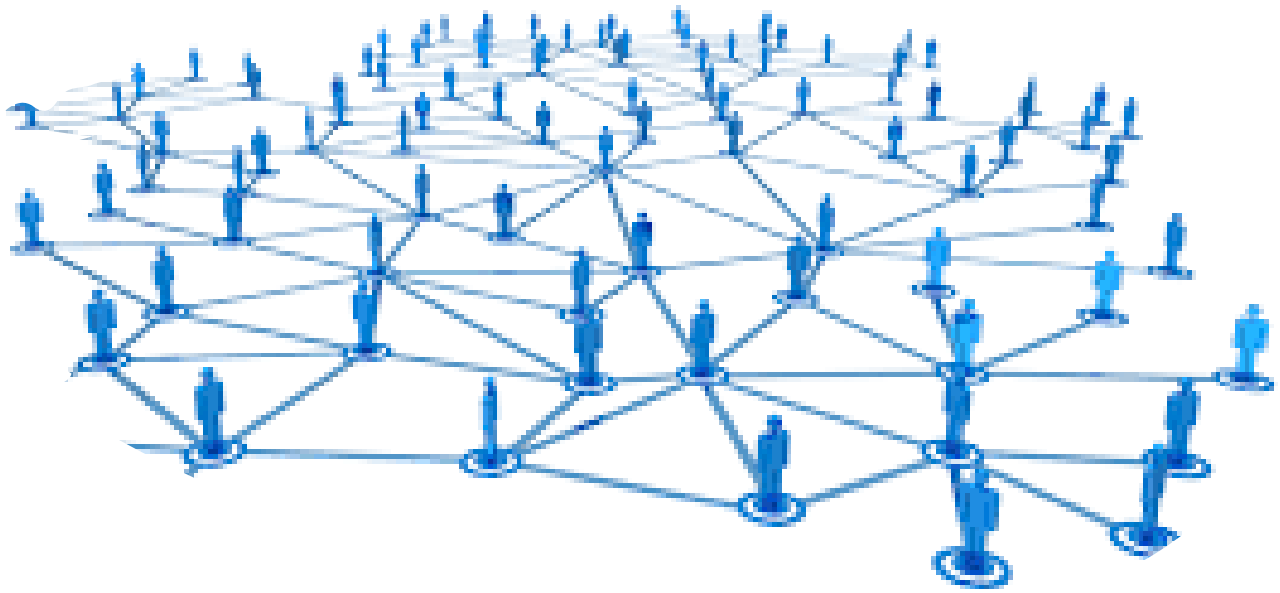


Network Effects

Lecture 6

Network Effects

- For all those firms, size is an important component of the Business Model.
- But size has always been important for business. What is new now?

Network Effects

- Many firms, or industries, exhibit some forms of increasing returns to scale.

  Ex: Cost= K+ cq, where K is a fixed cost and c a constant marginal cost.

- This is the case in the traditional network industries (Electricity Grid, Gas transportation) but also for many traditional Brick-and-Mortar activities.
- In the digital economy, there are network effects supply-driven (*hard to produce, easy to reproduce*) but also some demand-driven network effects.

Network Effects

- **Basic idea**: everything else equal, it's better for a consumer to be connected to a large network than to a small one.
- In econ Jargon, we will say that a user's payoff (or utility) is increasing in the number of users of that product or service.
- We can also say that network effects generates positive externalities among agents.

Rmk: we mostly talk about positive network effects, but they can be negative (like congestion).

Network Effects

- The network effects are ubiquitous in telecommunication services – so they existed before internet – but also in other industries at the firm level.
- They are two main types of network effects :
  - Direct
  - Indirect

Direct vs Indirect

- With **direct** network effects, individual consumption benefit depends positively on the number of people that buy the same product (or compatible product)
  - In this case, all agents are concerned in the same manner.
- With **indirect** network effects, individual consumption benefit affects and /or depends on the number of complementary services available.
  - This includes the case of complementary products (video console/games, hardware/software), but also many internet intermediaries (Uber, Facebook, …)
  - Most of this lecture will focus on this type of network effects, and more globaly on markets with many different sides, Two-Sided or Multi-Sided Markets.

Road Map

- To understand more this notion of network effects, we will look at the following topics.

1. Consumer behavior with network goods
2. Firm behavior with network goods
3. Public Policy with network goods

A simple model of Network Effects

- For economic or marketing purpose, it is useful to characterize the demand function.
- For this, we need to define a utility fonction that takes the network effects into account.
- When a consumer joins a network, his/her utility depends on
  - A stand-alone benefit: *a*
  - Some network benefits: *f(n),* where *n* denotes the number of consumers
  - The price charged by the network: *p*.
- The consumer's net utility can be written as

$$U = a + f(n) - p$$

A simple model of Network Effects

- Note that the expression is still valid in the case of indirect network effect.
  - Indeed, if $U = a + g(m) - p$ with m the number of applications, and that the number of application depends on the number of users, through the formula *m=h(n),* then we define *f(n)=g(h(n))* and we are back to the original formula.
- Note also that agents can be heterogenous:
  - different stand-alone benefits, $U = \theta a + f(n) - p$
  - different network benefits, $U = a + \theta f(n) - p$

Users with higher θ

represent early adopters…

Demand with Network effects

- We focus on the case of heterogenous and linear benefits, that is with $U = a + \theta v n - p,\ v > 0$, and θ uniformly distributed on [0,1].
- But when a consumer decides to join the network (or not), he does not know the size of the network, so his utility is $U = a + \theta v n^e - p$,where n^e is the anticipated number of users.
- To derive the demand for the network good,
  - First, we characterize the users indifferent between buying and not buying.
  - Second, this gives the demand for given p and n^e.
  - Last, we assume rational expectations, that is $n = n^e$.

Demand with Network effects

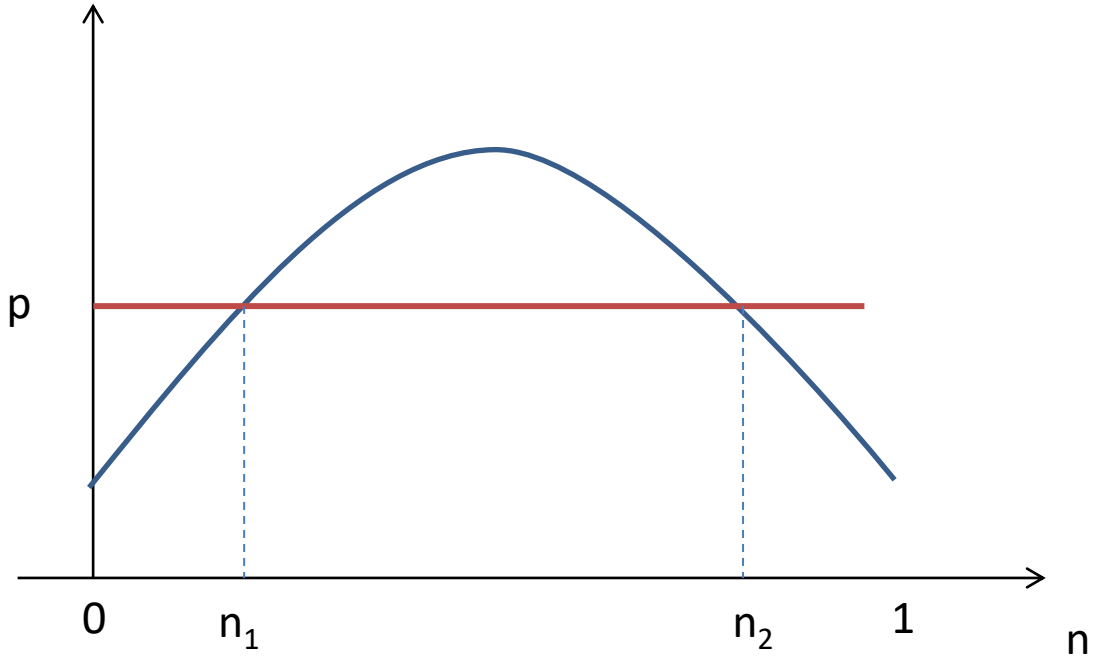
- The marginal consumer is such that $U = 0 \Leftrightarrow \theta^m = \frac{p-a}{vn^e}$.
- All consumers with a « type » larger than θ^m will buy the good, so $\theta^m = 1 - n$.
- This means that the inverse demand function can be written as

$$p(n, n^e) = a + vn^e(1 - n)$$

- For given expectations, the inverse demand function is decreasing in *n* as usual…
- …but assuming rational expectations, we have $n^e = n$ so the inverse demand function has now an inverse U-shape where
  - The price increases with the number of users for small networks
  - The price decreases with the number of users for large networks.

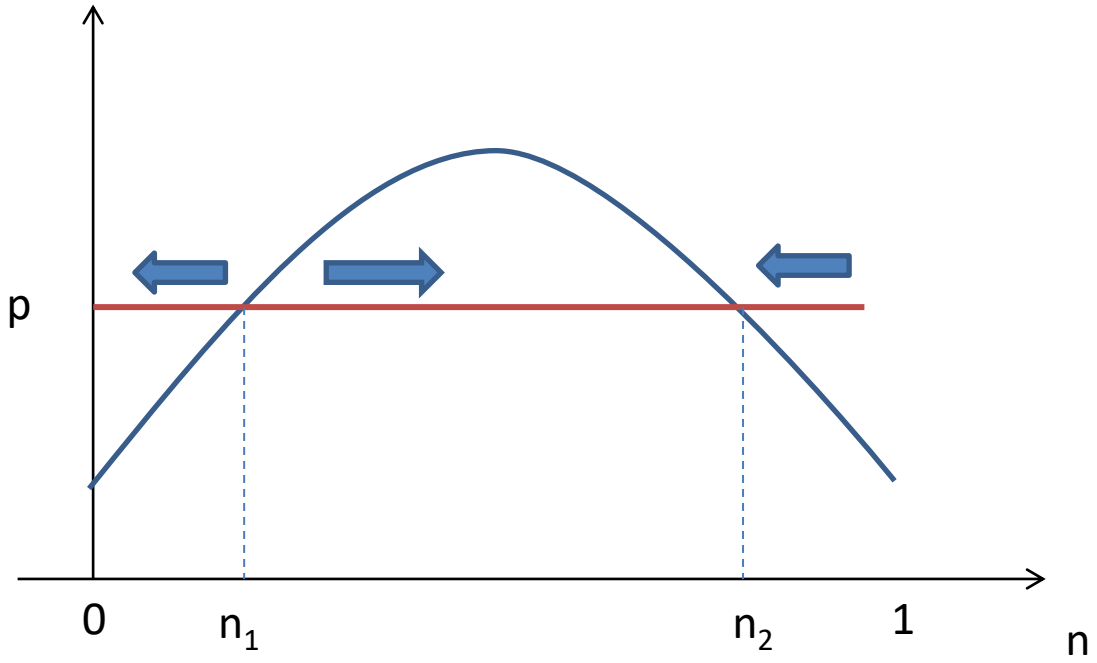
Demand with Network effects

- This means that for a given price there may be more than one network size at the equilibrium.



Stability and Critical Mass

- The equilibrium at n_1 is not stable whereas the two others are stable. How can we test stability?



Stability and Critical Mass

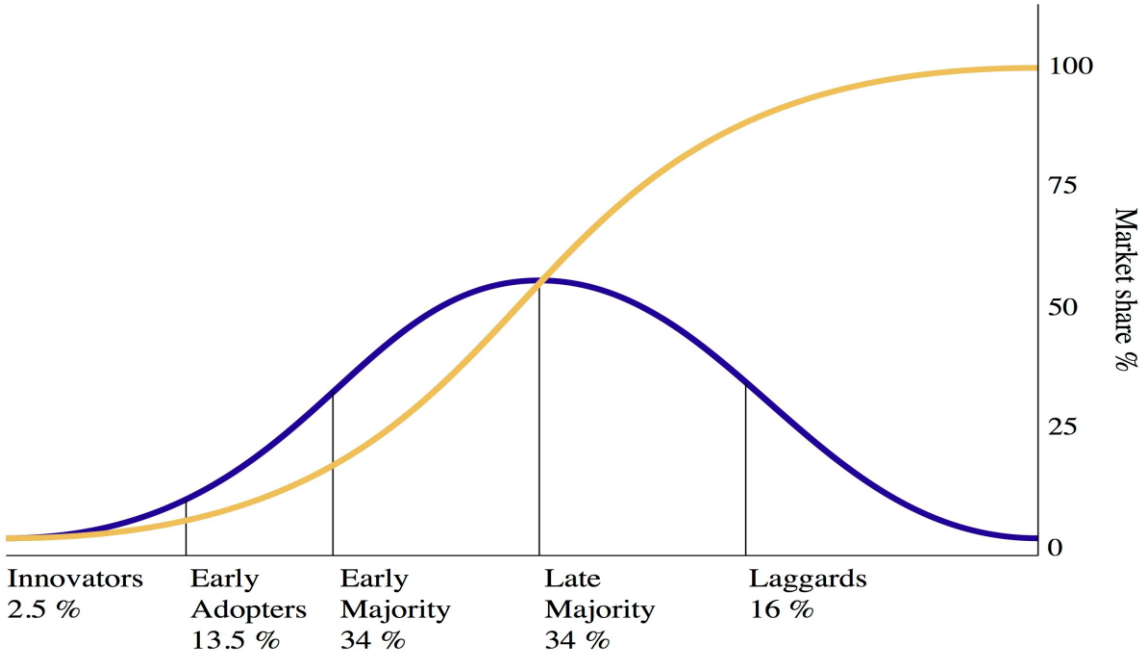
- At n_1, an additional user
  - triggers the purchase from new users, with slightly lower types than the initial cut-off type θ^m.
  - This further increases the benefits and new users decide to join.
  - As the marginal type decreases, the marginal size effect on benefits decreases.
  - And n_2 is the maximal size the network can sustain.
- Note that n_1 is called the **critical mass**, that is the threshold above which snowball effect starts.
- For business, it is important to trigger the snowball effect, that is to solve the chicken-and-egg problem. And sometimes, this means setting zero price.

