Competitive Markets for Personal Data

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February 2023

Motivation

Personal data fuels multi-billion dollar industries — essential input in digital economy

Status quo: consumers are imperfectly compensated for their data, and have limited control over their use $\rightsquigarrow$ possible market failures (Seim et al. 22)

Establishing competitive markets for personal data could improve efficiency and equity

Growing interest in studying theoretical properties of these markets and their problems e.g, Choi et al. 19, Bergemann et al. 22, Acemoglu et al. 22

This Paper

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This inefficiency:

- Originates from the specific role that **information intermediaries** play
- Present even if markets are otherwise **perfectly competitive**
- Present even if consumers data is **uncorrelated**

My Goal Today: Illustrate inefficiency through a simple example

example

(many consumers, one platform, one vendor)

A Simple Data Economy

The **vendor** sells a product to consumers and charges fee $a \in \{1, 2\}$

Consumers have unit demand and WTP of $\omega \in \{1, 2\} = \Omega$

Assume mass of consumers: $\bar{q}(\omega = 1) = 1$ and $\bar{q}(\omega = 2) = 2$

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Each consumer is uniquely identified by a **data record**, which reveals her ω

A collection of records is called a **database**, denoted by $q \in \mathbb{R}_+^{\Omega}$

A Simple Data Economy

Given a database q, the **platform** can intermediate these consumers with the vendor

Specifically, platform acts as **information designer** like in BBM15

- It sends a signal about a consumer's ω to the vendor to influence the fee he charges, and to maximize its own objective

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platform's expected payoff from database q

$$\overbrace{U(q)}$$

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$$\overbrace{U(q)}^{\text{platform's expected payoff from database } q} = \max_{x: A\times\Omega\to\mathbb{R}_+} \sum_{\omega,a} u(a,\omega)x(a,\omega)$$

$$\text{such that:} \quad \sum_{\omega} \big(\pi(a,\omega) - \pi(\hat{a},\omega)\big)x(a,\omega) \geq 0 \qquad \forall\, a,\hat{a}\in A$$

$$\sum_{a} x(a,\omega) = q(\omega) \qquad \forall\, \omega\in\Omega$$

a standard information design problem

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Payoffs:

	if consumer: keeps record	sells record
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Vendor	0	
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assume: $\beta < \varepsilon < 1/3$

Competitive Equilibrium

A **competitive equilibrium** is: prices $p^* \in \mathbb{R}_+^{\Omega}$; database $q^* \in \mathbb{R}_+^{\Omega}$; consumers' decisions $\alpha^* \in [0,1]^{\Omega}$ such that

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$$q^* \in \arg\max_q U(q) - \sum_\omega p^*(\omega) q(\omega)$$

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$$\alpha^*(\omega) \in \arg\max_\alpha (1-\alpha)\varepsilon + \alpha\Big(p^*(\omega) + \mathbb{E}_{q^*}(g(a,\omega))\Big)$$

3. And markets clear.

$$q^*(\omega) = \alpha^*(\omega)\bar{q}(\omega), \quad \forall \omega$$

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In the paper: many platforms, many vendors, arbitrary objectives, partially informative records, multiple types

analysis

A Useful Step

Imagine platform **expropriated** consumers of their records ($\approx$ status quo)

How would the platform use database $\bar{q}$?

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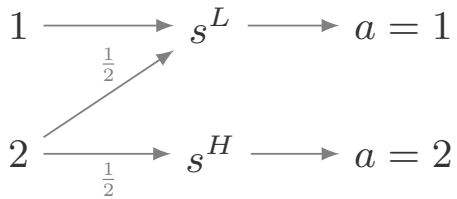

Payoffs		
C	**P**	**V**
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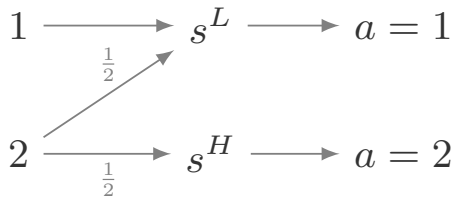

