Data, Competition, and Digital Platforms

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Regulating the Digital Economy

TSE

May 2022

Introduction

Digital platforms: information gatekeepers and competition managers.

Surplus **creation** from matching consumers and sellers.

Concerns over surplus **extraction** from inducing market power.

> *The Digital Markets Act addresses the negative consequences arising from certain behaviors by platforms acting as digital gatekeepers to the single market [...] Examples of these practices include [...] situations where users are locked in to a particular service and have limited options for switching to another one.* — *European Commission (2020)*

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> *One cannot exclude the possibility that a dominant platform could have incentives to sell "monopoly positions" to sellers by showing buyers alternatives which do not meet their needs.* *Cremer et al. (2019)*

Personalization and Its Limits

Personalized (sponsored) content drives both value creation and extraction.

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- Advertising platforms (including display networks): Google, Meta, Microsoft, Twitter, Tiktok, Youtube, Criteo...

Superior information on the platform improves **match quality**:

- Consumers can find their favorite sellers.
- Sellers can offer efficiently "tailored" products.

Information monetized by selling restricted access to consumer's attention.

- Market power after winning ad auction.
- No price discrimination, but **product steering**.

Questions

- How do different modes of *data governance* affect the creation and distribution of surplus, both on and off digital platforms?
  [$DG :=$ mechanisms for collecting and sharing consumer data.]
- How does the availability of free (organic) information affect competition for the consumer's attention? Retail vs. media vs. ad platforms.
- How do these effects depend on the intensity of competition among advertisers, on a platform's size, and on the precision of its information?
- What is the role of the platform's revenue model (e.g., auctions vs. fees)?

Today: a model of auction-based digital platforms where different information structures can be compared, and on- and off-platforms markets interact.

Related Literature

- Information gatekeepers: Baye and Morgan (2001, . . .).
- Showrooming, steering, and multiple sales channels: Wang and Wright (2020), Teh and Wright (2022), Miklos-Thal and Shaffer (2021), Bar-Isaac and Shelegia (2020), Idem (2021).
- (Data) externalities on digital platforms: Choi et al. (2019), Acemoglu et al. (2021), Kirpalani and Philippon (2021), Bergemann et al. (2022).
- Self-preferencing on platforms: Anderson and Bedre-Defolie (2021), Hagiu et al. (2020), Kang and Muir (2021), Lee and Musolff (2021). . .

Model

Setup

Unit mass of consumers with type $\theta \in \mathbb{R}^J$.

Consumer θ has value $\theta_j q_j$ for product of quality q_j by firm j.

J sellers offer vertically differentiated products with cost $c(q_j) = q_j^2/2$.

$\lambda \in [0, 1]$ consumers visit a monopolist platform that runs ads.

$1 - \lambda$ consumers buy directly from sellers, face search costs à la Diamond.

Information Structure

Consumers' valuations θ_j with distribution F, i.i.d. across j.

The platform observes $\theta \in \mathbb{R}^J$ perfectly.

Every consumer observes (an arbitrarily precise) signal s about θ.

Posterior mean $m_j = \mathbb{E}[\theta_j \mid s]$ with distribution G.

F is a mean-preserving spread of G. Assume same support.

Information and Prominence

Platform runs SPA for a **single** advertising slot.

- Consumer type $\theta \sim$ *targeting category:* bids $b_j(\theta)$ condition on type.
- Auction winner j targets type θ_j with personalized offer $(q_j(\theta_j), p_j(\theta_j))$.
- Consumer learns θ_j for auction winner j.