Stability and Critical Mass

"We provide the majority of our services to our members at no cost. We believe this approach provides the best way to continue to build a critical mass of members, resulting in beneficial network effects that promote greater utilization of our solutions, higher levels of engagement and increased value for all of our members."
(LinkedIn 2012 Annual Report)

Stability and Critical Mass

- We can use this model to illustrate the diffusion of network goods.
  - Initially, the number of users is small.
  - When the critical mass is reached, the network grows very fast.
  - Eventually, saturation or congestion limits network growth.



Food for Though

- We can derive the same type of results with a model in which the heterogeneity in on the stand-alone value, i.e. $U = \theta a + vn - p.$
- In this case, the marginal user is $\theta^m = \frac{p - vn^e}{a}$, where n^e is again the anticipated number of users
- In a setting with rational expectations
  1. What is the demand function?
  2. Under which conditions do we obtain multiple equilibria?
  3. What is/are then the stable equilibrium/bria?

Monopoly Pricing of a Network good

- As the value of the good is increasing with the number of users, firms want to hasten adoption.
  - A natural idea is to use below-cost pricing (penetration pricing) for the early adopters.
  - This amounts to adjusting the price to the quality of the good (small network=low quality).
  - Some platforms used this « divide-and-conquer » strategy on subgroups in order to attract others groups,
  - This pricing strategy is less relevant for durable goods (Tech-goods) as the early adopters will also benefit from the increase in the size.
  - This may also be in conflict with the impact of decreasing marginal costs, which calls for decreasing prices.

Competition with network goods

- We want to discuss how firms with network goods compete.
- There are two main forms of competition
  - Competition for the market, when networks are not compatible.
  - Competition in the market, when networks are compatible.
- Note that firms can often make their goods compatible but, as with sharing data bases, this mostly benefits small firms.

Competition for the Market

- We suppose that there are two incompatible network goods, A and B, of size n_A and n_B.
  - The prices for A and B are identical and fixed
  - Agent's utility depends on their stand-alone value and the network effects they benefit from.
  - There are two types of agents
    - « A-fans », deriving utility $r+\alpha n_A$ with good A and αn_B with good B.
    - « B-fans », deriving utility αn_A with good A and $r+ \alpha n_B$ with good B.
  - All agents have myopic expectations, that is they base their decisions on current network sizes.
  - And agents arrive sequentially in the market.

Competition for the Market

- We describe more precisely the game
  - At each period, a new consumer arrives,
  - who can be a A-fan of a B-fan with equal probability,
  - observes the networks size $n_A(t)$ and $n_B(t)$.
  - and has to decide which network to adopt.
- With no network effect ($\alpha=0$) , the choice depends simply on the random draws.
- And by the law of large numbers, the market will be equally split in the long run.
- What can we say with network effects?

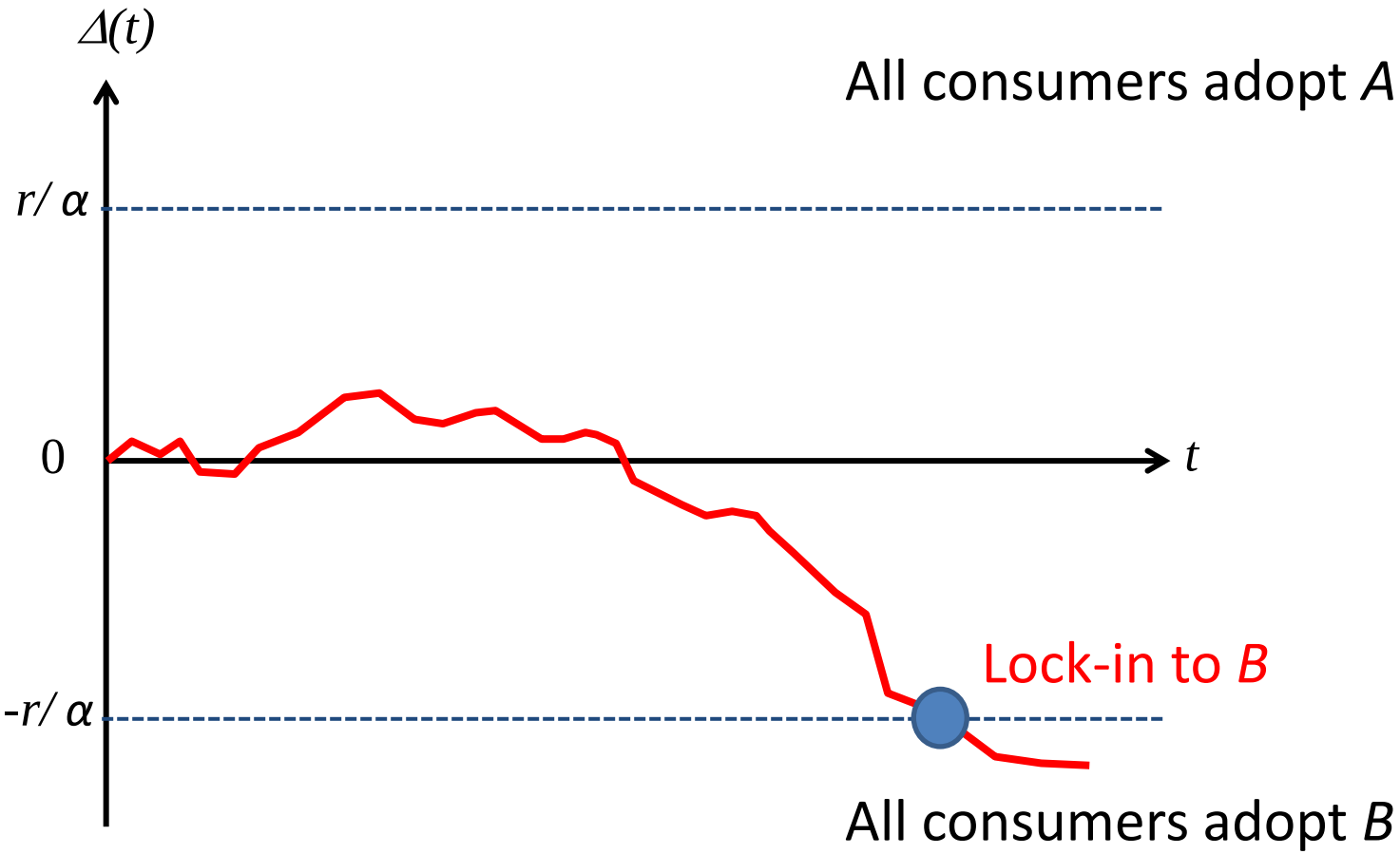
Competition for the Market

- Consider the choice of an A-fan.
  - She\he adopts A iff

$$r + \alpha n_A(t) \geq \alpha n_B(t) \Leftrightarrow \Delta(t) = n_A(t) - n_B(t) \geq \frac{-r}{\alpha}$$

  - So A-fans will adopt network A if its size is not too small compared to B but are willing to choose network B otherwise.
- The same analysis applies for B-fans that adopt network B iff $\Delta(t) \leq \frac{r}{\alpha}$.
- This means that
  - If $\Delta(t) \geq \frac{r}{\alpha}$, all consumers adopt A
  - If $\Delta(t) \leq \frac{-r}{\alpha}$, all consumers adopt B.

Competition for the Market



Tipping

- Lock-in (or Tipping) is the likely market outcome in the long run.
  - It means that in markets with network effects, monopolization is very likely.
- History matters since the final outcome depends on some historical (and random) events.
- It is not possible to predict who will win
  - If one firm is better (and has a higher *r*) it is more likely to win but as long as network effects are not too small, there is some remaining uncertainty.
  - This implies that the winning firm may not be the one generating the highest benefits for society.

Competition in the Market

- Let us now discuss the strategy competing firms A and B may choose.
- For this, we assume that consumers are only heterogenous wrt their standalone value, with $U=\theta+\alpha n^e$.
- The two network goods can be compatible and γ in (0,1) represents the degree of compatibility.
- A consumer opting for good A benefits from a network effect of size $n_A+\gamma n_B$.
- Each firm *i* is assumed to have an installed base of size β_i so if q_i represents the number of new firm-i users, the network benefit from firm A writes as

$$g_A = \alpha[\beta_A + q_A + \gamma(\beta_B + q_B)]$$

Competition in the Market

- Assuming homogeneous goods, the quality-adjusted prices should be equal for A and B, so we have

$$p_A - g_A = p_B - g_B = \hat{p}$$

- Only consumers with type $\theta > \hat{p}$ will adopt the goods.
- And assuming θ uniform on (0,1) leads to

$$q_A + q_B = 1 - \hat{p}$$

- We obtain $p_i = 1 - (q_A + q_B) + g_i$ for $i = A, B$.
- The model can then be solved as a Cournot model on which each firm chooses its quantity.

Competition in the Market

- Let us analyse the impact of an increase in compatibility.
  1. Network effects increase for both goods
  2. This increases total demand
  3. And the products are less differentiated
  4. Which lowers the effect of the installed base.
- When a firm, say A, has a large installed base, its incentive to increase compatibility is low since this base acts as a *barrier to entry*.
- Combining the critical mass concept and the role of installed base as barriers to entry explains the race for size in digital industries.

Public Intervention

- Network effects constitute a special form a externality so one may think that public intervention could be necessary.
  - To foster earlier adoption of more efficient technologies.
    - But it is hard to guess what the best technology is (demand-driven choice).
  - To induce compatibility between competing firms
    - But this dampens the incentives for innovation.

Competition Policy

- Network effects are likely to generate monopoly positions.
- But it is hard to control those firms since some behaviors which would be anti-competitive in standard markets are legitimate with network goods.

1. Below-cost pricing.
   - Usually banned by competition autorities but natural strategies with network effects;

2. Cooperation between firms
   - Firms are not suppose to cooperate but compatibility requires cooperation (data sharing, code sharing, patent pools).

Competition Policy

- In the last sessions of this course, we will discuss how anti-trust has coped with digital firms.
- Note that network effects were at stake in many cases in the last 20 years
  - The Microsoft case (Microsoft Explorer replacing Netscape) showed how because of the network effects the dominance over one product could create dominance over another complementary product.
  - The AOL/Time Warner (merger) case raised the issue of a merger involving firms producing complementary products in the presence of network effects and able to set standards and prevent entry.

Take-away

- Network effects arise when consumers value positively the number of other users of a product/service, or the number of compatible products.
- Multiple equilibria can exist, depending on consumers' expectations about the size of the network. A critical mass of users should be reached for the network to take off.
- Competition for a market with network effects may lead to 'lock-in'/'Tipping' and the dominance of one (possibly inefficient) technology.
- The presence of network effects may cause market failures, but public intervention is tricky and has pros and cons.

Platforms and Two-Sided Markets

Lecture 7

Presentation

- We will discuss the notion of Platforms and Two-Sided Markets.
- General characteristics:
  - A firm connects different groups of users, called sides.
  - This firm can price differently the different sides.
  - Some sides value all the more the service provided that the size of the other side is large.

Examples of Platforms

- The notions of sides, benefits, and service depend on the type of platforms considered
  - Google is a search engine but it matches indirectly consumers and advertisers
  - Uber matches drivers and riders
  - Facebook matches users but also advertisers with consumers.
  - Amazon is a more standard firm, but plays sometimes the role of intermediary, sometimes of a reseller.

More on Platforms

- What is really important about platforms and Two-Sided markets?
  - Size matters -> Network Effects.

