market position?
- If yes, then make anti-competitive actions more expensive
  - Prohibit anti-competitive actions
  - Seek liabilities in court
- Example 1: EU has fined Google above €9 billion for misuses.
- Example 2: U.S. DoJ suing Google

WHAT THE D.O.J. SUIT SAYS

"Two decades ago, Google became the darling of Silicon Valley as a scrappy start-up with an innovative way to search the emerging internet. That Google is long gone. The Google of today is a monopoly gatekeeper for the internet, and one of the wealthiest companies on the planet."

Figure: N.Y. Times, 20 Oct 2020.

Market power – Regulatory responses

- The current EU Commission is pushing for a more permanent legislative solution, EU Digital Markets Act, that will increase Big Tech liabilities
  - Targets "gatekeeper" firms that control how other firms can interact with users.
  - Includes online search, social networking, and online marketplaces.
- In the U.S. discussion on revoking Section 230 that provides liability protection for tech companies.

Externalities

Externalities – What are the concerns?

- Discrimination and other unwanted consequences of the combination of data and algorithms.
  - Externality in the sense that the data of some consumers reveal information about others.
  - See above.
- Externalities created by sharing and gig economy platforms.
  - Are people in the gig economy employed or not?
  - Should there be a concern for sharing platforms such AirBnB driving up the local housing market prices?
- Environmental externalities from data processing.

Externalities – Labor

- Large upfront investments by platforms to attract "workers".
- For individuals, selecting to contract with a platform may
  - Require investments of their own, e.g. own car, or
  - Mean a lost opportunity to do something else, e.g. drive a taxi, try to improve other skills.
- If the platform becomes successful, then it can leverage the dominant position to degrade the contract terms later.
  - Workers may get locked in to a poor paying low-skill jobs.
- Oversupply of cheap labor is an enabler for such activity
  - Problems not constrained to low income countries.
  - Policy solutions needed, trade-off with the overall efficiency gains.

Externalities – Labor – Example

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

Figure: Mark Kerrison / Alamy.

Externalities – Social

- Change from long-term rentals to short-term stays causes externalities to the neighbours.
  - Long-term tenants have incentives to limit the externalities to their neighbours.
  - 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

- The development of technology drives the costs of collecting, storing, and processing big data down.
- Data will continue to be processed as long as it has value.
  - Like with the manufacturing of other goods in the markets.
- Theory would suggest that environmental concerns are best tackled at source.
  - If electricity generation is polluting, tax the pollution there, which will increase the price and affect the consumption of electricity in all sectors.

Regulation of externalities

- The complexity of platform economics, data and algorithms makes the regulatory challenges complex.
- Critics charge that the primary competitive advantage of digital 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.

Summary

> Why do you think that the ecosystems in the U.S. have grown so big? *–Bengt Holmström*

Listen to Common Good Summit: Regulation of Platforms (have a look at least the clips from 36:10 to 40:30 and 47:00-49:50.)

Private regulation

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 may be sufficient.

But. . .

> How transparent should our life be to others?
> –*J. Tirole, Digital Dystopia, AER 2021.*

See also: Black Mirror, Series 3, Episode 1.

Big tech's harvest of sorrow?

- Connecting the world with social media has led to unintended consequences
  - Strict uniform rules online replace more nuanced off-line communication.
  - May contribute to the erosion of social capital and narrowing trust to traditional media.
- Market proponents highlight that in digital markets decision making is not centralized, allowing for market based corrections.
  - However, no guarantees on how big tech will behave.
- Final safeguard needs to be democratic oversight of how new technologies are developed and deployed.

Acemoglu, 2019.

Learnings today

- Particular motivations for regulation online are consumer protection (privacy), the limitation of market power, and negative externalities (social, environment).
- The lack of clarity in what regulatory options should be chosen make the regulators cautious. Also, the argument that private regulation is sufficient and that the benefits of increased economic activity outweigh the remaining concerns.
- Online, big data, the concentration of users, and the lack of transparency in what algorithms are doing, are the largest sources of concern.

