Competitive Markets for Personal Data

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Motivation

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

Yet, they often have **limited control** over how and by whom their data is used:

- This may lead to inefficiencies and distortions (Seim et al. 2023)

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

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

What properties would these markets have, and how should they be designed to promote desirable outcomes?

This Paper

Model. A stylized **competitive economy** where: ("GE meets ID")

- Consumers own their data and can sell it to a platform
- Platform uses this data to interact consumers with a merchant

Main Results

1. Identify **novel inefficiency** leading this perfectly competitive market to fail

2. Propose three solutions to this market failure:

- Data unions, Data taxes, Lindahl prices for data

model

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One merchant, one platform, a unit mass of consumers

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

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- If type-ω consumer doesn't sell her record, she gets reservation utility $r(\omega)$

Period 2: Product Market

Given acquired database q, platform acts as **information designer**: (as in BBM)

- It sends merchant signal 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 $x : \Omega \to \Delta(A)$ s.t.

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

(canonical ID problem, but with endogenous q)

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$$\zeta^*(\omega) \in \arg\max_{z \in [0,1]} z\Big(p^*(\omega) + \sum_a x^*(a|\omega) u(a,\omega)\Big) + (1-z) r(\omega)$$

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discussion

(in)efficiency of the data economy

Efficiency Benchmark

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Results extend to "aggregate" welfare and "unconstrained" efficiency discussion

Private and Social Benefit of Selling a Record

Fix an equilibrium (p^*, ζ^*, q^*, x^*)

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$$\psi_{q^*}(\omega) = \underbrace{p^*(\omega)}_{\substack{\text{change in platform's} \\ \text{gross payoff}}} + \underbrace{\xi^*(\omega)}_{\substack{\text{change in trading} \\ \text{surplus of } \textbf{all consumers}}}$$

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Result (informal): If U^* and ψ_q^* sufficiently aligned, eqm is constrained efficient

Main Characterization

When are U^* and ψ_q^* aligned? It depends on how platform uses the data and, thus, on its objective

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

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Proposition

- 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 consumers' welfare can be minimal, i.e., $\sum_\omega r(\omega)\bar{q}(\omega)$)

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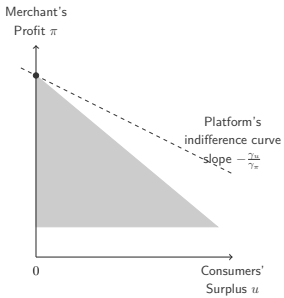

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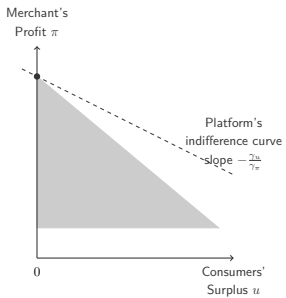

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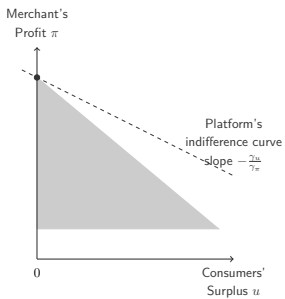

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- Therefore, $\xi^*(\omega) = \sum_a x^*(a,\omega)u(a,\omega) = 0$
- Therefore, $\psi_q^* = U^*$, perfect alignement
- **Result:** All equilibria are constrained efficient

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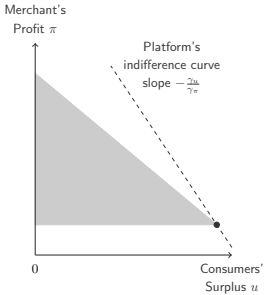

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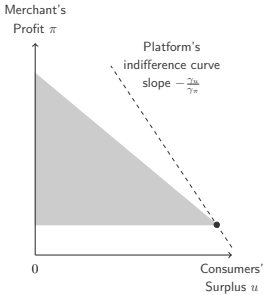

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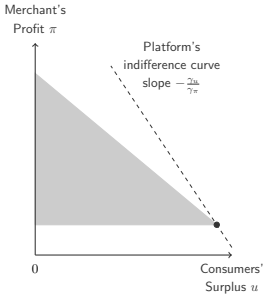

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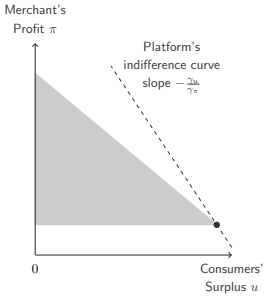

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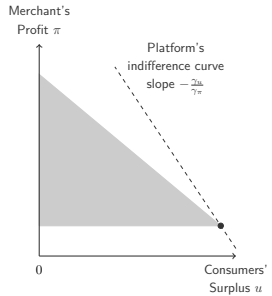

- Platform **withholds information** from merchant
- Pooling different consumers together makes their payoff inter-dependent
- Thus, $\xi^*(\omega) \neq \sum_a x^*(a,\omega)u(a,\omega)$
- **Example:** think of lowest-type consumer
- Externalities $\rightsquigarrow$ Eqm inefficiency

Stepping Back

Information intermediaries play ubiquitous role in digital markets

They often balance interests of conflicting parties (sellers-buyers, drivers-riders)

They do so by optimally withholding some information from the agents

This paper illustrates how and when this practice can lead to market failure

Inefficiency we emphasize is more general than our price-discrimination application with a monopolist merchant

remedies

Remedies

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   "*The **specific purpose** for which personal data is used should be determined at the time of the collection*" (GDPR)

related work

Related Work

Model rooted in a GE tradition but leverages on progress in info-design literature, which offers microfoundation for key components of a data economy:

- E.g., how data is used (BBM '15); How data is valued (GLP '23); How data is priced (this paper)

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We contribute to a recent literature that studies data markets:

- "Learning" externality — Choi et al ('19), BBG ('22), Acemoglu et al. ('22)
- Our inefficiency: Not due to exogenous correlation, but to platform's role as info intermediary — building on GLP '23

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More broadly, we contribute to the growing literature on the economics of platforms, data, & privacy — Jones and Tonetti '20, Hidir and Vellodi '21, Chen '22

conclusion

Summary

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

back

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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

back