  This will influence the firm's strategy and the anti-trust policies.
  - Price structure matters. Different sides value differently the platform and generate different benefits for others.
    - And platforms use different types of price (transaction vs subscription prices).
    - The price structure matters a lot, not only the total price.
  - Belief matters. « It takes two to Tango ». Need to solve coordination problems between sides.

Two-Sided Markets

- We will not make much difference between platforms, Two-Sided Markets and Multi-Sided Markets.
- We can define a multi-sided platform as an intermediary
  - between two (or more) groups of agents (called sides),
  - whose interactions generate direct or indirect network effects,
  - The platform being able to match efficiently the members of the groups.

    A key element is that there is a reduction in search and transaction costs with the platform.

Typology of platforms

- Software platforms
  - Microsoft, Playstation, Android
- Pure matchmakers
  - Meetic, SeLoger.com, The Fork.
- Peer-to-peer Marketplace
  - Uber, Airbnb
- Transaction systems
  - Paypal, Visa, Bitcoin
- Ads-supported Content Providers
  - YouTube, Facebook, The New York Times

Chicken-and-Egg and Pricing Strategy

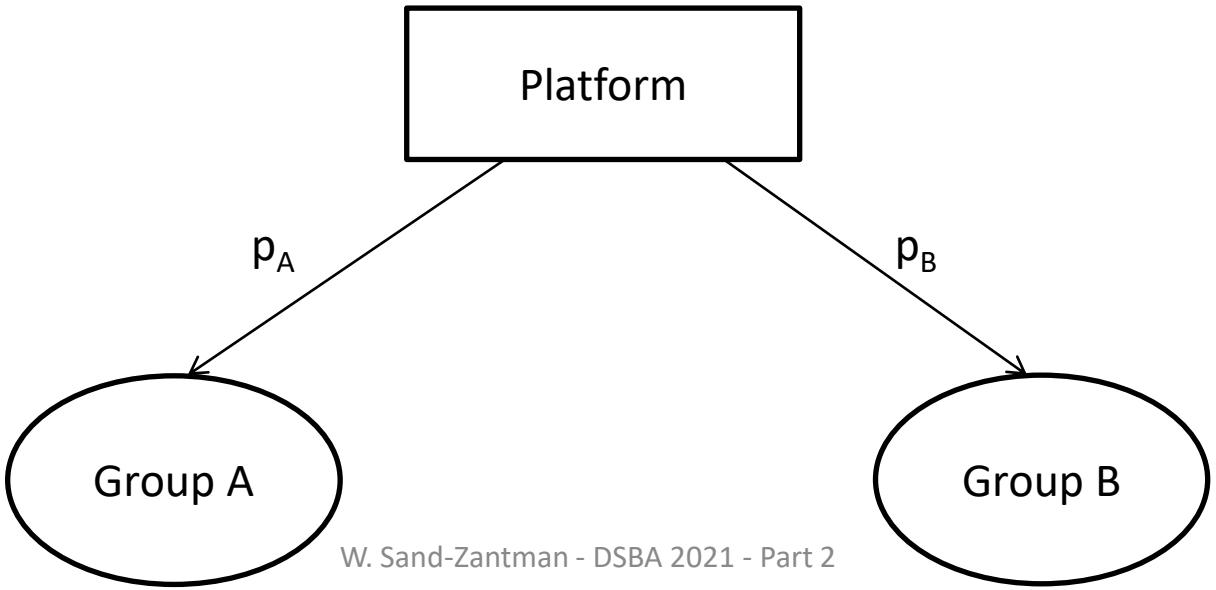
- For all these TSM, firms have to solve a chicken-and-egg problem.
  - They have to attract all sides on board.
  - But any side will only come if other sides are already there.
    - Ex: Video Games, advertisers on social media,…
  - Linked to the critical mass issue in standard network industries.
  - This can be solved by choosing a smart strategy (zero price for some sides, niche market first – see Facebook, …).
- We will mainly focus on pricing strategies, even if other elements will be analyzed.

Road Map for Today

- First, we look at the monopoly problem, showing how prices should differ accross sides.
- Second, we analyze pricing in a (more) competitive setting.
- We will also address various strategic and legal/regulatory issues related to platforms and Two-Sided Markets.

Monopoly Strategy

- We consider a monopoly platform with 2 groups of users, A and B.
- We focus here on the case where the platform sets membership/subscription price, p_i for $i=A,B$, and with no direct transaction between sides.



Reminder on Standard Monopoly Pricing

- Before looking at the case of platforms, let us review how a standard monopoly with marginal cost *c* chooses it prices.
- If all users have all the same willingness to pay, say θ >c, then the price should be equal to θ.
- But often θ varies across consumers so the platform cannot capture the whole surplus for all users.
- It will trade off between attracting more consumers and capturing more value -> **quantity vs margin**.
- Since only consumers with value θ >p will buy the product, the firm's profit can be written as $(p - c)Prob[\theta > p]$
- In this case, the price is equal to the cost *c* plus a mark-up that depends on how consumers react (the *price-elasticity of demand*) when the price is increased.

Preferences

- We now analyse the pricing problem with network effects.
- Assume that there is a unit mass of agents on both sides.
- Users have heterogenous stand-alone benefit within sides but only accross-side heterogeneity in network benefits. Formally,

$$U_i = \theta_i + \alpha_i n_j - p_i, \text{ with}$$

  - θ_i is the stand-alone benefit from joining the platform, following a distribution (say Uniform on [0,1]).
  - α_i is the per-user network benefit
  - p_i is the price for side-i users.
  - n_j is the number of subscribers on size j

Rmk: we assume rational expectations on the number of subscribers.

Demand and Cost

- A consumer from side *i* will join the platform iff his/her utility is positive, i.e. $U_i = \theta_i + \alpha_i n_j - p_i \geq 0$.
- If θ follows a distribution with cumulative F(.), then $n_i = 1 - F(p_i - \alpha_i n_j)$ or equivalently $n_i = D(p_i - \alpha_i n_j)$ where $p_i - \alpha_i n_j$ is the quality-adjusted price.
- In the simple case of a uniform distribution on [0,1], this leads to $n_i = 1 - (p_i - \alpha_i n_j)$.
- We assume that the firm's marginal cost to serve group *i* is c_i.
- The platform's profit is given by

$$\Pi = (p_A - c_A)\, n_A + (p_B - c_B) n_B$$

Profit Maximization

- We know that $n_i=D_i(p_i-\alpha_i n_j)$ which means that n_i depends on both prices.
- We now write the two First Order Conditions

$$\frac{\partial \Pi}{\partial p_A}=0 \Leftrightarrow D_A+(p_A-c_A)\frac{\partial n_A}{\partial p_A}+(p_B-c_B)\frac{\partial n_B}{\partial p_A}=0$$

$$\frac{\partial \Pi}{\partial p_B}=0 \Leftrightarrow D_B+(p_B-c_B)\frac{\partial n_B}{\partial p_B}+(p_A-c_A)\frac{\partial n_A}{\partial p_B}=0$$

- Now, since $n_i=D_i(p_i-\alpha_i n_j)= D_i(p_i-\alpha_i D_j(p_j-\alpha_j n_i))$, then

$$\frac{\partial n_A}{\partial p_A}=-\left(-D_A'\left[1-\alpha_A\alpha_B\frac{\partial n_A}{\partial p_A}D_B'\right]\right)\Rightarrow\frac{\partial n_A}{\partial p_A}=\frac{D_A'}{[1-\alpha_A\alpha_B D_A' D_B']}$$

- Similarly, we find $\frac{\partial n_B}{\partial p_A}=-D_B'\alpha_A\frac{\partial n_A}{\partial p_A}=-D_B'\alpha_A\frac{D_A'}{[1-\alpha_A\alpha_B D_A' D_B']}$.

Profit Maximization

- So the FOCs are now

$$\frac{\partial \Pi}{\partial p_A} = 0 \Leftrightarrow D_A + (p_A - c_A)\frac{D_A{}'}{[1 - \alpha_A \alpha_B D_A{}' D_B{}']} - (p_B - c_B)\frac{D_B{}'\,\alpha_B D_A{}'}{[1 - \alpha_A \alpha_B D_A{}' D_B{}']} = 0$$

$$\frac{\partial \Pi}{\partial p_B} = 0 \Leftrightarrow D_B + (p_B - c_B)\frac{D_B{}'}{[1 - \alpha_A \alpha_B D_A{}' D_B{}']} - (p_A - c_A)\frac{D_B{}'\,\alpha_A D_A{}'}{[1 - \alpha_A \alpha_B D_A{}' D_B{}']} = 0$$

- We combine the FOCs (1rst+2nd$*\ \alpha_B\ D_A{}'$) leads to

$$D_A + \alpha_B D_{A'} D_B + (p_A - c_A) D_{A'} = 0$$

- If $\varepsilon_A = -\frac{p_A \mathrm{D_A}'}{D_A}$, then the optimal price is such that

$$\frac{p_A - (c_A - \ \alpha_B n_B)}{p_A} = \frac{1}{\varepsilon_A}$$

Optimal Price Formula

- The optimal price for a two-sided monopoly is given by

$$\frac{p_i - (c_i - \alpha_j n_j)}{p_i} = \frac{1}{\varepsilon_i}.$$

Rmk: $c_i - \alpha_j n_j$ is sometimes called the opportunity cost.

- The price decreases with the elasticity of demand.
- The price decreases with the number of users on the other side (n_j) and with the size of the externality (α_j).
- The price depends on the cost but can be lower than this cost (or even negative)

- Note that socially optimal price is $p_i = (c_i - \alpha_j n_j)$ so the monopoly price exceeds the social optimum.

Asymmetric Pricing principle

➢Prices can very different across sides, some sides are profit-making while others are loss-leader.

Loss-leader side

- ❑ Readers/viewers/listeners of media providers
- ❑ Buyers in marketplaces (or shopping malls)
- ❑ Application developers for operating systems

Profit-making side

- ❑ Advertisers in the media market
- ❑ Sellers in marketplaces (or shopping malls)
- ❑ Users of operating systems

The loss-leading (resp. profit-making) side is the side for which the externality generated by the other side is the lowest (resp. highest).

Non-price strategy

1. How many sides on board.

Ex: 3 sides with Windows (users, app developers, hardware manufacturer) but only 2 with Apple (users, app developers).

- With more sides, there are more sources of revenues and more diversity of services.
- But there are more coordination issues (conflicts of interest between sides, many chicken-and-egg pbs to solve, lack of control).
- This is also linked to the choice of having an open system vs a closed system.

Non-price strategy

2. Choice of features and functionalities

- Reduction of search cost or not….
  Ex: search diversion with Google Ads

- Reduction of transaction cost.
  Ex: Integration of Paypal with eBay.

- Reduction of development cost.
  Ex: Sony provides Apps easy programming interfaces

- Privacy Policy.
  Ex: before GDPR or CCPA, some platforms but not all included do-not-track option.

Non-price strategy

3. Governance Rules

- Who is allowed to join?
  - Selection in some dating websites,
  - Control of app developers by Apple.
- Control over the actions
  - Google allows developers to use many different tools.
  - Developers with Apple's iOS are much more controlled.

- More control allows to guarantee higher quality and unified ecosystem but it may be costly.

- Platforms play the role of regulator (control of hate speech) and curator (banning bad drivers/tenants/restaurants/…)

Competition in TSM

- In the real world, there are many cases in which multiple large platforms coexist.
- How can we explain this in spite of the presence of network effects?

  1. Product differentiation (Facebook vs Tik Tok vs Instagram, Apple vs PC, iOS vs Android)

  This is important but can only happen if different consumers may have different views about the relative merits of two platforms

  2.Multi-homing (Facebook and Strava, HBO and Netflix, Visa and Amex)

  This is relevant when the cost (money, time) of joining more than one platform is not too high.

- We will mostly focus on the first motive and then discuss the second.

