Online Privacy and Information Disclosure by Consumers

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No Data-Based Third-Degree Price Discrimination

> *We've never tested and we never will test prices based on customer demographics*
>
> —*Jeff Bezos, 2000*

- Still seems to be accurate
- Political Economy reasons might be in the work here
- But there might be reasons beyond platforms expecting consumer backlash. . .
- . . . as this paper shows

A Personal Story on Cookies

The end of cookies?

Fundamental Tradeoff

- For a multi-goods monopolist recommending products to a consumer, consumer information disclosure has two effects:
  1. Better matching products
  2. Higher price
- 2 might lead consumers to conceal info on their favorite product (different from standard 3rd DPD);
- Best-responding, the seller might want to commit to not price discriminate.
- This seller commitment can increase social welfare and decrease consumer welfare.

Result in Short

If consumers can decide to conceal information,
sellers might want to commit to not price discriminate;
this can be bad for consumers.

Related Literature

Multi-Goods Monopolist In contrast to Multi-Goods Monopolist Daskalakis+ EMA '17, consumer partition is endogenous

Durable Goods Monopolist Nuanced relationship to Coase Conjecture Wilson+ JET '85

Information Design Studies a multi-dimensional version of Bergemann+ AER '15, finds new inefficiencies

Privacy Hidir+ WP '19 does cheap talk, this is Bayesian Persuasion

Hidir+ WP '19

We study a bilateral trade setting in which a buyer has private valuations over a multiproduct seller's inventory. (. . .) Our analysis speaks directly to the debate regarding product steering versus price discrimination in online retail.

Primitives

- 1 seller, 1 buyer
- unit demand with iid values $u_1, u_2, \ldots, u_K \sim F$, $u_i \in V$
- Buyer chooses disclosure rule ϕ: $V^k \to \Delta(M)$
- Seller proposes good u_i take-it-or-leave
- Quasi-linear utility for good i and price p: $u_i - p$
- Solve for Pure-Strategy PBE (+equilibrium selection)
- Consumer surplus CS, producer surplus PS
- (Effectively only treats $K = 2$ and $K \to \infty$)

Timeline I: Commitment Regime

1. Seller sets a uniform price p for the goods
2. Buyer chooses a disclosure rule ϕ
3. Nature draws u, $\phi(u)$
4. Seller recommends a product i
5. Buyer decides to buy i at price p or leave

Timeline II: Non-Commitment Regime

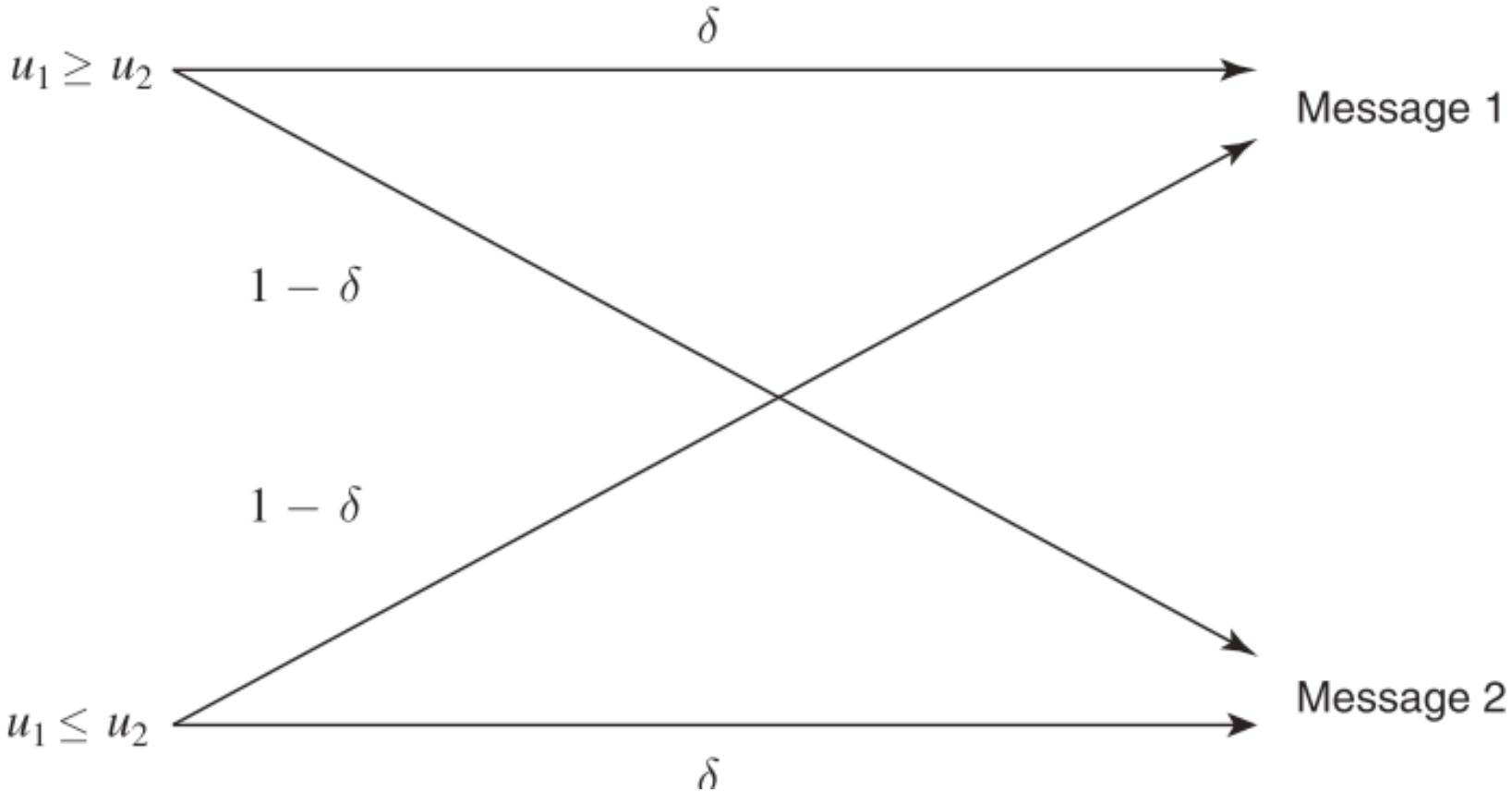
1. Buyer chooses a disclosure rule ϕ
2. Nature draws u, $\phi(u)$
3. Seller sets a uniform price p for the goods
4. Seller recommends a product i
5. Buyer decides to buy i at price p or leave

