Competitive Markets for Personal Data

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Consumers supply crucial input for modern economy: their personal data

Yet, they often have **limited control** over who uses it and are **imperfectly compensated** in return

- Expropriation and barter, common practice in the industry ${
m (FTC~'15)}$

This status quo may be source of market failures (Seim et al. '22)

Could a competitive market for data avoid these problems?

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- Platform uses this data to interact consumers with a merchant

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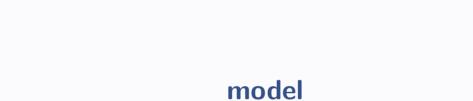
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- 2. Propose three alternative solutions
 - Data taxes; a data union; an making data markets more complete



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A Stylized Data Economy

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The merchant wants to sell widgets to consumers

(zero MC)

(finite)

Each **consumer** has unit demand for widget and WTP $\omega \in \Omega$

Consumer's WTP distributed as $\bar{q} \in \Delta(\Omega)$

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Two periods: 1. Data records are traded, 2. Data records are used

Platform and consumers trade the data records in a competitive market

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Demand Side:

Platform demands database $q=(q(\omega_1),\ldots,q(\omega_N))$ and pays unit price $p(\omega)$ for each ω -record

Supply Side:

If type- ω consumer sells her record, she is paid price $p(\omega)$

If consumer does not sell, she forgoes price and platform's "service" and obtains reservation utility $r(\omega)$

Given acquired database $q \in \mathbb{R}^{\Omega}_+$, platform acts as information designer:

- It sends merchant signal about each consumer in database
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The **payoffs** in period 2 are:

Consumer's: $u(a, \omega) = \text{surplus}$

Merchant's: $\pi(a,\omega) = \text{profits}$

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

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I.e., Platform chooses recommendation mechanism $x:\Omega\to\Delta(A)$ to solve

$$\begin{split} V(q) &= \max_{x:\Omega \to \Delta(A)} \sum_{\omega,a} v(a,\omega) x(a|\omega) q(\omega) \\ \text{s.t. } \forall a,a' \colon \sum_{\omega,\omega} \Big(\pi(a,\omega) - \pi(a',\omega) \Big) x(a|\omega) q(\omega) \geq 0 \end{split} \tag{\mathcal{P}_q}$$

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- (c). Given p^* and x^* , ζ^* solves consumers' problem, i.e.,

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(d). Markets clear, i.e. $q^*(\omega) = \zeta^*(\omega)\bar{q}(\omega) \quad \forall \omega$

analysis

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Definition

An outcome (q°, x°) is **constrained efficient** if it solves

$$\max_{q,x} \quad W(q,x)$$

s.t. $q \leq \bar{q}$ and x solves platform's ID problem given q

Main Result analysis

Question: Are equilibrium outcomes constrained efficient?

Eqm efficiency depends on how platform uses data, thus on its objective

Recall:
$$v(a,\omega) = \frac{\gamma_u}{u} u(a,\omega) + \gamma_\pi \pi(a,\omega)$$

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Proposition

- If $\gamma_u < \gamma_\pi$, equilibria are constrained efficient and thus consumers' welfare is maximal
- If $\gamma_u \geq \gamma_\pi$, equilibria can be inefficient (and consumers' welfare can be as low as $R = \sum_{\omega} r(\omega) \bar{q}(\omega)$)

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Equilibrium maximizes consumers welfare when platform cares more about merchant's payoff \rightsquigarrow Why?

- When $\gamma_u \geq \gamma_{\pi}$, platform withholds some information from merchant
- How? Platform pools consumers of different types
- Composition of a pool determines merchant's belief, thus his fee
- If a consumer does not sell her data, she affects pool composition and, thus, other consumers' payoff
- Consumers exert externality on each other

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See paper for:

- Existence
- General characterization of eqm efficiency
- Stronger sufficiency conditions for inefficiency
- Social welfare
- An illustrative example

remedies

Remedies

How to fix this market failure?

We explore three alternative market designs:

- 1. Introducing data taxes
- 2. Introducing data unions
- 3. Making data markets more complete



Data Taxes remedies

Introduce a simple data tax on consumers:

lacktriangle When selling her record, consumer pays tax / receive subsidy $t(\omega)\in\mathbb{R}$

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Proposition

Fix any constrained-efficient outcome (q^*, x^*) .

There exists an equilibrium of the competitive economy (p^*, ζ^*, q^*, x^*) and taxes

$$t^*(\omega) := \sum_{a} u(a, \omega) x^*(a|\omega) + p^*(\omega) - \psi_{q^*}(\omega) \qquad \forall \omega$$

supporting the constrained-efficient outcome. Thus, consumer welfare is maximized, regardless of platform's preferences.

Moreover, the budget is balanced.

Idea: with data tax, consumers internalize social benefit of selling their data

data union

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- Union manages data on behalf of all consumers i.e., all consumers voluntarily participate in the union, $\zeta(\omega)=1,\ \forall \omega.$
- Union sells part of its database \bar{q} to platform (price maker) i.e., it sells $q \leq \bar{q}$ for V(q) (extracting platform's payoff)
- Union distributes proceeds V(q) of the sale back to consumers i.e. it chooses p s.t. $\sum_{\omega} p(\omega) \bar{q}(\omega) = V(q)$ to guarantee participation

Proposition

Equilibria of the data-union economy are constrained efficient and maximize consumers' welfare, regardless of platform's incentives

more-complete markets

We allow consumers to trade the way their records are used by platform

More-complete markets:

- There is a market where type- ω records can be sold for "intended use a"
- The price of ω -records, $p(a,\omega)$, can now depend on how it is used

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Equilibria of the Lindahl economy are (unconstrained) efficient and maximize consumers' welfare, regardless of platform's incentives

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Drop competitive market assumption and suppose platform is price maker

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Definition

 (p^*,ζ^*,q^*,x^*) is an equilibrium of the ${\bf monopsonist\ economy}$ if it solves

$$\max_{(p,\zeta,q,x)} V(q) - \sum_{\omega} p(\omega)q(\omega)$$

s.t. conditions (b), (c), (d) satisfied

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Remark

In a monopsony equilibrium, outcomes are constrained-efficient (and vice versa). Moreover, platform's payoff is maximal, while consumers' welfare is minimal



conclusion

Summary

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

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

2. Emphasize a novel market failure

Platform's role as an information intermediary enables an externality that leads to inefficiencies

3. We propose three alternative market designs that fix inefficiency: data taxes, data unions, more-complete data markets