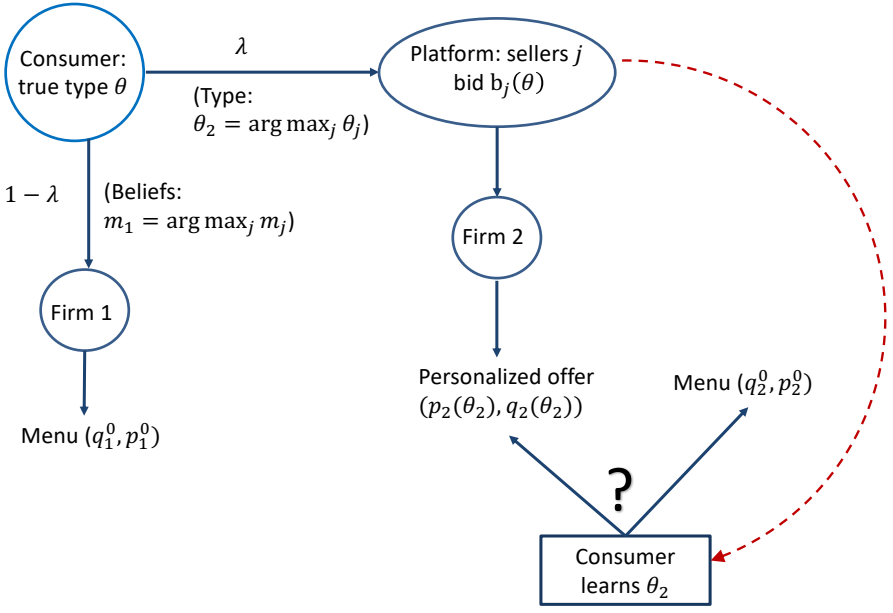
Off the platform, consumer search.

- Consumer with beliefs m visits seller $j^* = \arg\max_j m_j$.
- Seller j^* elicits consumer's wtp m_j through menu $(q_j^0(m), p_j^0(m))$.
- Not an inspection good: learning θ requires the platform's data.

Timing

1. Sellers simultaneously set off-platform menus $(q_j^0(m), p_j^0(m))$.
2. Sellers place their bids $b_j(\theta)$ for each type on platform.
3. Auction winner j offers a single product of quality $q_j(\theta)$ at price $p_j(\theta)$.
4. Consumer learns θ_j, can buy on-platform or search off-platform.

Preview


Consumer: true type θ
λ
(Type: $\theta_2 = \arg\max_j \theta_j$)
Platform: sellers j bid $b_j(\theta)$
$1-\lambda$
(Beliefs: $m_1 = \arg\max_j m_j$)
Firm 2
Firm 1
Personalized offer $(p_2(\theta_2), q_2(\theta_2))$
Menu (q_2^0, p_2^0)
Menu (q_1^0, p_1^0)
?
Consumer learns θ_2

Interpretations

Small search costs, small informational advantage:

- $1 - \lambda$ off-platform consumers use beliefs m, face search costs $c > 0$ (after the first search) and expect symmetric menus;
- λ on-platform consumers infer in equilibrium that $\theta_{j^*} = \max_j \theta_j$; they expect symmetric menus, and compare on- and off-platform offers by j^* only.

Brand recognition and consideration sets:

- each brand has $(1 - \lambda)/J$ loyal (imperfectly informed) customers already shopping off platform;
- the remaining λ consumers are not currently shoppers—they do not recognize any brands without the platform's data.

Equilibrium Menus

Matching and Product Steering

On platform, sellers can extract surplus through product steering.

"Showrooming constraint" for the winner of auction θ:

$$U(\theta) \triangleq \theta\ q_j^*(\theta) - p_j(\theta) \geq \max_m \left[\theta\ q_j^0(m) - p_j^0(m)\right] \triangleq U^0(\theta).$$

Incentive-compatible menus off platform $\Rightarrow$ on-platform consumer compares

$$(q_j^*(\theta), p_j(\theta)) \text{ and } (q_j^0(\theta), p_j^0(\theta)).$$

On platform, clearly optimal to offer efficient quality $q^*(\theta) = \theta$.

On platform, surplus extraction limited by $U^0(\theta)$.

Seller's Problem

Consider offline menu (q_j^0, U_j^0). Seller j's profits on online type θ_j:

$$\pi(\theta_j, U_j^0) = \theta_j^2/2 - U^0(\theta_j).$$

Losing the auction for $\theta \Rightarrow$ zero revenue. Seller j bids $b_j(\theta) = \pi(\theta_j, U_j^0)$.