Competition in TSM

- We assume that two platforms, 1 and 2, propose a service to users A and B.
- Each platform *k* sets a price p_A^k for side A and p_B^k for side B.
- We follow Armstrong (2006) and assume that each agent on each side is located on the Hotelling interval, with both platforms located at the opposite ends of the Hotelling interval [0,1].
- With this model, each user has an ideal platform and has to pay a cost *t* by unit of distance to join each platform.
- As above, we assume each user on side *i* values the presence of a user on side *j*, and we denote by α_i this value.
- This means that the agent's utility from side *i* located at θ from joining platform 1 located at 0 is given by

$$\mathrm{U}_\mathrm{i}^1 = v_i^1 - \theta t \textit{ where } v_i^1 = \alpha_i n_j^1 - p_i^1$$

Competition in TSM

- We assume now full participation on both sides.
- Users from each side choose which platform to join as function of
  - The surplus they get on each platform, v_i^k.
  - Their preference for one platform or the other, i.e. their location θ on the Hotelling interval.
- We have to
  - characterize each platform's market share, as function of prices.
  - Choose the optimal prices for each firms
  - Solve for the Nash equilibrium

Competition in TSM

- Note that in the classical Hotelling model, the price is given by $p = cost + t$.
- First note here that the number of users for each platform is given by the market shares on each side.
- Agent on side *i* with type θ prefers firm 1 rather than firm 2 iff

$$v_i^1 - \theta t \geq v_i^2 - (1-\theta)t \Leftrightarrow \theta \geq \frac{1}{2} + \frac{v_i^1 - v_i^2}{2t} = n_i^1$$

- Using the fact that $v_i^1 = \alpha_i n_j^1 - p_i^1$ and that $n_i^2 = 1 - n_i^1$, we obtain

$$n_i^1 = \frac{1}{2} + \frac{\alpha_i\left(2n_j^1 - 1\right) - \left(p_i^1 - p_i^2\right)}{2t}$$

- We can then write the firm's profit (say 1) as

$$\Pi = (p_A^1 - c_A)n_A^1 + (p_B^1 - c_B)n_B^1$$

Competition in TSM

- Solving this problem (first by writing the market share as function of prices, and then optimizing) leads to an symmetric equilibrium such that, for all firms,

$$p_A = c_A + t - \frac{\alpha_B}{t}(\alpha_A + p_B - c_B); p_B = c_B + t - \frac{\alpha_A}{t}(\alpha_B + p_A - c_A)$$

- The first two terms are similar to the standard Hotelling price while the last one is specific to the TSM setting.
- The term $(\alpha_A + p_B - c_B)$ represents the extra benefit when an additional group-B agent is attracted and $\frac{\alpha_B}{t}$ is the additional group-B agent attracted when the firm has an extra group-1 agent.

Competition in TSM

- Solving fully this system leads to

$$p_A = c_A + t - \alpha_B; p_B = c_B + t - \alpha_A$$

or equivalently (with $\varepsilon_i = \frac{p_i}{t}$, and $n_j = 1/2$)

$$\frac{p_i - (c_i - 2\alpha_j n_j)}{p_i} = \frac{1}{\varepsilon_i}$$

- Comparing with the monopoly formula shows that a duopolist has a lower opportunity cost, and therefore lower prices.

Competition in TSM

- As usual in settings with imperfect competition, the price results from a trade-off between margin and quantity.
- As in the monopoly case, when a consumer on one side joins F1, network externalities are increased on the other side, inducing higher demand on this latter side.
- But in a competitive setting, a gained consumer is also a lost consumer for the competitor.
- Competition between platforms can be quite intense because each agent is also an asset in the competitive process.
- Keeping an agent is valuable
  1. to capture his surplus,
  2. to increase the benefit of the agents on the other side
  3. to prevent the other platform from being of higher quality

More on Platform Competition (1)

- When product differentiation cannot be achieved through product design, alternative business strategies may relieve competitive pressure.
- Adopting different price skewness to court different segments from competitors on each side of the market is one way to propose a different value than competitors.
- Suppose that on each side, there are two types of consumers, some who value large networks highly and (many) others with low valuation for large networks.
- One possible strategy is to set a low price on one side (A for example), in order to attract the large mass of consumers with low valuation and set a high price on the other side (then B).
- If one platform proposes low prices on side A and high prices on side B, the other platform should do the opposite.
  - Ex : the market for online job search in the US (or in the credit card industry).

More on Platform Competition (2)

- Similarly, we can explain the co-existence of outlets with opposite business models in the media market: free-to-air (FTA) and pay-TV.
- If one media outlet chooses an FTA business model, the other may have some incentives to choose the Pay-TV business model.
- When one firm increases the level of advertising and reduces the viewers' subscription fee, it induces the other station to do the reverse – that is, to decrease the level of advertising and increase the viewers' subscription fee.
  - the two media are substitutable channels for conveying the same advertising content when consumers view the two outlets.
  - the amount of advertising induces a trade-off between increasing the price for advertisers and decreasing the price for viewers

Impact of Multihoming

- Many people use more than one search engine, social networks, or have more than one credit card. And some advertisers show their ads on many media.

  What can we say with multi-homing?

- Assume that side A still single-homes while side B wants to join both platforms.
- Side-B agents make their choice to join each platform separately
  - no more direct competition between platforms.
- Since each side-A user single-homes, this type of user is a scare resource for which each platform is ready to fight,
- If any side-B agent wants to be connected to any side-A agent, he must join this platform, which then acts as a **competitive bottleneck.**
- Platforms can raise their price on side B, whereas prices on side-A can
  - either increase because each agent is connected to all side-B agents,
  - or decrease because platforms are not competing to attract side-B agents

Resellers vs Platforms

- Some intermediaries can choose to act as platfoms or as standard resellers.
  - We can contrast 7-eleven (or Casino) and Alibaba.
  - For digital content, Netflix or Itunes are mostly resellers whereas Apple App Store or Google Play are marketplaces.
  - For car sharing, Uber and Blablacar are platforms while Avis or Budget are resellers.
  - Amazon started as a platform but has now a mixed business model with some reselling activities.

Resellers vs Platforms

- What is the difference between these two modes of organization?
- This question is related to the make-or-buy or vertical integration literature (Grossman-Hart, 1986).
- The main distinction between resellers and platforms lies in the allocation of control rights.
  - When the platform is many-sided, there may be complementarities and a reseller is better equipped for that.
  - But the cost is higher with resellers as they need capital, employees, and have less flexibility than platforms.
  - At last, with a reseller, there is fewer coordination issues (choice of price of the various components, belief on the others' behavior) than with a platform.

Regulation of Dominant Platforms

- General claim that there is less competition for the market now than before in many markets.
- Pb of measurement can explain that.
  - What is the market?
  - What is the right cost and so what is the right price?
  - What/where are the revenues?
- Implication for merger review to maintain dynamic competition.
  - Growing demand for more enforcement in public policy.
- Notion of Strategic Market Status that would be more investigated (see 2019 Furman CMA report).

Taxation of Dominant Platforms

- With digital goods, there are problems to define what is to be taxed.
- As a result, the digital firms average tax rate is about 9% (less than ½ the normal rate).
- Debate about
  - Which country should tax when the location of producers and users differs?
  - What can be taxed, when data or immaterial services are hard to measure and some services are free?
  - How to tax when taxation on one side can have unexpected impact on the other sides?
- On top, digital firms are very flexible and can easily transfer their activities, use royalties and dodge the tax system.
- The main ideas are (so far)
  - to use turnover rather than profit as a fiscal base,
  - to consider users as value generators and therefore tax (in particular ads revenues) as a function of the number of users.

Take-away

- Prices can very different across sides, some sides being profit-making while others loss-leader.
  - The higher the externality generated, the lower the price.
- Competition with network effects in a TSM environment can lead to very aggressive pricing.
  - An extra consumer on one platform erodes the attractiveness of its competitors.
- The choice between the MSP and the reseller business models involves a trade-off between the benefits of control over transactions, and the costs associated to it.
- Dominant platforms generate concerns for regulation, anti-trust, and taxation.

Exercise: pricing in a TSM

Consider the pricing decision of a monopoly firm providing a service at zero marginal cost. Suppose first that there are 200 potential users, 100 with a valuation for the good equal to 50 euros and 100 with a valuation equal to 10 euros.

1) What is the optimal monopoly price?

Assume now that the users are part of two different groups, A and B, each of equal size (100). For group-A users, there is no change and half of them have a valuation equal to 50, the other half with a valuation equal to 10. For group-B users, on top of the valuation described in the benchmark case, their valuation for the good is increased by 0.5 euros each time a group-A user purchases the good.

2) What are the profit-maximizing prices?

Digital Economics

Lecture 8

Privacy – Presentation

- The objective of this lecture is to discuss the notion of privacy.
- Keep in mind that privacy is not a new topic
  - USA: Privacy Act (1974) and Fair Credit Reporting Act (1970).
  - France: setting up of the CNIL (1978), administrative body regulating the collect and storage of personal data.
  - Note that most schools do not disclose student grades to prospective employers.
- So what is really new?
  - The increased ability to combine these sources to infer precisely some data that was not directly observable. And use it to adjust the prices, the goods, the ads,…
- And we share/spread our data in many more ways than before
- So the issues of Privacy have emerged (again) in the last decade.

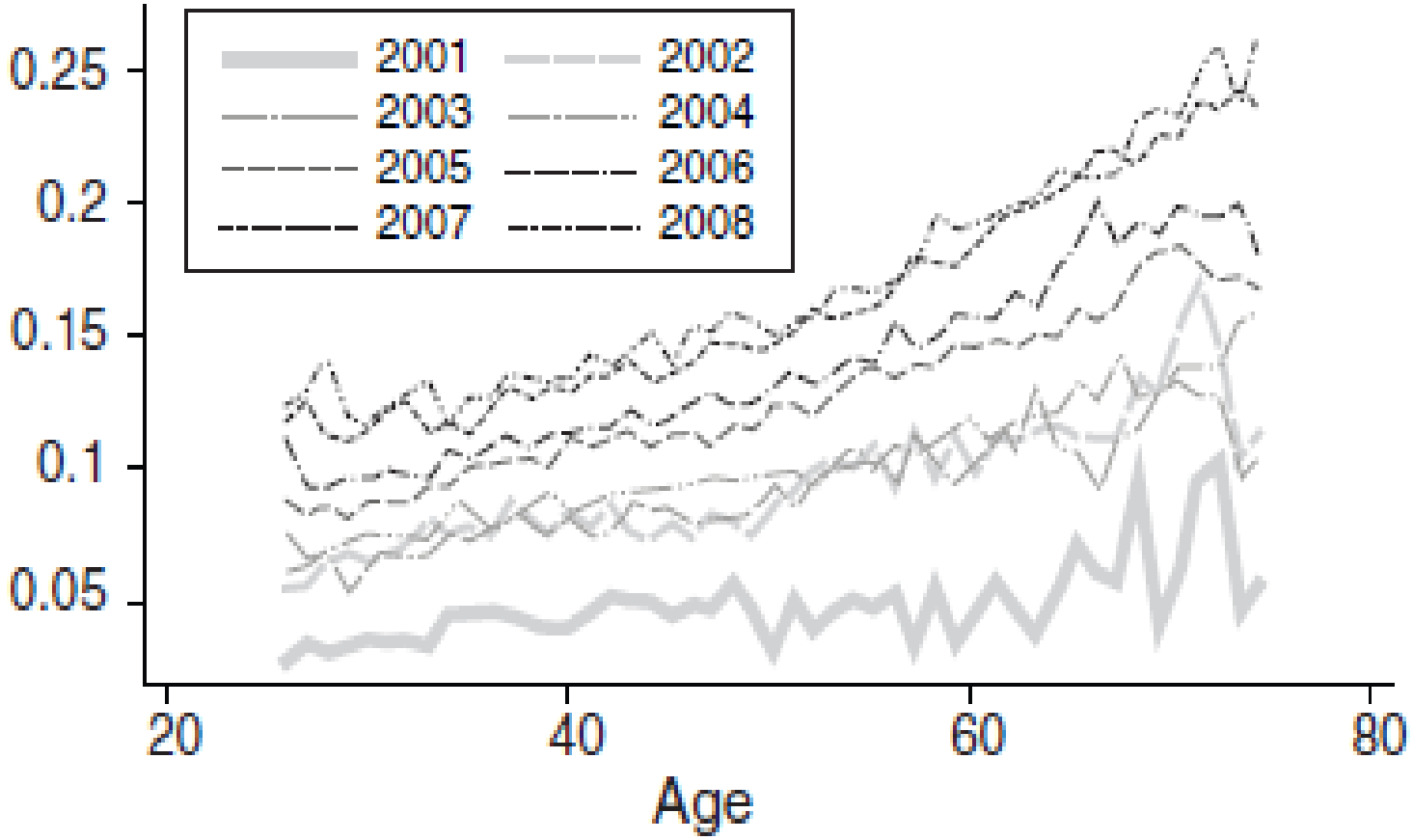
Privacy – Presentation

- Many different approach to privacy: protection of personal space, autonomy, boundaries between the self and other.
- We will focus on the control over information but it is still ambiguous: public *vs.* private info, information about type (health, wealth,..), information about actions, information about others.
- New regulation: E-privacy (EU 2002), California Online Privacy Act (2003) EU Electronic Communications Regulations (2009), GDPR (2016), CCPA (2019).
- Even old regulations can be protective,
  - see United States *vs* Jones (2012) where the US Supreme Court rules that GPS tracking of a drug trafficker was a search and (in this case) violated the 4rth Amendment.
- A real market for data (with Data Brokers, Data Analysts, ...) has emerged offering data related services to companies or protecting consumers from the threats linked to data dissemination.
  - Rmk: some firms (like Oracle) can propose services to do both.