Materials for this week

Reading assignment 6:

- **Digital markets**. Lambrecht, Anja, Avi Goldfarb, Alessandro Bonatti, Anindya Ghose, Daniel G. Goldstein, Randall Lewis, Anita Rao, Navdeep Sahni, and Song Yao (2014) "How Do Firms Make Money Selling Digital Goods Online?" Marketing Letters.
  - References to literature, the models that do get sometimes slightly complicated can be freely skipped.
- **Regulation**. Demange, G. (2018) "Mechanisms in a Digitalized World", CESifo Working papers. Should be relatively easy read.

The square and the tower

Market square in Siena, Italy. Source: Tuscany, Beautiful Everywhere.

Appendix

Big data and privacy – Example

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 – Example

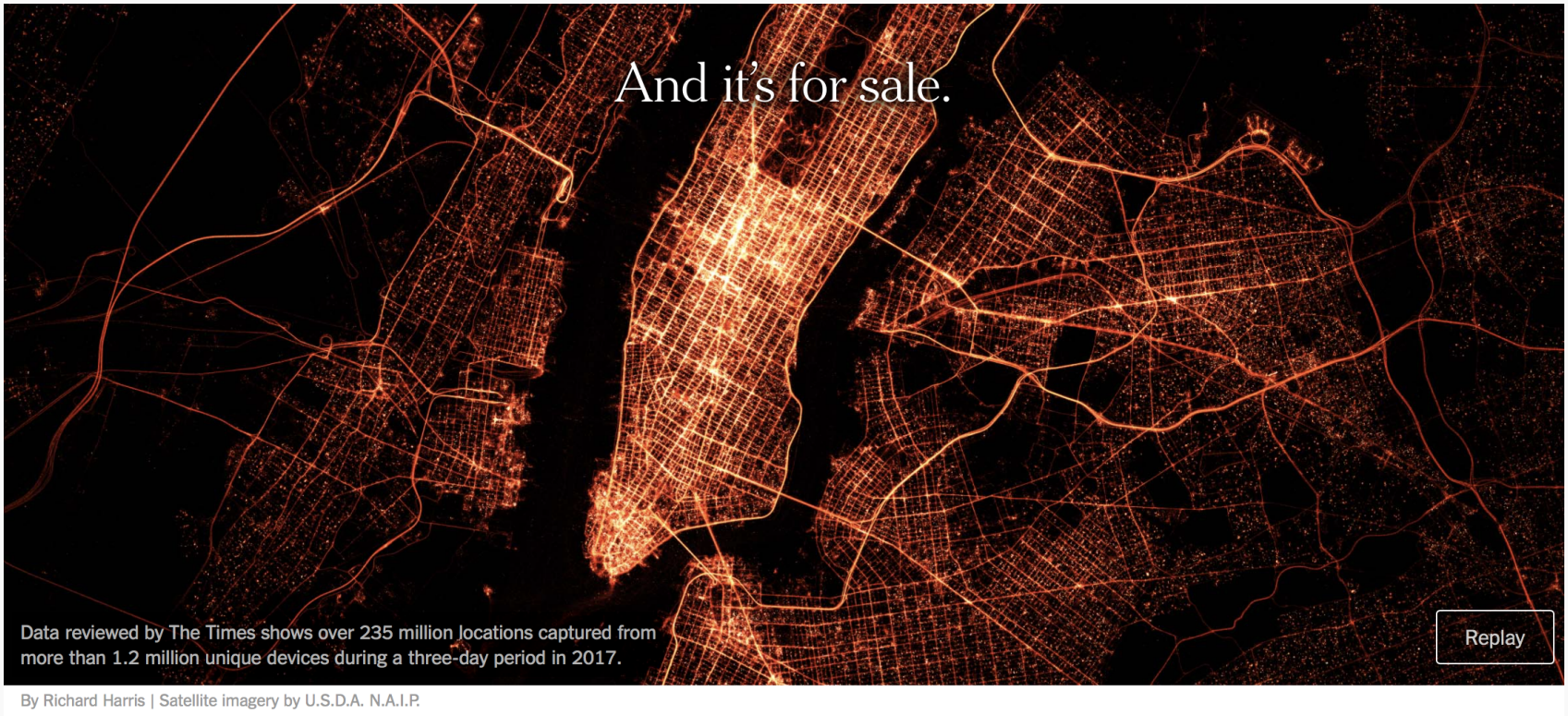


Figure. Example of mobile phone location data in New York City.

