

Competitive Markets for Personal Data

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Consumers supply a crucial input for modern economy: their **personal data**

Yet, they often have **limited control** over who uses their data and how:

- “Expropriation” and barter, common practice in the industry, may lead to inefficiencies and inequality FTC '15, Bergemann et al. '23

New legislation gives consumers more control over their data (GDPR, CCPA, ...)

- Lays foundations upon which **data markets** could emerge

What properties would such markets have? Which institutions should be designed to ensure efficient outcomes?

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2. Propose three **remedies** to this market failure:

- Data unions; Data taxes; Lindahl prices

model

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Two periods: 1. Data markets are open 2. Product market is open

The consumers and the platform trade data records at market prices $p = (p(\omega))_{\omega \in \Omega}$, which they take as given

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- Platform demands **database** $q = (q(\omega))_{\omega \in \Omega}$, for which it pays $p \cdot q$

The supply side:

- If type- ω consumer sells her record to the platform, she is paid $p(\omega)$ and is later intermediated with merchant
- If type- ω consumer doesn't sell her record, she obtains \bar{r}

Given acquired database q , platform acts as **information intermediary**: (as in BBM'15)

- It sends signal to merchant about each consumer in database
- Given signal, merchant charges each consumer a fee a
- Given a , type- ω consumer purchases product if $\omega \geq a$

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The **payoffs** in period 2 are:

Consumer's: $u(a, \omega) = \max\{\omega - a, 0\}$

Merchant's: $\pi(a, \omega) = a \mathbb{1}(\omega \geq a)$

Platform's: $v(a, \omega) = \gamma_u u(a, \omega) + \gamma_\pi \pi(a, \omega)$

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Info-design problem equiv to platform choosing mechanism $x : \Omega \rightarrow \Delta(A)$ s.t.

$$\begin{aligned} V(q) = & \max_{x: \Omega \rightarrow \Delta(A)} \sum_{\omega, a} v(a, \omega) x(a|\omega) q(\omega) \\ \text{s.t. } & \forall a, a': \sum_{\omega} \left(\pi(a, \omega) - \pi(a', \omega) \right) x(a|\omega) q(\omega) \geq 0 \end{aligned}$$

(canonical ID problem with endogenous q)

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inefficiency of the data economy

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Definition

An allocation (q°, x°) is **constrained efficient** if it maximizes

$$\begin{aligned} \max_{q, x} \quad & \text{Consumers's Welfare}(q, x) + \text{Platform's Welfare}(q, x) \\ \text{s.t.} \quad & q \text{ is feasible (i.e., } q \leq \bar{q}) \\ & x \text{ is IC for the platform, given } q \end{aligned}$$

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Results extend to using *social* welfare and *unconstrained* efficiency

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Result. If Private and Social Benefits are aligned for all ω , equilibrium is constrained efficient

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Note: How can Private and Social benefits be misaligned given that we assumed data records are uncorrelated?

The misalignment depends on how platform uses consumers data, and thus on its objective

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- ▶ If $\gamma_u < \gamma_\pi$, equilibria are constrained efficient, and consumers' welfare is maximal
- ▶ If $\gamma_u \geq \gamma_\pi$, equilibria can be inefficient (and, in fact, consumers' welfare can be as low as \bar{r})

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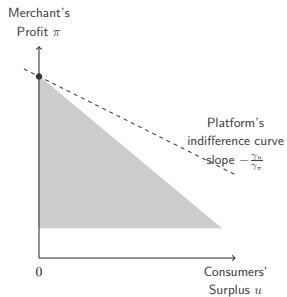
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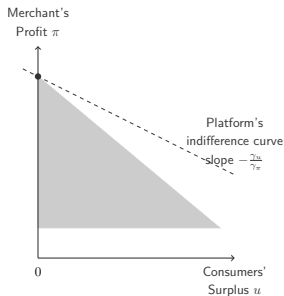
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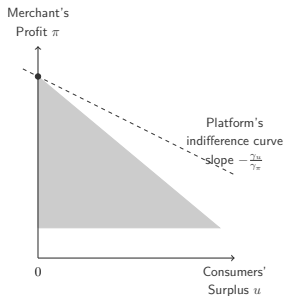


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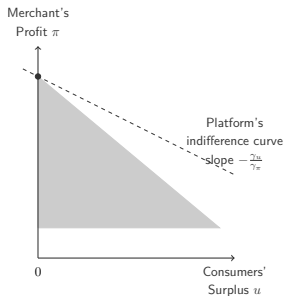
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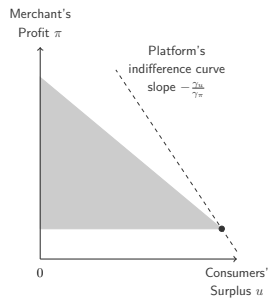


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- Therefore, $\sum_a x^*(a, \omega) u(a, \omega) = \xi^*(\omega) = 0$
- Private and social benefit are aligned
- All equilibria are constrained efficient