Shift in Privacy Concerns

- A. Goldfarb and K. Tucker (2012) analyzed how privacy concerns have changed during from 2001 to 2008.
- They used a 3M individual survey and asked every year the same questions about the agent's willingness to reveal potentially sensitive information about their income.
- Rmk: the survey was not directly about income (it was asking about purchase preferences for different types of products, as health insurance or detergent).

Shift in Privacy Concerns
Fraction Refusing to Reveal Income



Goldfarb-Tucker (2012)

Shift in Privacy Concerns

- There are 3 main patterns (confirmed by a full econometric analysis)
  1) older people are more privacy-protective than younger people.
  2) Privacy is increasing over time across all age groups.
  3) The difference across age groups is increasing over time.
- What are the drivers?
  - The more time people spend online, the less likely they are to reveal.
  - The type of survey matters. The more personal the context is (financial or health survey), the more likely people are to refuse revealing their income.
  - But this context-specific attitude tends to disappear at the end of the period.

	(1)	(2)
Nonpersonal topic	−0.024***	−0.012*
	(0.0023)	(0.0062)
Nonpersonal topic × years	0.0032***	0.0013
	(0.00033)	(0.0011)
Nonpersonal topic × age		−0.00031**
		(0.00014)
Nonpersonal topic × age × years		0.000051**
		(0.000024)
Age × years		0.00022***
		(0.000021)
Years since 2001	0.010***	0.00045
	(0.00036)	(0.00094)
Age	0.0023***	0.00091***
	(0.000029)	(0.00012)
Female	0.045***	0.045***
	(0.00073)	(0.00073)
Average payroll (00,000)	−0.0067	0.014
	(0.013)	(0.012)
Month fixed effects	Yes	Yes
Site category fixed effects	Yes	Yes
Product type fixed effects	Yes	Yes
County fixed effects	Yes	Yes
Observations	3,176,706	3,176,706
Log-likelihood	−985,877.5	−985,456.8
R^2	0.02	0.02

Goldfarb-Tucker (2012)

Privacy – Presentation

- Key economic questions related to privacy
  - What is the impact of privacy on economics efficiency?
  - What is the impact of privacy on competition?
  - What is the value of privacy for individuals (taste for privacy)?
- Additional question: is privacy private or is it a common issue?
  - The disclosure of information (health status, prevention activities) is important for everyone.
  - Should the privacy decision be left to individuals?

Privacy and Efficiency

- As privacy is about the disclosure of information, we start by reviewing the classical results regarding the impact of asymmetric information in markets.
- Let us assume that there exists different versions (vertically differentiated) of the same product.
- If it is easy to differentiate the various versions of the same product, then it is as if the different versions were different goods with a specific market and a specific price for each product.
  - This is the "complete market" assumption, a necessary condition for the efficiency of markets.
- When it is not possible to distinguish the different versions, Akerlof (1970) showed that
  - Either all the versions are sold at a unique price corresponding to the average quality.
  - Or if the average price is too low, the high quality products will not be sold on the market.
  - And sometimes, the problem is so acute that the whole market will disappear (*market breakdown*)

Privacy and Efficiency

- In one of the first articles explicitly dedicated to the privacy issue, Richard Posner (1980) used this idea to advocate the ban on privacy in markets.
  - In the case of insurance, privacy means making some people (low risk) pay what others (high risk) “should” pay.
  - In the job market, this leads to mismatches, and therefore higher search costs for firms.
  - In the market for goods, the privacy policy is tantamount to a kind of fraud where some agents try to pass off their products as something they're not.
  - On the credit market, insolvent borrowers are confused with the good one, which increases the cost for all to contract loans.
- All this impedes the good functioning of markets, destroys value and prevents an efficient allocation of goods.

Privacy and Efficiency

- According to Posner, and most Chicago School economists, privacy is a way to conceal some information relevant to adjust the terms of trade.
- There is a redistributive dimension – as the price is the same for all – but at the expense of economic efficiency.
- The protection of personal data in economic matters is akin to the protection of a criminal's past.
- And for Posner, there's no reason why "honest" people should pay for people who have engaged in fraudulent, malicious or simply slippery behavior.

Privacy and Insurance

- In the previous analysis, the characteristics were given and only known by one side of the market.
- The classic article by J. Hirshleifer (1971) takes up the same questions but from an ex-ante point of view, i.e. assuming that the agents do not know their characteristics.
- Let us suppose that individuals are subject to a risk. For example, demand may be high or low, or their health status may be good or bad (function of your DNA, that you do not know).
- Initially, individuals don't know their risk but they may go to a market to insure themselves on an interim basis, i.e. before that risk is realized.
- Ex-post, the risk will be realized and contingent payments realized.
- In this context, ex-ante uncertainty allows these individuals to ensure a fair rate.

Privacy and Insurance

- Now suppose that, before the opening of the insurance market, the true type of agents is publicly revealed.
- This revelation destroys any possibility of insurance, which is detrimental to agents from a global point of view. Indeed,
  - Some individuals (the low-risk ones) benefit because they can insure themselves at a lower cost,
  - but ex ante, these individuals didn't know their risks;
  - They would rather not find out so the risks could be shared.

- Rmk 1: an agent may have some private incentives to learn this information but in this case, insurers will require it and those who do not provide it will be considered high-risk.
- Rmk 2: if the information allows to adjust production (and not only exchange), this information has a social value that must be compared to the loss of insurance.

Privacy – From Market to Firms

- The dissemination of personal data is a factor of efficiency for trade but related to random events, it can destroy the possibilities of insurance and thus turn against the agents.
- How data is used by firms and how this use can change the behavior of consumers?
- This is important because the fear of data misuse/management can lead consumers to shun the guilty firms.
- Key idea: if firms want to keep their business profitable, they should be cautious when using personal data.
- As personal data is used to personalize offers, we will focus on whether and when the fear of data misuse can be justified.

Privacy and Price Discrimination

- Consider a setting in which consumers are characterized by their valuation for the good, that it is maximal price they are ready to pay.
- For a given price, only consumers with valuation higher than the posted price will buy the good.
- As discussed before, firms with market power will face a standard trade-off between margin and quantity when setting their price.
- In classical analysis of markets, it is assumed that there is a unique price, either the competitive price or the price set by the firm.
  - Idea: firms can only propose one price because they are unable to screen consumers according to their valuation.
- This is exactly this last assumption that is questioned by Data Analytics and AI, and more precisely the increased ability to tailor offers (product, price, ads).

Privacy and Price Discrimination

- A firm price-discriminates when it charges two consumers (or the same consumer) different prices for two units of the same product or similar products, and the price difference does not reflect cost differences.
- Its objective is to extract as much as possible of what the consumers are willing to pay for its products or services.
- The economic literature distinguishes three types of price discrimination (PD):
  - First-degree PD (or personalized pricing): firms observe or infer all relevant heterogeneity and can set the price at the exact consumers' valuation.
  - Third-degree PD (or group pricing): firms observe or infer some but not all the relevant heterogeneity and construct groups. Using direct signals about demand, they are able to price-discriminate between groups.
  - Second-degree PD (or versioning): when the relevant heterogeneity cannot be observed, firms offer menus of options or packages, and consumers select an option/package based on their preferences.
- We set aside the last type of price-discrimination (second-degree) as this type of PD does not rely on data analytics.

Privacy and Price Discrimination

- Group pricing (or third-degree PD) is prevalent both in the digital economy and in the old economy.
  - Firms use the location and time of trade, some characteristics of consumers (age, gender,…) to set their price.
  - This data collection is made easier in the digital world, as an increasing number of submarkets can be defined.
    - more and more specific prices.
- Individual pricing (or first-degree PD) is the most interesting case as it becomes increasingly cheap to do so.
  - In theory, the idea is to set the price exactly to each consumer's valuation.
  - This was only a chimera for economists until 10 years ago but it is much more realistic now thanks to high dimensional data correlations.
  - Currently, individual price discrimination is feasible but rarely observed directly.
  - However, personalized rebates are very common, and have the same effect.

Privacy and Price Discrimination

- General idea: firms use the past behavior of consumers to infer current taste and valuation, and use this information to increase profit.
- Potential issue: consumers may alter their behavior and so will the competitors.
- Consider a situation in which a monopoly faces consumers repeatedly.
  - Repetition is important because inference is made using past data.
  - Each consumer is characterized by his valuation *v* for the good, assumed to be constant over time.
  - We focus on price setting to study how the dissemination of personal data can change surplus sharing.
  - But past data can also be used to propose the right item (at the right price) and increase total surplus.
- At the first period, the firm proposes a price *p* based on her initial belief about *v*.
  - Consumers buying signal themselves as high-valuation $(v \geq p)$.
  - Consumer not buying signal themselves as low-valuation $(v < p)$.

Privacy and Price Discrimination

- What is the firm's optimal strategy at the second period?
- Using the first period behaviors, the firm updates her belief on every agent.
- As this is only a binary data, this is equivalent to having two submarkets at this period.
- The firm can then propose two prices
  - A high price for the consumers that bought at t=1;
  - A low price for the others.
- Using past information allows the firm to sell more (which is good for everyone) and make more money (which is good for the firm). This has a positive impact on efficiency – i.e. value creation - and profit.
- But we have assumed that the firm's second-period strategy was not anticipated by consumers.
- What can we say when consumers are not that naïve?

Privacy and Price Discrimination

- At the first period, some consumers with type $v>p$ may refrain from buying to benefit from a lower price at the second period.
- To thwart this strategic behavior, the firm has two options
  - To decrease the price in the first period.

    -> this lowers profit and blurs market segmentation.
  - To commit not to use the information obtained in the first period.

    -> This commitment is not easy but firm's reputation or regulation can help.

- Thus, the benefit the firm can gain from the information obtained about consumers is limited, null, or even negative.
- The more consumers are rational/informed about the potential use of their data, the harder it is for firms to make use of it at the expense of their clients.
- What can we say in a (more) competitive environment?

Privacy and Competition

- We consider a situation of repeated relationships between a group of consumers and two firms, F1 and F2, proposing competing but differentiated products.
- Now, the taste of consumers is to what extent consumers are more attracted at equivalent prices by the F1's products or by F2's product….

  ….and we assume that this is only known by consumers.
- At the first period, each firm will offer a price with two objectives:
  - to extract the maximum surplus of captive consumers (those who particularly like her products).
  - to conquer consumers without particular preference for a type of product or another.
- The first-period price should tradeoff these two effects, and lead the firms to set price above cost, but not too much.

Privacy and Competition

- Note that this situation is well captured using a Hotelling setting with,
  - Two competing firms, A and B, located at the end of the interval [0,1], producing their product at a marginal cost 0.
  - A mass 1 of consumers uniformly distributed on the internal [0,1].
  - Firms propose prices and consumers incur a disutility increasing in the distance with the firm they buy from, Utility of a consumer located at θ and buying from a firm A located at 0 is given by $U = v - \theta t - p_A$

  where v is a constant representing the maximum value consumers can benefit from their preferred product, and t a coefficient measuring how heterogeneity (or differentiation) matters for consumers.
- In the standard Hotelling model, the market is fully covered and firms share the market equally, setting the same price $p = t$.
- Here, the profit for each firm is given by $t/2$.

Privacy and Competition

- At the second period, each firm has some information on the consumers' past behavior and can infer which consumers prefer her product and which consumers prefer her competitor's product.
  - Ideally each firm would like to set a high price for the former and a low price to the latter.
  - But since the other firm will do the same, both firms must lower their price on their turf.
- As firms are very aggressive on the competitor's turf and cannot exploit their own turf, their profit will be low.
- In general, the industry profit when data is used is therefore lower than when it is not used.
- This is similar to a prisoner's dilemma as individually each firm benefits from more information but collectively this hurts the industry's profit.
- In this competitive setting, less privacy means less profit but a higher consumer surplus.

Privacy and Competition

- Quite often, the information used by the firms to tailor their offers comes from different product markets and different sources.
- To analyze this, we modify the previous setting and introduce a Data Broker from which the firms can buy individual data about potential consumers. Specifically,
  - for a group of consumers of potential consumers, the new ones, the broker has no information;
  - for another group, the old ones, information is potentially available about the position on the Hotelling line, i.e. taste, of the consumers.
- With this information, the firms (A, B, or both) will then have the possibility to adjust their price.
  - Consumers will then face either a standard price or a customized price.
- We also assume that old consumers have the possibility to erase their history at a cost $c>0$.

Privacy and Competition

- A consumer will decide to pay this cost *c* if
  - the sum of the anticipated standard price and the cost is less than the anticipated customized price.
  - the anticipated standard price is low enough for him to consider buying the product.
- If no firm decides not to buy any information, consumers have no interest in becoming anonymous.
  - The equilibrium is that of Hotelling and the single price is $p = t$.
- If both firms choose to purchase the database, there is no incentive for consumers to anonymize.
  - Indeed, the firms will compete à la Bertrand for each consumer.
  - This will drive the prices down for the old consumers with $p_A(\theta) = \max\{0, t(1-2\theta)\}$ and $p_B(\theta) = \max\{0, t(2\theta-1)\}$
  - For consumers to the left (resp. right) of 1/2, A (resp. B) can set a strictly positive price and keep this consumer even if B (resp. A) offers a zero price.
- The profit on the market of the old consumers is therefore lower than that on the market of the new ones.