Figure: NYT 10 Dec 2018.

Big data and privacy – Example

The Secretive Company That Might End Privacy as We Know It

A little-known start-up helps law enforcement match photos of unknown people to their online images — and "might lead to a dystopian future or something," a backer says.

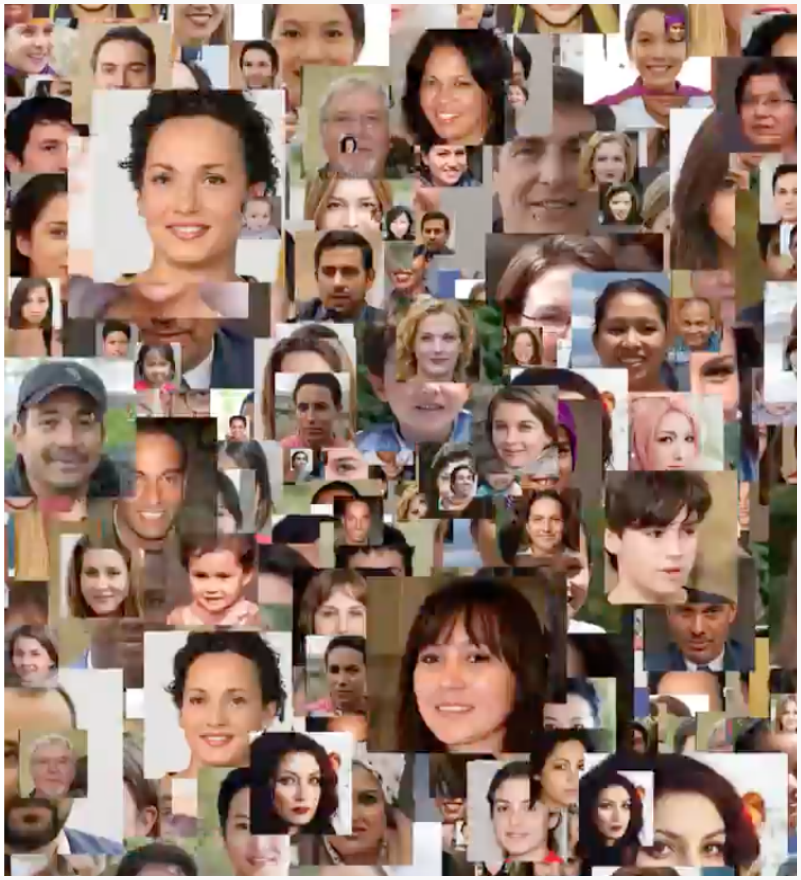


Figure. A start-up helps law enforcement match photos of unknown people to their online images.

New York Times, 18 Jan 2020.

Digital dystopia?

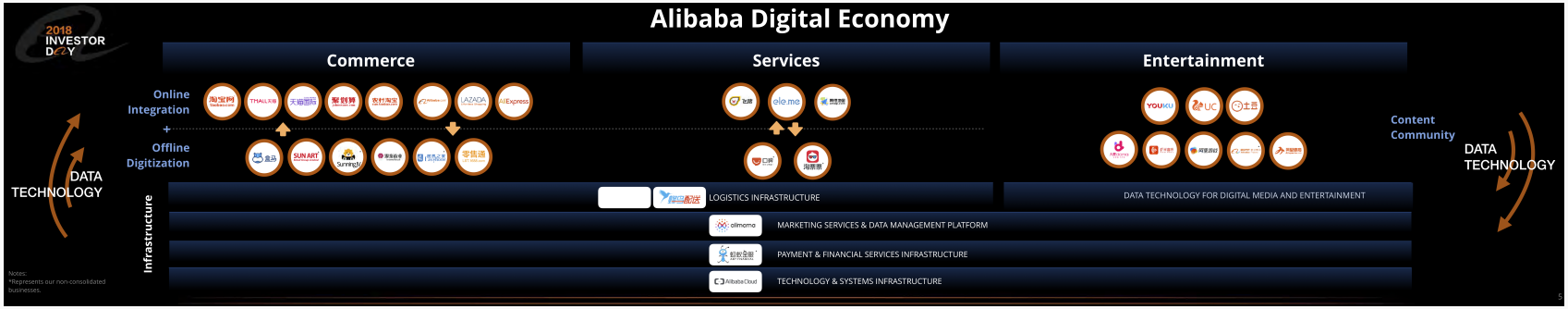


Figure. In 2015, Alibaba was asked (among others) to develop a credit score calculation system that included data on financial history, social media connections, and purchasing habits. The Chinese government is continuing to develop a "social credit" system.