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Fix bids $b(\theta_k)$ by firms $k \neq j$. Seller j's problem off-platform:

$$\max_{q^0, U^0} (1-\lambda) \int_0^1 \left(\theta q^0(\theta) - q^0(\theta)^2/2 - U^0(\theta)\right) G^{J-1}(\theta) \mathrm{d}G(\theta)$$
$$+ \lambda \int_0^1 \int_0^{s^*(\theta, U^0)} \left(\theta^2/2 - U^0(\theta) - b(s)\right) \mathrm{d}F^{J-1}(s) \mathrm{d}F(\theta).$$

Equilibrium Menus

Proposition (Quality Provision)

The (unique, symmetric) equilibrium quality levels are given by

$$q^*(\theta) = \theta,$$
$$q^0(\theta) = \max\left\{0\ ,\ \underbrace{\theta - \frac{1-G^J(\theta)}{JG^{J-1}(\theta)g(\theta)}}_{\text{MR quality}} - \frac{\lambda}{1-\lambda}\frac{1-F^J(\theta)}{JG^{J-1}(\theta)g(\theta)}\right\}$$

Furthermore,

$$U^*(\theta) = U^0(\theta) = \int_0^\theta q^0(m)dm.$$

Equilibrium Properties

Platform's data matches consumer to favorite brand.

Winning sellers invest in efficient quality (product customization).

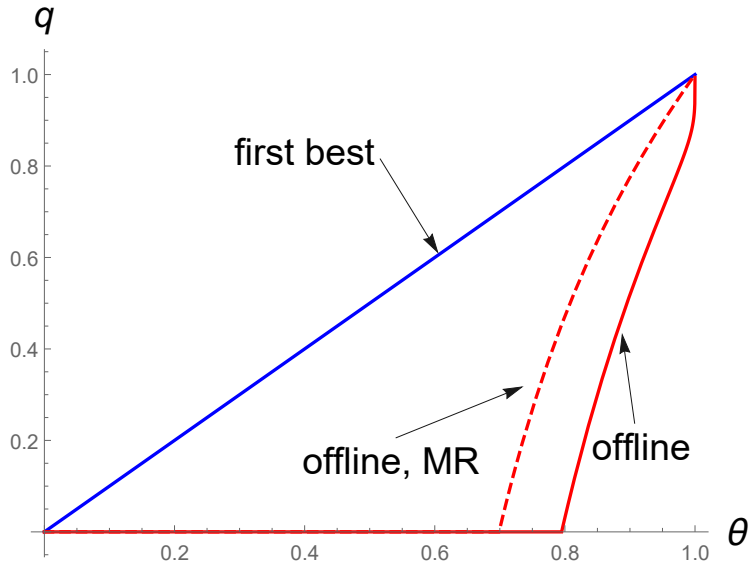
Off platform, inefficient matching based on insufficient information, and inefficient quality under asymmetric information.

Opportunity cost of off-platform sales: positive rents on platform,

$$U^*(\theta) = U^0(\theta) > 0 \text{ iff } q^0(\theta) > 0.$$

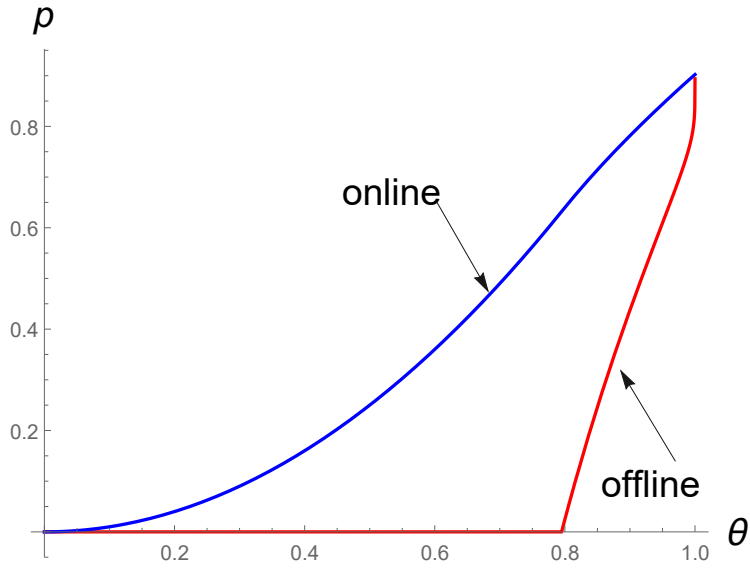
Offline q^0 further distorted downward.