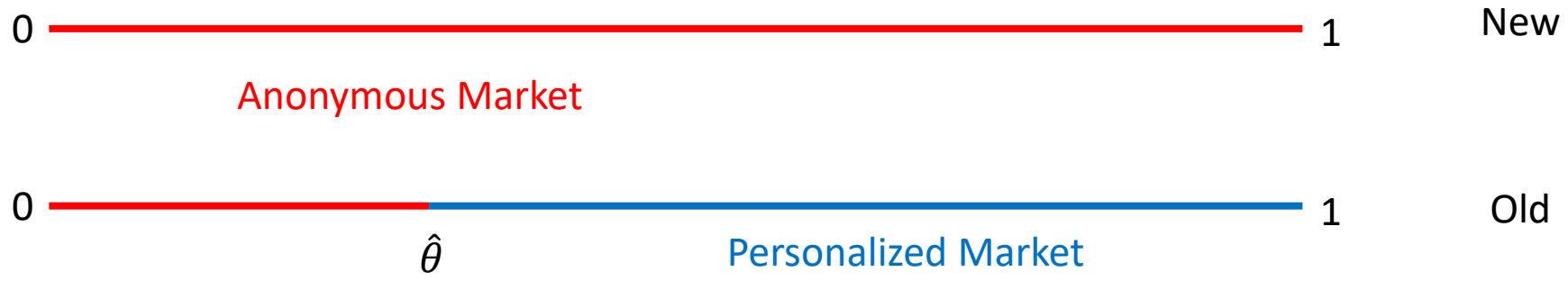
Privacy and Competition

- We focus on the case where only one firm (A) buys information about consumers.
  - This is therefore a case of exclusive dealing.
- Firm B will set a unique price for all consumers whereas Firm A chooses customized prices in order to make old consumers indifferent between A and B,
  - This leads to $p_A(\theta) = p_B + (1 - 2\theta)t$.
  - Note that this price is strictly positive if the price set by B is not too low.
- An old consumer with type θ decides to pay the cost of anonymization only if she considers buying from A. Then, she must either pretend to be new (by paying c) or face a personalized price.
- She will pay the privacy cost when

$$v - p_A - \theta t - c \geq v - p_A(\theta) - \theta t \Leftrightarrow \theta \leq \frac{1}{2} + \frac{p_B - p_A - c}{t} = \hat{\theta}$$

- Consumers who like product A very much want to conceal that to avoid facing a price in line with their willingness to pay.

Privacy and Competition



- We need to analyze how firms react to this behavior, that is how they choose their price
  - On the anonymous market (new consumers + old consumers close to A)
  - On the personalized market (old consumers not too close to A) but only Firm A can propose personalized prices.

Privacy and Competition

- When the privacy cost c is low,
  - many old consumers close to A choose to be anonymous ($\hat{\theta}$ increases).
  - Since the anonymous market is biased in favor of A, Firm A will set a high price allowing firm B to capture a higher share of the new consumers.
  - Because firm B can earn a large profit with the new consumers by setting also a high price, it will leaves A a monopoly on the personalized market.
- When the privacy cost is high,
  - Few old consumers choose to be anonymous.
  - The anonymous market is less biased in favor of good A, forcing A to lower its standard price.
  - The strategic complementarity of prices leads B to lower its price as well, allowing it to compete on both markets.
  - This also forces A to lower its personalized prices.

Privacy and Competition

- To sum up
  - increasing the cost of privacy for consumers reduces the bias toward A on the anonymous market so the price set by A decreases.
  - This leads B to decrease its own price, and A should propose better deals to all consumers, even to those who did not pay the privacy cost.
  - Therefore, the **profit of both firms goes down with c**.
  - In contrast, **consumer surplus goes up with c, even if some consumers (the old ones still paying the cost) are worse off.**
- This shows that, setting aside the intrinsic preference for privacy, consumers may benefit from more lenient rules on information disclosure.
  - At least if there is enough competition in the market…

Privacy and Data

- To avoid tough competition, the data was sold to one firm only.
- But what should be the price for Data?
- We take a simple example and suppose that
  - without additional data, each firm earns $2 millions.
  - when both firms have access to the data, profits drop to $1 million.
  - If Firm A benefits from additional data, its profit jumps to $3 millions whereas the other firm's profit is reduced to $0.5 million.
- As Firm A gains 1 million thanks to the data, one could belive that it is ready to pay up that amount.
- Is it true? What is the optimal Broker's pricing strategy?

Privacy and Data

- The Broker could threaten Firm A to sell the data to Firm B, which would result in a « loss » of $2.5 millions.
  - So even if Firm A only gains $1 million more with the data, it is « forced » to pay $2.5 millions.
- This price can be either proposed directly by the broker or the outcome of a competitive process (an auction).
- When a firm purchases data (and uses it), it generates an **externality** on the other firms.
  - This is what allows the broker to extract more than $1 million in the above example.
- General takeaway: the price for data is the differential value compared to an alternative situation that depends on the number of competing buyers and sellers.

Privacy, a private decision?

- One important aspect about privacy is that it is not fully a private issue.
- Indeed, there are some interactions among consumers so that the privacy decisions of agents are interconnected.
- Two aspects to study
  - Informational externalities
  - Privacy and public good

Privacy and voluntary profiling

- It has been proposed that the decision to disclose one information be left to each individual.
  - Voluntary profiling in the insurance industry.
  - In fact, voluntary profiling may lead to full information revelation.
- Consider the Hotelling model with only one firm (A) located at 0 and producing at zero marginal cost.
- With no additional information, the firm will choose a price maximizing

$$\frac{p[v-p]}{t} \Rightarrow p^m = \frac{v}{2}.$$

- In this situation, all the agents such that $v - \theta t - p^m \geq 0$ will buy that good, i.e. all agents with type below $\hat{\theta} = \frac{v}{2t}$.

Privacy and voluntary profiling

- Suppose that the firm proposes a reward *r* to all agents that voluntarily disclose their type.
- Who is willing to accept this offer?
  - By revealing their type, agents know that they will get a personalized price with 0 surplus afterwards.
  - The agents willing to accept this offer are such that

$$v - \theta t - p^m \leq r \Leftrightarrow \theta \geq \frac{\frac{v}{2} - r}{t} = \hat{\hat{\theta}},$$

$$\text{so } \hat{\hat{\theta}} < \hat{\theta}.$$

- Since the anonymous consumers have types lower than or equal to $\hat{\hat{\theta}}$, the firm can adjust its price upward.
  - The price will be chosen to extract all the surplus from this marginal agent, i.e. such that $v - \hat{\hat{\theta}} t - p = 0 \Rightarrow p = p_1^m = \frac{v}{2} + r$.
  - As this $\hat{\hat{\theta}}$ consumer anticipates that he will get zero surplus, he is willing to accept the initial firm offering of r, as well as all the agents such that $v - \theta t - p_1^m \leq r$.
- How should the firm then react?

Privacy and voluntary profiling

- It is optimal for the firm to increase the price even more, inducing more people to accept the initial offering.
- In fact, we can show that for any offer r>0 (even very small), all consumers are driven to reveal « voluntarily » their type.
- This unraveling mechanism allows the firm to extract all the information, and therefore all the surplus, at a minimal cost (zero in the limit).
- This could justify the ban on voluntary profiling or the restriction on the type of information firms can ask.

A Pizza for your Data

- When asked by the National Cyber Security Alliance (NCSA) in a survey, 60% of consumers said that they would never feel comfortable sharing their list of contacts if asked.
- In the same survey, information about one's contacts ranked as the second most private piece of data.
- How do people actually behave?
- Empirical study by Athey, Catalini, and Tucker (2017).

The Experiment

- In 2014, the MIT Bitcoin club raised capital to give each undergraduate students $100 in Bitcoin.
- As part of the signup process, participants were asked for their preferences for privacy.
- Using different questions, the students were divided into 3 groups, as a function of which privacy matters the most for them (« their peers », « intermediaries », « Government »).
- Students were asked to give the emails of close friends and some of them (randomly chosen) were offered a pizza to share with them.
  - The authors of the study could check whether the addresses given were valid or not.

Results

Table 2: Effect of Small Incentives on Privacy

VARIABLES	(1) All Invalid	(2) All Invalid	(3) All Invalid	(4) All Invalid	(5) All Invalid	(6) All Invalid	(7) All Invalid
Ask + Incentive	-0.0285***	-0.0268***	-0.0224***	-0.0249***	-0.0245***	-0.0327***	-0.0332***
	(0.0059)	(0.0066)	(0.0076)	(0.0068)	(0.0074)	(0.0060)	(0.0066)
Ask + Incentive × High Privacy Public		-0.0045					
		(0.0079)					
Ask + Incentive × High Privacy Intermediary			-0.0110				
			(0.0081)				
Ask + Incentive × High Privacy Government				-0.0085			
				(0.0078)			
Ask + Incentive × High Trust Government					-0.0080		
					(0.0079)		
Ask + Incentive × High Trust Startup						0.0153	
						(0.0100)	
Ask + Incentive × High Trust Retailer							0.0105
							(0.0081)
Constant	0.0531***	0.0531***	0.0531***	0.0531***	0.0531***	0.0531***	0.0531***
	(0.0057)	(0.0057)	(0.0057)	(0.0057)	(0.0057)	(0.0057)	(0.0057)
Observations	3,086	3,086	3,086	3,086	3,086	3,086	3,086
R-squared	0.005	0.006	0.006	0.006	0.006	0.006	0.006

Results

- The incentivized condition has a large, negative effect on the probability that students will protect the privacy of their friends relative to their behavior in the non-incentivized condition.
  - In Column (1), the coefficient estimate of -0.0285 for `Ask + Incentive' represents a 54% decrease in the probability of all invalid emails over the baseline.
- Differences in gender, expectations about the price of Bitcoin, and technology preferences (e.g. digital wallets, browsers etc.) also do not have a meaningful effect on the impact of incentives.
- Note that the study also included some results showing that
  - when proposed digital wallets, the ranking matters.
  - when more information is given about Privacy protection software to secure their future Bitcoin transactions, privacy concerns decrease.

Takeaways

- The economic impact of privacy depends on
  - how one tradeoffs efficiency and others considerations (insurance, fairness),
  - the degree of competition in markets
    - Idea of data as an essential facility/essential input.
- Privacy is not only a private issue as there are some informational externalities across agents
  - Example of digital twins, and voluntary profiling.
- And most people seem to care less about privacy in reality than they claim they do.
  - Do we need to regulate more (paternalism?) or open a new market for information?

Antitrust in Digital Industries

Lecture 9

A primer in Competition Policy

- What is Competition Policy?

  "the set of policies and laws which ensure that competition in the marketplace is not restricted in a way that is detrimental to society." (Motta, 2004)

- General ideas:
  - competition enhances economic efficiency.
  - competition puts firms under constant pressure to make the best offers (product/price).
  - in a free market, business should be a competitive game with consumers as the beneficiaries.

A primer in Competition Policy

- The idea is not much of protecting competition *per se*.
  - Some practices restricting competition can be acceptable if they enhance ``welfare".
  - Protecting competition does not mean protecting competitors but the competitive process.
- Competition policy may clash with industrial and/or trade policy: national champions to fight on international markets, export cartels are legal in some countries…
- The idea of welfare is not clear and depends on the country or time
  - In Europe, some potentially problematic conducts can be accepted if consumers get a fair share of the benefit.
  - In the US, there is a general idea of ``consumer welfare", and the FTC mission is ``protecting America's consumer"

A primer in Competition Policy

- The European legislation relies on articles 101 and 102 of the TFEU (previously 85 and 86, and then 81 and 82, of the Treaty of Rome).
- Article 101 is about agreements restricting competition (price-fixing, sharing markets, discrimination between customers).
- These agreements are forbidden unless
  - They improve the production of goods
  - Promote technical or economic progress
  - Consumers get a fair share of the benefit
  - And this cannot be achieved by other means and does not allow to eliminate competition.
- Usually vertical agreements are not considered as problematic and some horizontal agreements benefit from block exemptions (ex: R&D).