Systems similar to the one tested in China are in place for fraud detection, beyond the credit score used by the banks in the U.S.

Figure: Alibaba.

Reminder: Market power – Search engine manipulation effect

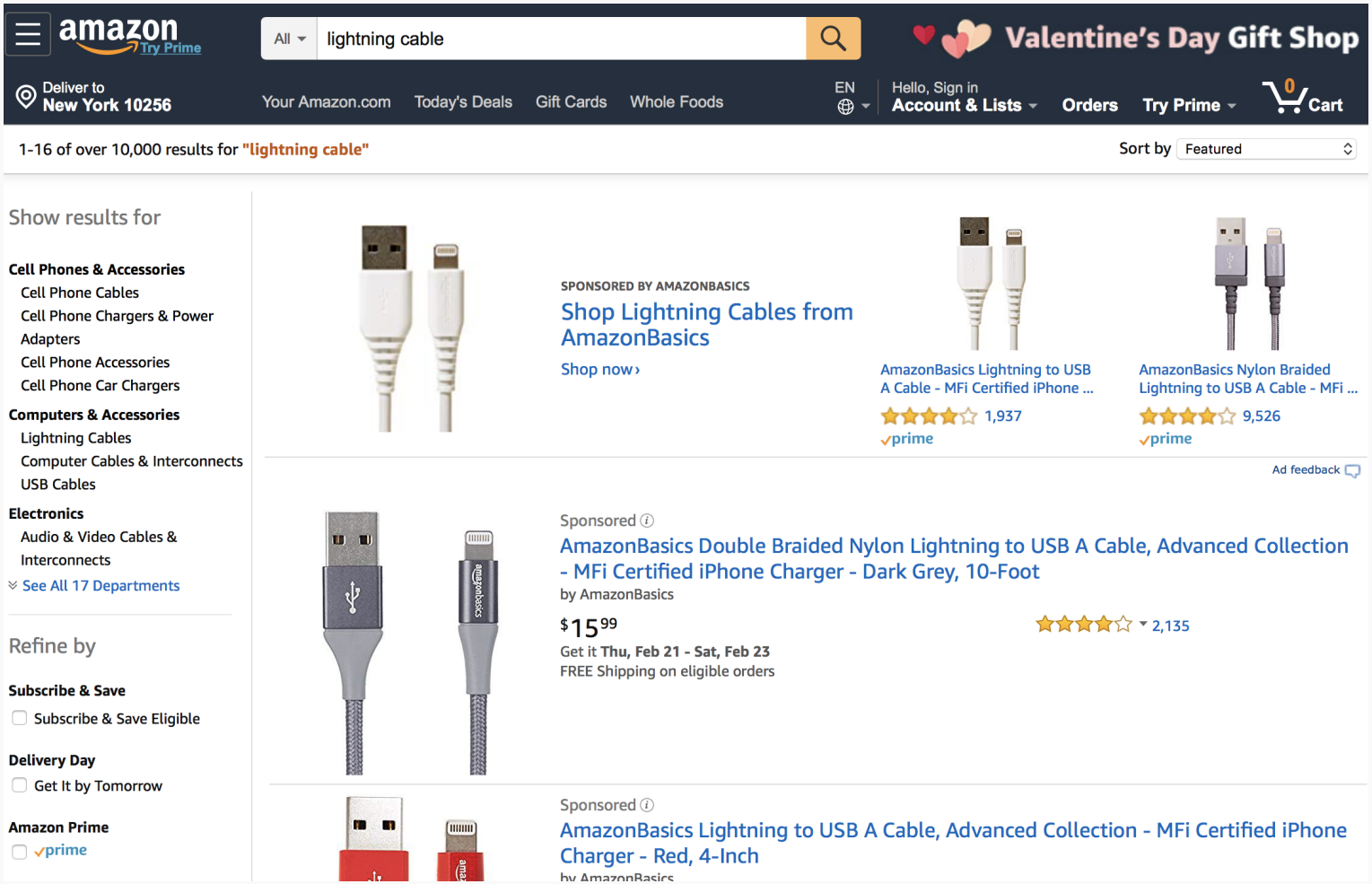


Figure. Example of Amazon search for "lightning cable".