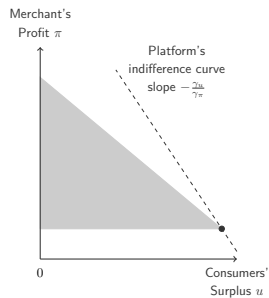
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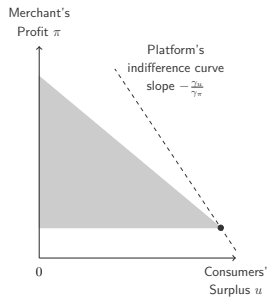


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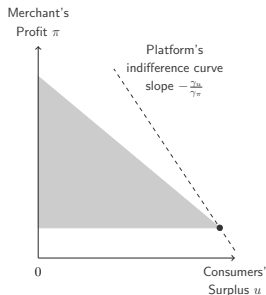


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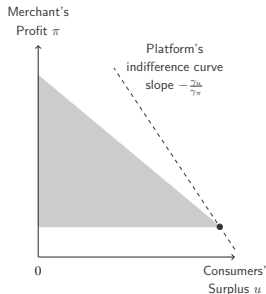


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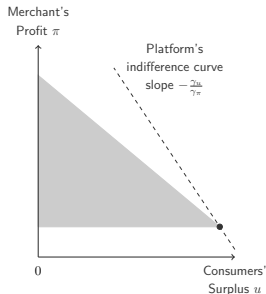
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- Externalities \rightsquigarrow Eqm inefficiency
- **Example:** think of lowest-type consumer

example

Suppose:

- Only two types of consumers: $\omega \in \{1, 2\}$ with $\bar{q}(1) < \bar{q}(2)$
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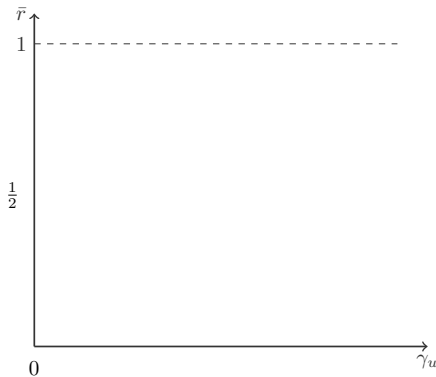
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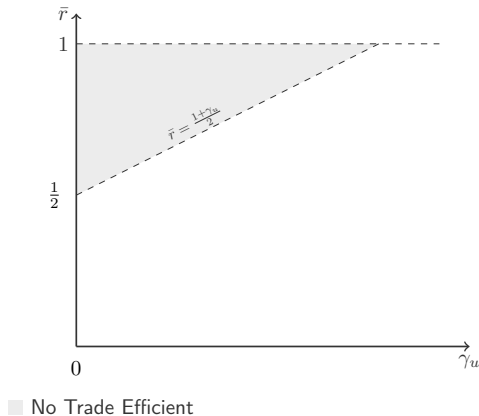
- Market unravels \rightsquigarrow No trade \rightsquigarrow Inefficiency

Low-type consumers do not internalize positive externality they exert

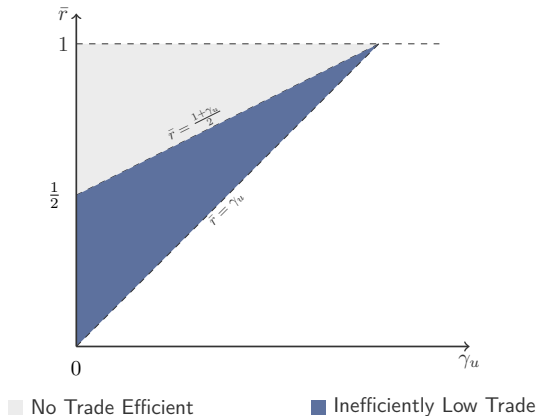
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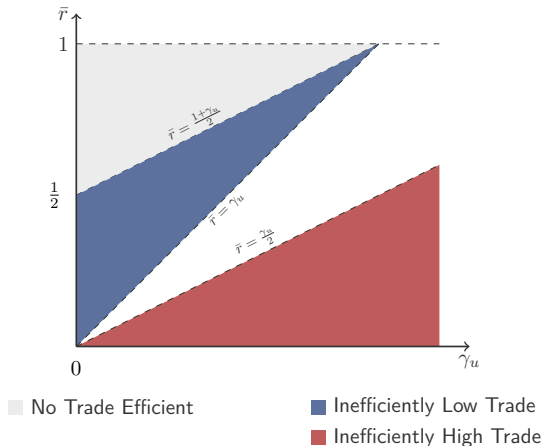
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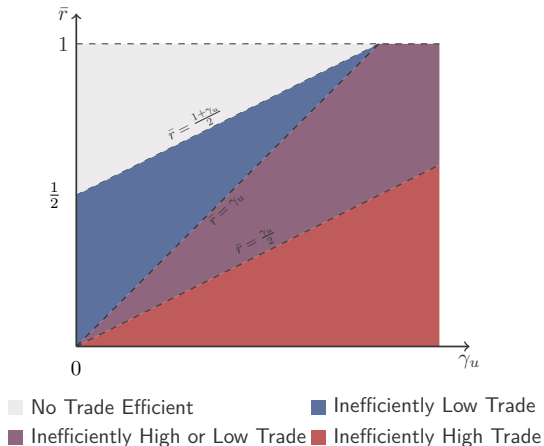
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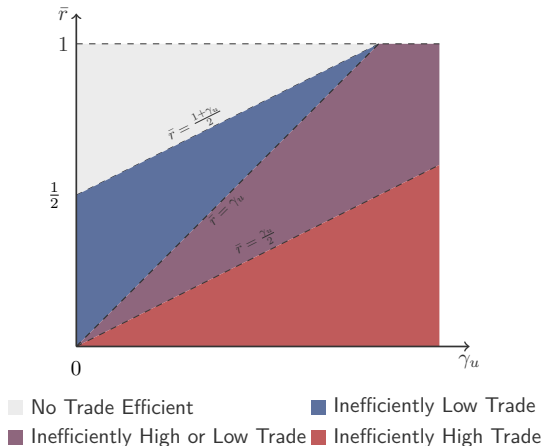
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Information intermediaries play key role in digital markets