A primer in Competition Policy

- Article 102 focuses on the abuse of dominant position

  *"Any **abuse** (…) **of a dominant position** within the internal market (…) shall be prohibited (…)*

Such abuse may, in particular, consist in:

*(a) directly or indirectly **imposing unfair purchase or selling prices** or other unfair trading conditions;*

*(b) **limiting** production, markets or technical development to the prejudice of consumers;*

*(c) applying **dissimilar conditions** to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage;*

*(d) making the conclusion of contracts subject to acceptance (…) of **supplementary obligations** which (…) have no connection with the subject of such contracts."*

A primer in Competition Policy

- It is important to keep in mind that a dominant position by itself is not illegal.
- But a dominant firm has "special responsibilities" to ensure that its conduct does not distort competition.
- This means that some practices as exclusive dealing, predation, refusal to supply, charging excessive prices may qualify as abuses by a dominant firm.
- In the process of suing a firm for an abuse of dominant position, there are two main stages.
  1. Dominance should be assessed.
     - This is done first by defining the market, then computing market shares, and considering the barriers to entry.
  2. Then a *theory of harm* should be formulated, that is one has to show that the conduct is capable of restricting competition (except when the practice is per se forbidden).

A primer in Competition Policy

- There is a long history of antitrust in the US
- **Sherman Act** (1890): outlaws all contracts that unreasonably restrain trade. These include agreements among competitors to fix prices, ring bids, and allocate customers, which are punishable as criminal felonies.
  - The first case 1911: Standard Oil Co. of New Jersey v. United States
    - Supreme court broke up Standard Oil into 3 firms.
- **Clayton Act** (1914): civil statute (carrying no criminal penalties) that prohibits mergers or acquisitions that are likely to lessen competition.
- **The FTC Act** (1914): creates FTC; bans "unfair methods of competition" and "unfair or deceptive acts or practices”

A primer in Competition Policy

- The First Section of the Sherman Act deals with agreements between firms.
  - This is what is called the "Antitrust" policy and concerns cartels, horizontal and vertical agreements.
- The Second Section is concerned with monopolization.
  - Monopolization is the issue, not the exploitation of market power, even if the case law is more and more in line with Europe.

"The mere possession of monopoly power, and the concomitant charging of monopoly prices, is not only not unlawful; it is an important element of the free-market system" (US Supreme Court, Verizon vs Trinko, 2004).

Anti-trust in Digital Industries

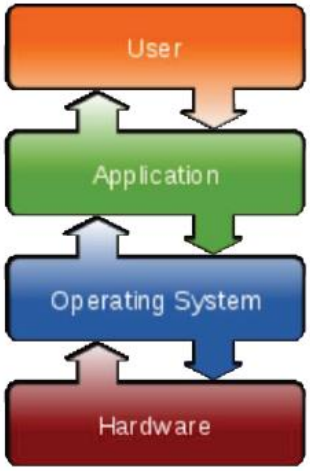
- Digital industries are now very concentrated.
- There is a concerns that the Big-Tech firms abuse (or are in the capacity to abuse) of their dominant position to
  - Prevent the entry of competitors in their core market
  - Enter and conquer other markets.

Rmk: here, I refer to markets as if they were clearly defined but we saw that it is far from being easy in TSM.

- In most developed countries, Competition Authorities are worried about this threat and there has been a few important cases in the last 20 years.
- In this chapter, we will discuss the most prominent cases and see how/if dominant firms can use their market power.

Description Android Case

- The first case studied involved Google and how it has used its dominance on the OS market to secure its dominance on another market.
- It is difficult to understand this case without understand how the market works.



Description Android Case

- Google acts as a multi-sided platforms setting zero prices on some sides to generate some money from other sides.
- It provides the Operating System (OS) Android for free but makes its money by its control over the Apps, the search engine and the app store mostly.
  - The app store (Google Play) which is a gatekeeper.
  - The tools for the apps (API) are crucial to allow communication between OS and the apps.
  - The search engine (Google Search) and the ads revenues associated.

Description Android Case - History

- Before the development of mobile devices, Google was mainly focused on the Browser market.
- But the shift from PC to smart devices led Google to change its strategy.

"If we are unable to attract and retain a substantial number of alternative device users to our web search services or if we are slow to develop products and technologies that are more compatible with non-PC communications devices, we will fail to capture a significant share of an increasingly important portion of the market for online services, which could adversely affect our business." (Google 2007 Annual Report)

Description Android Case

- This was done by developing Android (acquired in 2005) and the Android ecosystem.
- Idea
  - provide Android for free to the OEMs under an open source license.
  - make sure that all the environment was Android compatible in order to attract developers (GPS library for apps developers)
  - Make sure that no other « compatible but competitive environment » could emerge.
  - secure a deal with Apple in order to control at least the search activity (no way to control the App Store).

MADA, AFA, and RSA

- Google used 3 types of contract with members of the Android ecosystem.

1. The Mobile Application Distribution Agreements (MADA)
   - A device manufacturer which takes the Google Play Store must take a suite of apps including Search and Chrome.
   - Google search is the default search providers and any change in the system is subject to Google approval (a test).
   - Any pre-installed Google apps should be close to the home screen.
2. Anti-fragmentation obligations (AFA)
   - Licensing of Play Store and other apps conditional on device manufacturers agreeing not to produce and market forks: foreclosure in mobile operating systems and in search
3. Revenue Share Payments (RSA) with OEM for Google Search
   - This is conditioned on exclusive portfolio-wide pre-installation of Google Search.

Effects of MADA and AFA

- In Theory, Manufacturers could install bare Android with no App, but in this case, there were not allowed to include any Google app (including Google Play).
- If they opt for the normal Android, then all Google applications must be installed and be prominent or by default (MADA).
  - Note that Amazon (Fire Phones) has tried to run bare Android but there were many complaints on the absence of the major apps or the absence of compatibility between apps available and Google apps.
- The problem is mainly the difficulty of running third-party apps with Android.
- To make bare Android works, it is necessary to have a full alternative environment.
  - It exists in China, where the government has blocked some Google actions (data transfer) making it possible for competitors to develop.

Google Android Case

- What are the effects of these restrictions?
- Google's MADA requirement to include some Google apps and default to get any part of GMS prevents competition for App Store and Search.
- Google's AFA prohibition that device manufactures sell devices running on competing OS based on Android also prevents competition
  - Google financial incentives to device manufacturers for exclusive pre-installation of Google Search
- Even by paying, a competing service will never be prominent.
  - To show that the pre-installment is crucial, note that Google paid $1billion to Apple in 2014 to keep Google Search Bar on I-phones.
  - This means that only an entrant with substantial financial resources could compete (need for paying huge sum upfront).
  - The fact that Google apps are by default is crucial as most people do not change the default settings (or the security settings to install other apps).

Google Android Case

- Google has justified the restrictions on several grounds.
  1. since it is an open system, people are free,
  2. the Android system is costly to produce but provided for free so they must make the money somewhere (a TSM argument).
  3. the restriction are necessary so that users benefit from the full environment (as there is an Apple experience, or Microsoft).

Google Android Case

- A simple analysis of the case is as follows.
- Google provides its operating system for free.
  - OEM are induced/forced to use it.
  - Then developers use it.
  - Developers sell apps and Google gets a share of that.
  - As Google search is the default Search Engine, Google also makes some money.
- To enter that market for search, competitors must be on the mobile main page. But space is limited (competition for attention…).
- To enter the App store market, they also need to have compatible apps. Less likely to be developed for OS with small audience.
- The key instrument is tying.

Final decision by the European Commission

- Legal view on Tying
  1. the tying and tied products are two separate products;
  2. the undertaking concerned is dominant in the market for the tying product;
  3. the dominant undertaking does not give its customers or end users a choice to obtain the tying product without the tied product;
  4. the tying is capable of restricting competition.
- Note that a firm can be dominant in a market where there is no price (OS) even if the dominance is shown with no standard tools.
  - No easy way to look at SSNIP test (standard way to define market dominance).
- Google was fined 4.3 billions euros in 2018.

Economic Analysis of the Android Case

- Google's behavior can be seen as an example of *foreclosure*.
- Foreclosure refers to a dominant firm's denial of proper access to an essential good it produces, with the intent of extending monopoly power from that segment of the market to a potentially competitive segment.
- Google case is more complex than usual cases of foreclosure because there are many products involved.
- Nevertheless, the basic idea it that of a firm with a monopoly on one market (here the OS market) tries to extend this monopoly position on adjacent markets (App Store and Search markets mainly).

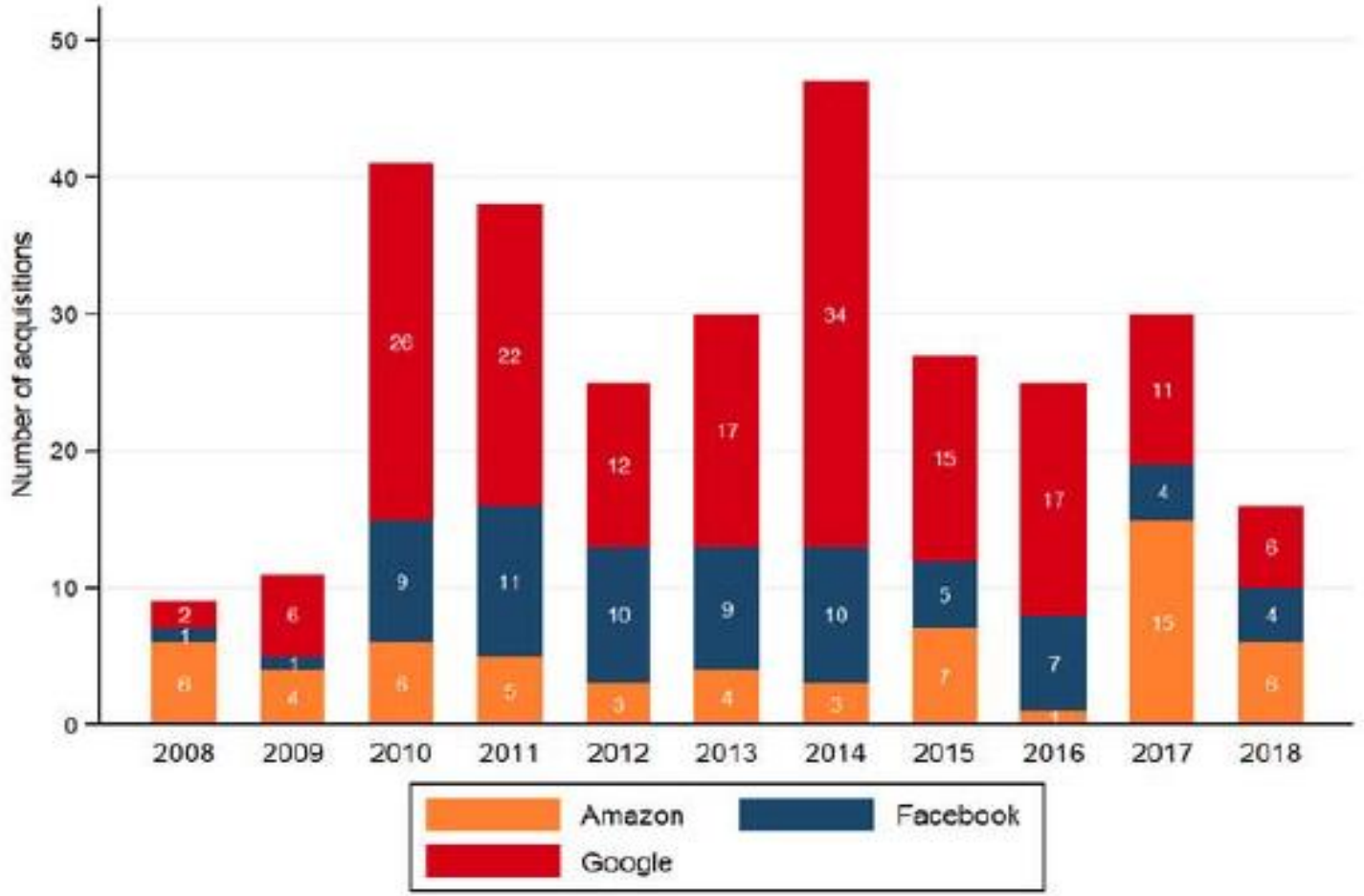
Big-Tech Mergers

- Some mergers concern firms providing complementary products (development tools, machine learning).
  - These vertical mergers do not create much competitive problem.
- Others concern firms developing their own customer base and creating fast network effects.
    - These mergers were seen as a tool to prevent future competition for the market.
- Facebook/WhatsApp, Facebook/Instagram and Google/Waze have been the most discussed cases (see also Microsoft/Skype, Apple/Shazam,…).
- The difficulty is that these mergers who do not appear as horizontal could be in reality.
  - What is the market (goods, service, attention)?
  - What is a big firm (profit, turnover, number of users)?
- We first discuss the standard way merger reviews are done, then analyze the specific issues in digital markets, and at last some specific mergers.