Figure: Amazon.

Moral hazard – Search engine manipulation effect

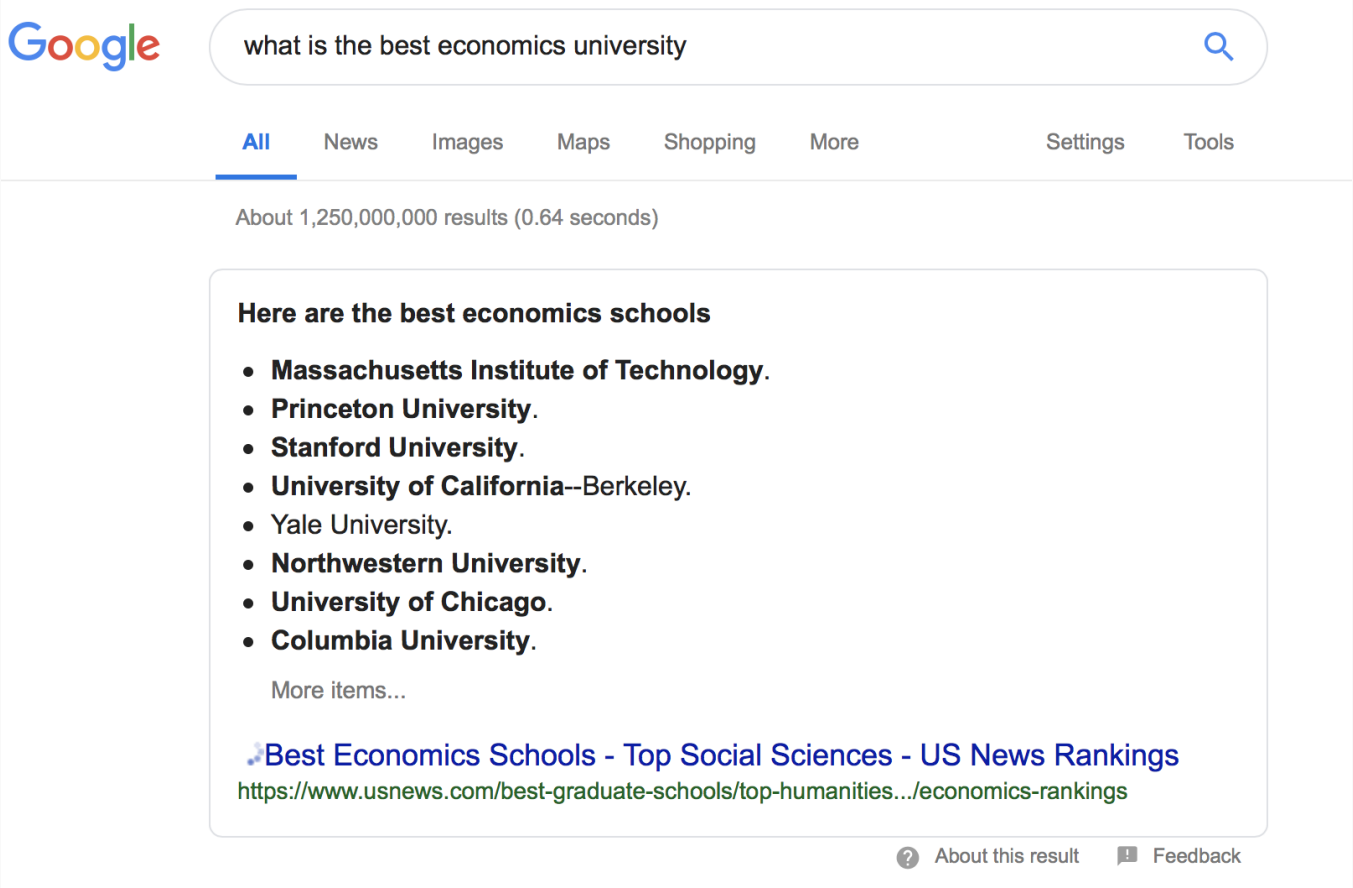


Figure. Example of the power of Google, search "what is the best economics university" in the U.S.