When does this Model Apply?

- Consumers can commit to disclosing information whose realization they don't know ($\rightarrow$ cookies, blockers)
- Consumers don't look at all products ($\rightarrow$ search costs, behavioral IO)
- Consumers foresee how their disclosure will affect posterior
- Sellers cannot commit to pricing contingent on disclosure rule

Example

$K = 2$, disclosure rules



Lemma

Fix any pricing strategy. In any equilibrium where consumer chooses $\delta > \frac{1}{2}$, seller recommends product k upon seeing k.

- $\max\{u_1, u_2\} \sim F^{\max}$, $\min\{u_1, u_2\} \sim F^{\min}$

Lemma

Given a disclosure level δ it is a best response for the seller to choose price

$$p(\delta) = \min \arg\max_{p \in \mathbb{R}} p(1 - \delta F^{\max}(p) - (1 - \delta)F^{\min}(p))$$

Theorem

The equilibrium payoffs in equilibria in the commitment regime (S_C), and in the no-commitment regime (S_{NC}),
$\mathrm{CS}(S_C) < \mathrm{CS}(S_{NC})$, $\mathrm{PS}(S_C) > \mathrm{PS}(S_N C)$, *strict for generic F.*

Inefficiency

Definition

Vertical efficiency Efficient trade almost surely

Horizontal efficiency Preferred good recommended almost surely

- Equilibria are inefficient, and this inefficiency has a structure

Proposition

Commitment regime: The outcome is horizontally efficient, but (under a condition) not vertically.

Proposition

No-commitment regime: The outcome is vertically efficient, but (under a condition) not horizontally.

Proof Strategy for the Second Proposition and Theorem

- Characterize an auxiliary disclosure rule which maximizes consumer welfare conditional on horizontal efficiency
- Find another (not horizontally eficient) disclosure rule which strictly increases consumer surplus

Large K

Theorem

Assume that the optimal price at the sellers prior is $< \max V$. *Then, for large* K, *the commitment regime is more efficient than the no-commitment regime.*

Proof.

- The commitment regime is vertically efficient, hence the optimal good will converge to $\max \operatorname{supp} F$.
- The seller can set a price arbitrarily close to $\max \operatorname{supp} F$, extracting almost all surplus.
- Under the no commitment regime, the buyer can disclose no information and receive strictly positive surplus, inducing vertical inefficiency.

Extensions that work

- Correlation among items if exchangeable
- Costly disclosure if symmetric
- Informational/data externalities
- Production Cost if symmetric

Alternative Interpretations

- An interpretation à la Holmstrom
- An interpretation as tragedy of the Commons/Data Externality

Policy Implications

- It can be good for consumer welfare to limit the amount of information they can disclose; this can hurt social welfare.
- "Data Markets" with 0th stage (ϕ, t) and no-commitment regime can increase efficiency
  1. Seller offers (ϕ, t)
  2. Buyer accepts or chooses disclosure rule ϕ_0
  3. Nature draws u, $\phi(u)$
  4. Seller sets a uniform price p for the goods
  5. Seller recommends a product i
  6. Buyer decides to buy i at price p or leave
- So what are the policy implications of not allowing cookies

Open Problems/Discussion

- What effects would "killing cookies" have?