Big-Tech Mergers

(source Argentesi et al. Vox (2020))

Figure 1 Acquisitions by Amazon, Facebook, and Google, 2008–2018



Merger Review in standard Industries

- Most of the merger reviews concern horizontal mergers.
- What are the potential issues with mergers?
  - Collusion (easier to cooperate when the number of firms is low) – link to TFEU 101
  - Too much market power- link to TFEU 102.
- But mergers can be good for efficiency (lower cost, more innovation from large firms).
- The classical trade-off (stated by Williamson, 1968) is then between efficiency and market power.
- How mergers are assessed in the real world?

Merger Review in standard Industries

- First, the market must be defined. And this is done by measuring demand substitutability.
  - Suppose that there are two firms A and B.
  - If A and B raised their price, do they make more profit?
  - If yes, A and B constitute the market.
  - If not, some other firms must be included in the market.
- There are different ways to conduct this price test and other elements (transport cost, localization of firms) are taken into account.

Merger Review in standard Industries

- The second step is often to compute a concentration index (based on sales), for example, the HHI.
  - This index is based on the sum of squares of market share.
    - If 3 firms capture 1/3 the market, the HHI is given by

$$33{,}33^2 + 33{,}33^2 + 33{,}33^2 = 3333{,}33$$

    - If 1 firm capture ½ of the market and the other 1/4, we get

$$50^2 + 25^2 + 25^2 = 3750$$

  - The HHI is between 0 (perfect competition) and 10000 (monopoly).
  - There is a merger review if
    - The initial HHI is high (higher than 1500 or 2500)
    - The HHI increase is important (more than 100).
- HHI indexes are helpful it is hard to foresee the firm's ability to increase its price after the merger.
- A special attention is also given to the impact on innovation and product variety.

Big-Tech Mergers

- In the case of digital mergers, the cases must to be reviewed differently.
- In particular, without price on some sides of the market, a new theory of harm (ToH) is needed to explain why the merger can be socially harmful.
- There are two main types of ToH
  - Some related to horizontal mergers
  - Others related to vertical mergers.
- We first discuss these ToH and then analyse the Facebook/Instagram merger.

Big-Tech Mergers

Let us first look at some horizontal theories of harm.

1. Network effects tend to create an advantage for large firm.

- Having too large a firm can prevent the entry of a more efficient but (first) small competitor.
- And this is all the more true that it is hard for users to coordinate on their platform choice.
- Two factors tend to mitigate this network effects
  - Multi-homing.
  - The existence of inner circle, i.e. small groups interacting on the platforms regularly and therefore likely to make simultaneous change.
- These two factors explain why the merger between Microsoft and Skype was cleared by the CA.

Big-Tech Mergers

2. The loss of competition **on the market for attention** is also a potential issue.

- Even if the users on the merger firms are different on one side (say consumers), they can be the same on the other side (advertisers).
- In the Facebook/WhatsApp case (2014), the privacy policy of WhatsApp (who was neither selling ads not data) seemed to be OK on this aspect..
- The existence of other social media made it unlikely that WhatsApp change its privacy policy.
- This is why the Facebook/WhatsApp merger was cleared.

Big-Tech Mergers

3. One of the big fear is the **loss of potential competition**.

- This happens if the merging firms, even if there were not competing yet, could be have competed later.
- This is a very difficult issue as it is hard to know whether a small firm in a niche market could have become a major player.
- In the Google/Double Click case (2008), this question has been raised as both firms were active in the online advertising sector (DC was more into technology).
- DC intended to compete with Google and enter the ad intermediation service but at that time there was enough other competitors to exert competitive pressure to the merged entity post-merger.

Big-Tech Mergers

4. **Loss of innovation** is also a common concern.

- Note first that there is a debate in general on whether more competition leads to more of less innovation.
- The potential issue is that a big firm would buy a small and innovating one, and would not use the innovative product/idea.
- This issue is related to the « killer acquisition» debate in the pharmaceutical industry.
- For this reason, there is sometimes the idea that a necessary remedy is for the big firm to be divested from its R&D unit, to maintain some competition in innovation.

Big-Tech Mergers

- In the case of digital mergers, there are also some vertical theories of harm to consider.

1. For example, in the Microsoft/LinkedIn, merger, the issue of vertical foreclosure was raised.
    - A possible strategy could be for Microsoft to pre-install LinkedIn in order to foreclose LinkedIn competitors in the Professional Service Network (PSN) market.
    - If on top, other PSN were denied access to Microsoft API, this would totally foreclose the market.
- But in contrast with the Android Case, multi-homing was a possible factor mitigating network effects.
- Nevertheless, to prevent possible foreclosure, the EC made sure that pre-installment was limited and that other PSN will have access to Microsoft API.

Big-Tech Mergers

2. Data was also considered as an essential input to compete.
   - If it is the case, foreclosure can result from a combination of previously independent datasets.
   - this would mean that mergers between different firms (even conducting unrelated business) could give them a decisive competitive advantage.
   - Note that in the case, this advantage comes from increased efficiency.
   - This question was raised in the Apple/Shazam merger as Shazam' information could help Apple selling music.
   - But the EC considered that the same information (customer's taste on music) was available to other internet players (Facebook, Twitter).
   - So even if the merged entity were to deny Apple music's rival access to Shazam's data, the impact on competition would be minimal.

The Facebook/Instagram Merger

- The Facebook/Instagram merger is a nice case where it is hard to use standard methods.
  - No price on the consumers' side.
  - No monetization (yet) of consumers' data by Instagram.
  - Many markets (social media, advertising, attention) with potentially many players on each market.
- Nevertheless, Facebook paid $1billion (mostly in shares) for Instagram.
- The legal challenge here is a potential abuse of dominant position
  - In general, concentration is treated as such but in this case, the concentration was below turnover thresholds (so this was dismissed by the French Competition Authorities).
  - The OFT (UK) examined this merger on this ground but considered that there was no real issue.

"*the OFT does not believe that it is or may be the case that the merger may be expected to result in a substantial lessening of competition within a market or markets in the United Kingdom".*

The Facebook/Instagram Merger

- At the time of the merger,
  - Instagram was providing a free mobile app allowing users to take, modify and share photos on Instagram or on other social media.
    - In this sense, Instagram could be seen both as a complement and a substitute to other social media.
  - Facebook was a digital platform supplying social media service and had just launched a mobile photo app (Facebook Camera).

The Facebook/Instagram Merger

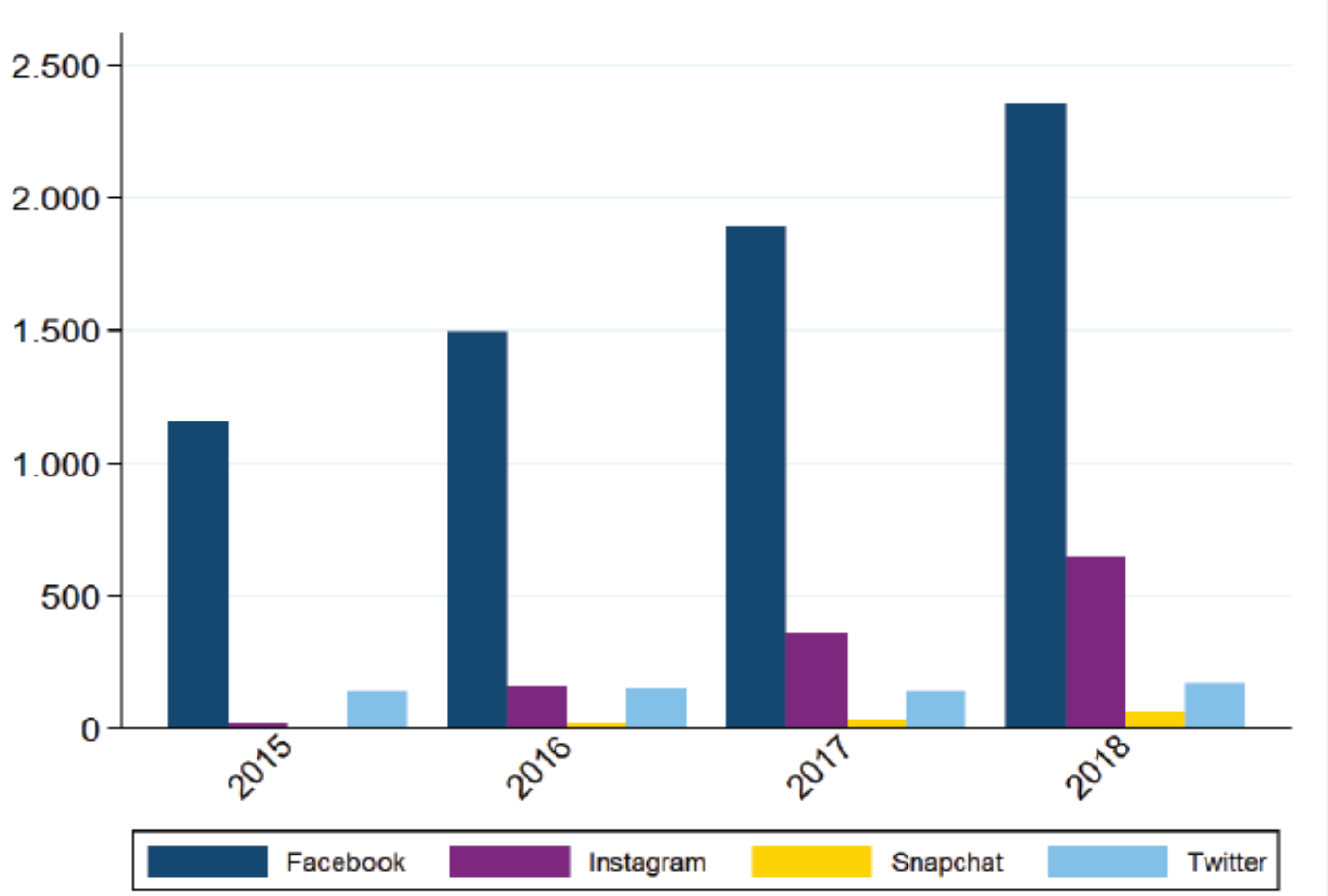
- 3 main potential problems
  - Less competition in the market for supply of photo apps.
    - There were many competitors so this did not appear as a major issue.
  - Instagram could have competed with Facebook for advertising revenue
    - This did not seem to be the case in the short run and there were other competitors in this market.
  - Instagram could make it more difficult to repost across the other social networking websites
    - There was the idea that the ability to repost on many social was part of Instagram's appeal.

The Facebook/Instagram Merger

- A full analysis of the advertising was in fact missing.
- It is true that, at the time of the merger, Instagram was not in this market.
- But it was about to change.
  - This merger allowed Facebook to have most of its users as single-homing users.
- When users are single-homing, advertisers have to pay much more than in the multi-homing case (the incremental pricing principle).
- Potentially, the ability to merger users' bases was an asset both to reduce transaction costs but also to better target ads.
- The growing importance of Instagram in the advertising market can be seen by looking at the post-merger data (here for UK).

The Facebook/Instagram Merger

Figure 7: UK advertising revenue for the main social networks (million GBP)



Source: Argentesi et al. (2019)

The Facebook/Instagram Merger

- According to the assessment made by Argentesi *et al.* (2019), the Facebook/Instagram merger.
  - has generated efficiencies with increased functionality and better targeting,
  - has eliminated a potential competitor in the social media market and in the advertising market.
- It was clear that Instagram alone would have tried to monetize its data base on the ads market but harder to tell whether it could really have competed with Facebook
- What this clear is that this merger has cemented Facebook leading position and, therefore, prevented any other competitor from emerging.

More on Facebook's Mergers

- Note that two years later, Facebook acquired WhatsApp for $19billion.
- This concentration was notified in 2014 (even if the turnover thresholds were only met in a few countries).
- However,
  - Facebook and WhatsApp were considered to operate in different markets (social networking services and consumer communications services).
  - WhatsApp did not sell any advertising
  - WhatsApp did not store any personal data
  - WhatsApp and Messenger were more complementary than substitute.
  - Multihoming is quite easy for consumers.
- The EC did not oppose the merger but there is a debate on that, and the view that if Facebook paid so much for a firm that was making almost no money ($1,3M in the first 3 quarter of 2014), there was a reason.
  - Is this the value for consumer's data?
  - Or the price to pay to make sure that multi-homers become single-homer so extract the full surplus from advertisers?

Remarks on merger reviews

- Competition authorities try to balance two types of risk
  - False positive, i.e. wrongly refuse mergers that pose no competitive threat
  - False negative, i.e. wrongly accept mergers that lessen competition.
- So far, there is a feeling that too much weight has been put on avoiding false positive.
- This has probably led many CAs to accept too many mergers (*underenforcement*).
- In order to restore the balance, many people (academics, politicians) ask that major players in the digital industries be more scrutinized.
- In particular, the idea is that for firms with special responsibilities (gatekeepers), the burden of the proof be reversed in the merger case.
- This would force them to prove that any merger does not generate a lessening of competition.