Figure: Google.

Moral hazard – Search engine manipulation effect

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

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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 – Google

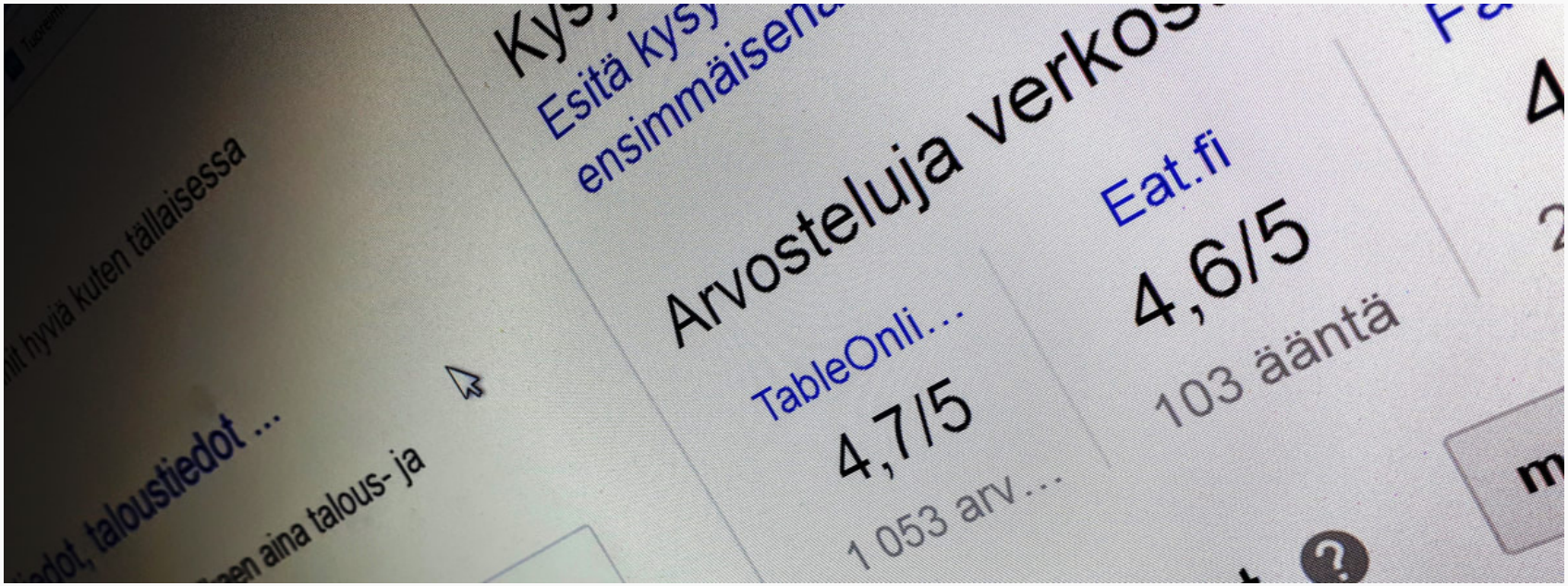

Figure. Example of how Google uses third party data directly on their user search webpage (Yle News 12 Oct 2018).

Figure: Yle.

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 – Example


The New York Times

Account

The SoftBank Effect: How $100 Billion Left Workers in a Hole

SoftBank poured money into start-ups that use armies of contractors. That has upended the lives of drivers, hotel operators and real estate agents around the world.

Figure. Drivers for Grab protesting against unfair oversight.

Figure: Storyful News, via New York Times.

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, new rules adopted in Helsinki in Jan 2020.

Private regulation – Examples

- Firms need to maintain reputation
  - For example, Amazon year 2000 DVD story.
  - Brands who want to differentiate with quality, e.g. relating to privacy (Apple vs. Facebook).
  - Twitter closing the account of Donald Trump in January 2021.
- Competition has worked in the past
  - 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.