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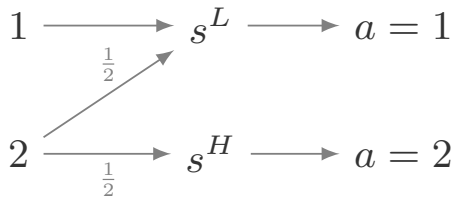

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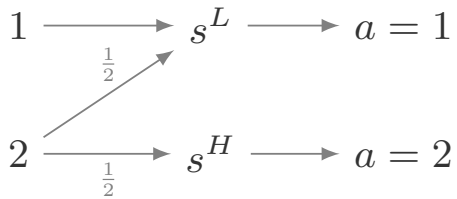

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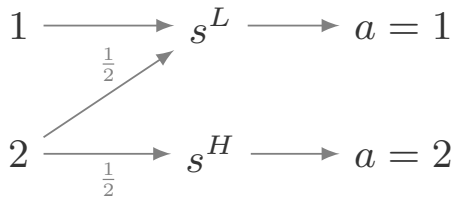

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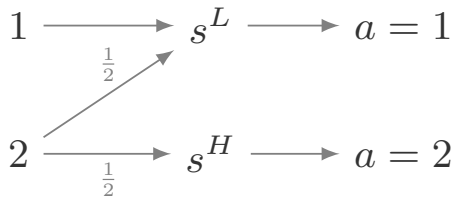

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$\omega = 2$	0	$2 \to s^H \to a = 2$ (prob $\frac{1}{2}$)	

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Payoffs

Comments:

1. Since platform's and vendor's objectives are not aligned, it is optimal to withhold some information (key feature of platform mkts: examples)

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(each arrow out of 1 and 2 has probability $\frac{1}{2}$)

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Comments:

2. When data records are pooled, one consumer's payoff depends on what other records platform has

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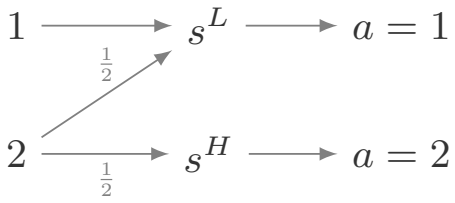

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Comments:

3. This "pooling externality" (GLP '22) is the root of inefficiency in our data economy

Competitive Equilibrium

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Comments:

1. Consumers have no incentive to sell: prices too low

$(\beta < \varepsilon)$

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Comments:

2. Platform has no (strict) incentive to buy: prices too high $(\beta < \varepsilon)$
   The value of a pair of records is β

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Comments:

3. Equilibrium is inefficient ("too little data"): Consumer welfare is lower than under expropriation (remember $\varepsilon < \frac{1}{3}$)

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Comments:

4. High-type consumers would like to subsidize low-type consumers to sell their data, but this market is too incomplete

More Generally

Beyond this example?

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- Our data economy is generally inefficient, i.e., equilibrium data allocation does not maximize consumers' welfare

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solutions?

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A classic solution: Arrow (1969), Laffont (1978)

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Back to example:

Record Type	**Prices**
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Result. In this economy, every equilibrium data allocation maximizes consumer surplus (and vice versa)

Discussion

How realistic?

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Open Questions:

1. Intermediate solutions, partial decentralization?

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Open Questions:

1. Intermediate solutions, partial decentralization?
2. "Non-market" solutions: Data Unions? Seim et al. 2022

conclusions

Summary

We study competitive markets for personal data:

1. We identify a novel inefficiency that a data market can suffer from, even when it is otherwise perfectly competitive

   It shows how giving consumers control over their data can backfire

2. The inefficiency originates from how data is endogenously used by the intermediaries "pooling externality"

3. We discuss possible solutions and their limits

thank you