Acquisti et al. '16

They often intermediate agents with conflicting interests
(drivers-riders, etc.)

(sellers-buyers;

Due to conflicting interests, platforms may withhold some information from the agents \rightsquigarrow pooling \rightsquigarrow externality

This paper illustrates how this practice can lead to market failures

This force more general than our price-discrimination application, or the merchant being a monopolist

remedies

How to fix this market failure?

We explore three alternative market designs:

1. Introducing a **data union**
2. Implementing **data taxes**
3. Making data markets more **complete**

data union

A **data union** manages the data of participating consumers on their behalf

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It works as follows:

- Consumers choose whether to become members of the union
- If they do, they relinquish their data to the union
- Union chooses which data to sell to the platform

Consumers retain reservation utility unless record is sold to platform

- With the proceeds of sale, union compensates all participating consumers (to incentivize their participation)
- Union maximizes welfare of participating consumers

Formally, the data union problem is:

$$\max_{(p,q,x)} \quad \sum_{\omega} p(\omega) \bar{q}(\omega) + \sum_{a,\omega} u(a,\omega) x(a|\omega) q(\omega) + \sum_{\omega} (\bar{q}(\omega) - q(\omega)) r(\omega)$$

such that $q \leq \bar{q}$,

and $\sum_{\omega} p(\omega) \bar{q}(\omega) = V(q)$,

and x solves \mathcal{P}_q ,

and $p(\omega) + \frac{q(\omega)}{\bar{q}(\omega)} \sum_a u(a,\omega) x(a|\omega) + \left(1 - \frac{q(\omega)}{\bar{q}(\omega)}\right) r(\omega) \geq r(\omega).$

Proposition

Equilibria of the data-union economy are constrained efficient and maximize consumers' welfare

Union coordinates consumers by deciding which records should be sold and how consumers should be compensated

This offers theoretical support to recent policy proposals that discuss role data unions could play in the data economy

Posner Weyl 18; Bergemann et al 23

data taxes

Enrich competitive economy by introducing a simple **data tax**:

- ▶ When selling her record, consumer pays tax $\tau(\omega) \in \mathbb{R}$ to the govt

Proposition

Let (q°, x°) be a constrained-efficient allocation. There exists a profile of taxes τ^* and an equilibrium of the economy with taxation τ^* that implements (q°, x°) .

When properly designed, data taxes force consumers to internalize effects that selling their records create on economy

Let allocation (q°, x°) be constrained efficient

Let p^* be a supergradient of $V(q^\circ)$

Define $\tau^*(\omega) \triangleq p^*(\omega) + \sum_a x^\circ(a|\omega)u(a, \omega) - r(\omega)$

Notice that $U^*(\omega) - \tau^*(\omega) \equiv r(\omega)$

Therefore, all consumers indifferent \rightsquigarrow choose ζ^* to implement q°



more-complete markets

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Proposition

Equilibria of this Lindahl economy are (unconstrained) efficient and maximize consumers' welfare

conclusion

1. A stylized framework to study competitive markets for personal data

Rooted in GE tradition but leveraging recent progress in info-design

2. Identify novel inefficiency leading this otherwise perfectly competitive market to fail

Show how inefficiency critically depends on platform's role as an information intermediary

3. Propose three alternative market designs that fix inefficiency: data unions, data taxes, richer data prices

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Thank You!

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Bonus: In eqm, platform makes not profits. Thus, $W(q^*, x^*)$ equals consumer welfare. Thus, any constrained-efficient eqm maximizes consumer welfare

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Tractability a dynamic microfoundation in XY '23

Discussion of Main Assumptions

model

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Three aspects of the consumer problem have been simplified:

Record fully reveals underlying type alt see GLP '23

Record bundles access and information alt see ALV '22

Reservation utility $r(\omega)$ is exogenous alt see BB '23

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