Quality Provision



$\lambda = 1/2, J = 5, G(m) = m, F(\theta) = Beta(\theta, 1/4, 1/4)$

Payments



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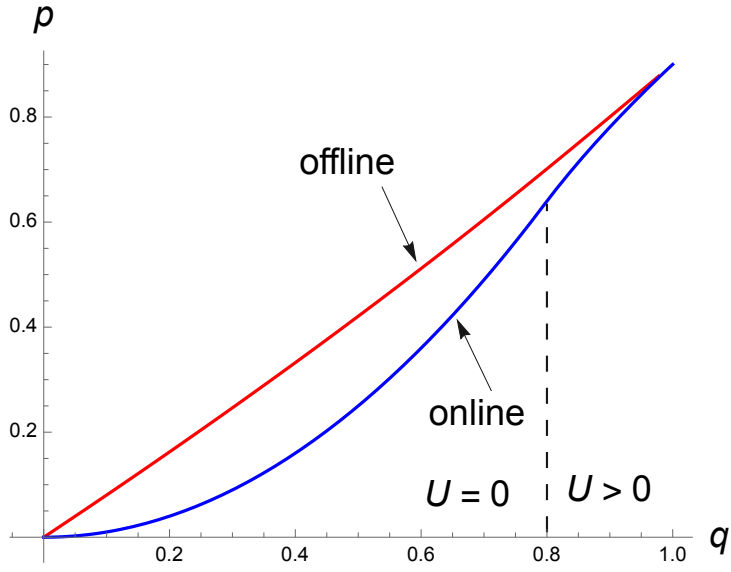
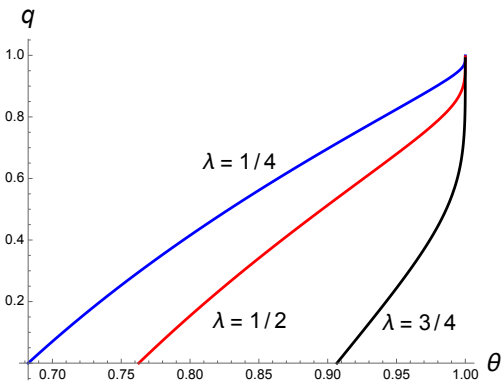
Nonlinear Tariffs

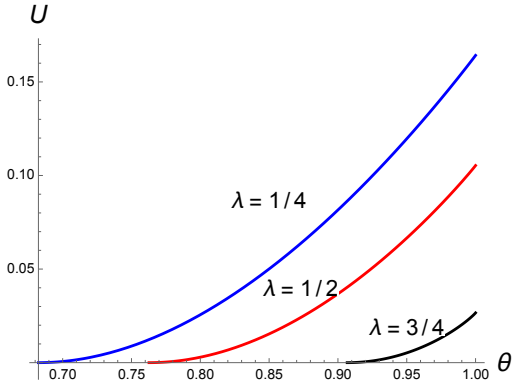


Every offline product is sold at a lower price online

Comparative Statics

Platform Size (λ)





$$J = 3, G(m) = m, F(\theta) = Beta(\theta, 1/4, 1/4)$$

Information Precision

Consider true type distribution F and beliefs distribution G.

Suppose the platform has access to information with distribution $\tilde{F}$, where

$$F \succ_{mps} \tilde{F} \succ_{mps} G.$$

Compare equilibrium menus under $\tilde{F} \in \{F_1, F_2\}$.

Proposition (Rotations)

Let $F_1 \succ_{rotation} F_2$, and assume $F_1(\theta) \leq F_2(\theta)$ for all θ such that $q^0(\theta; F_2) > 0$. Then, $q^0(\theta; F_1) \leq q^0(\theta; F_2)$, with strict inequality whenever $q^0(\theta; F_2) \in (0, 1)$.

Platform size (λ) and information precision $\tilde{F}$: reinforcing effects .

Platform Revenue—Comparison

Information precision $\tilde{F}$ increasing in platform size (λ).

Fix a family of distributions $\tilde{F}_\lambda$ ordered by rotations.

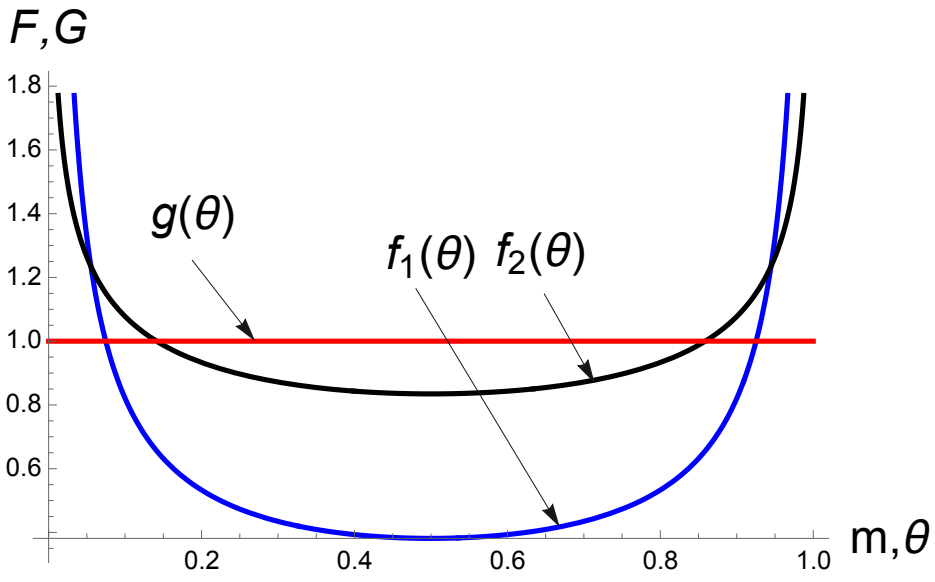
Does the platform want to share all its data with bidders and consumers?

"Conflation through privacy:" more information, better matches, higher firm profits; less information, bidders' values closer together.

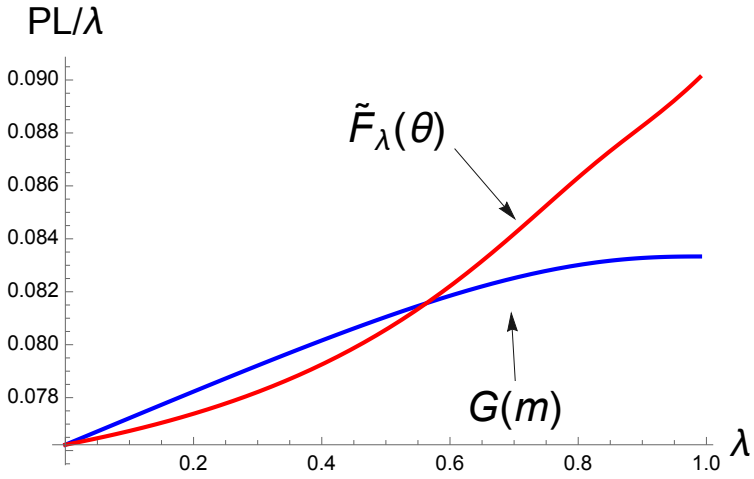
For each λ, compare platform revenues under distribution G and $\tilde{F}_\lambda$.

Example with Beta distributions.

Belief and Type Distributions: Example



Endogenous Information Precision



$G(m) = m, F(\theta) = Beta(\theta, 1 - 2\lambda/3, 1 - 2\lambda/3), J = 2$

Platform shares maximal data for large λ only.

Extensions

Managing information

- Managed campaigns: when to reveal values to the firms?
- What to reveal? Full, contextual, rank-based targeting?

Managing competition

- Organic links vs. single advertising slot.
- Multiple advertising slots.

Conclusions

Digital platforms with superior information about consumer preferences; monetized by selling restricted access to consumers' attention.

Consumer surplus on- and off- is driven by information rents off platform.

The growth of a platform's database (through the participation of more consumers) reduces each consumer's outside option and leads to higher prices.

When the platform sells exclusive access to consumers, a large number of sellers $\Rightarrow$ higher average realized match values, but not higher consumer surplus.

Product design and price decisions interact with modes of data governance (e.g., with the rules by which a platform shares its data).