User data and endogenous entry in online markets

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CRESSE
July 1st - 3rd 2022, Crete
Motivation

- **Data Brokers** (DB) collect data mainly from publicly available sources and process them in targeted market segments that are sold to firms
  - Data on 1.4 billion consumer transactions and over 700 billion aggregated data elements
  - 3000 data segments for nearly every U.S. consumer (FTC 2014)
  - DBs are often away from the media’s spotlight or people’s awareness
- The DB’s sector is a **concentrated industry** whose revenue is estimated at USD 200 billion (FTC, 2014; Crain, 2018)
- By selling data, **DBs can affect competition in downstream retail markets**
This paper

How does the DBs’ strategy about data sales affect competition and market entry?

- We consider a horizontally differentiated market à la Salop where an endogenous number of firms can buy data to price discriminate
- Data is sold by a monopolistic DB who decides to which firms he sells data, its quantities and its price
- We also study how data acquisition can affect firms’ entry decision in the downstream market
- We consider alternative models of data selling mechanism: auction with and without reserve prices, and Take-It-Or-Leave-It offers, associated with lower DB’s market power
The effect of DBs on competition has been analysed mostly in duopolistic downstream markets. In a Hotelling framework, a DB influences downstream competition either by selling all data (Montes, Sand-Zantman and Valletti, 2019) or a portion of them (Bounie, Dubus and Waelbroek, 2021) to only one firm. Firms’ profits are reduced and consumers are better off. In a circular city with three firms, the DB always sells data to more than one of them (Delbono et al., 2021).

What if the number of firms is endogenous?
The model: consumers, firms

- Salop model of circular city of length 1 with uniformly distributed consumers
- \( n \) (endogenous) firms, \( i \in \{0, 1, 2, \ldots, n - 1\} \), enter at equidistant locations
- Marginal costs are 0, and fixed entry cost \( F \)
The model: the DB

- DB has data on all consumers’ locations and offers data partition $d_i \in [0, 1]$ to any firm $i$, centered on its location.
- Data allows firms to price discriminate on an arch of size $d_i$.
- The partition set is $P = (d_0, d_1, d_2, \ldots, d_{n-1})$. 
Downstream prices and the price of data

- Firms offer basic prices $p_i^B$ to unidentified consumers, and tailored prices $p_i^T(x)$ to identified consumers.

- The DB sells data through auctions with reserve prices.
  - The DB sets the reserve prices $w_i$ equal to firms’ willingness to pay for data (WTP) and realizes profits $\pi_{DB} = \sum w_i$.
  - A firm’s WTP is the difference in profits between winning and losing the auction: $w_i = \pi_{i,W}(P) - \pi_{i,L}(P)$.

- After observing the firms’ bids, the DB can decide to not fulfill some auctions.
Timing

- **Stage 1.** Firms enter the market and pay the fixed cost $F$
- **Stage 2.** The DB chooses a partition set $P$ and the reserve prices $w_i$. Offers are non-renegotiable.
- **Stage 3.** Firms place their bids in the auctions.
- **Stage 4.** The DB observes the bids and chooses the auctions he wants to fulfill. The winning firms receive their respective partitions and pay $w_i$.
- **Stage 5.** Firms set basic prices $p_i^B$ for the unidentified consumers.
- **Stage 6.** Firms set tailored prices $p_i^T(x)$ for the identified consumers if they have won an auction.
DB’s equilibrium strategy

To which firms the DB sells data?

▶ The DB sells same sized partitions $d_H$ to every other entering firm
  ▶ By making informed firms compete against uninformed ones, the WTP for data increases
DB’s equilibrium strategy/2

To which firms the DB sells data?

- The DB offers the whole dataset in the auctions he does not intend to conclude
  - By threatening to sell the whole dataset to direct rivals, the WTP for data increases
Equilibrium data partitions

How much data does the DB sell?

- $d_H^* = \frac{6}{7n}$ (non-overlapping partitions)
- Data have a non-monotonic effect on firms’ profits
- Surplus extraction effect (+)
  - The larger the partition, the more consumers are identified, which are offered tailored prices
  - The tailored price allows the firm to extract the surplus from closest consumers
  - Firm profit increases with data
- Competition effect (-)
  - The larger the partition, the more distant are the unidentified consumers, which are offered the basic price
  - A lower basic price means lower profits
Firm entry

How many firms enter in equilibrium?

- Firms enter as long as their profits after paying for entry and data are $\geq 0$
  - By imposing $\pi^L_i (P^*_H) = 0$, we find
    $$n^* = \frac{1}{2} \sqrt{\frac{t}{F}} < n^{BENCH} = \sqrt{\frac{t}{F}}$$

- The DB originates an entry barrier effect that reduces firm entry with respect to the standard Salop model
Consumer surplus and welfare

- Consumer surplus is

\[ CS = u - \frac{5t}{4n^*} + \frac{n^* t d_{\text{H}}^*}{9} \]

- Data have two opposite effects on CS:
  - It reduces firms’ prices
  - It reduces firms’ entry, which increases transportation costs

- The net effect of the data sale on CS is negative: the *entry barrier effect* more than offsets the effect of data alone

- Welfare instead increases, although it is mostly extracted by the DB
We examine two alternative selling mechanisms, associated with lower degree of DB’s market power:

- **Auctions without reserve prices**
- **Take It Or Leave It (TIOLI) offers**

In auctions without reserve prices, the DB still prefers selling data to half the firms. However, his ability to threaten firms is reduced, and he offers bigger partitions.

Under TIOLI, the DB instead opts for selling data to all firms.

Reducing the DB’s bargaining power limits the *entry barrier effect* and increases CS, which is highest under TIOLI.
Extension 2: privacy cost

- Consumers incur in a **privacy cost** $c > 0$ when receiving a tailored price, due to their loss of privacy.
- $c$ lowers consumers’ willingness to pay when they are reached by a tailored price, and thus informed firms’ profits.
- As $c$ increases, the effect of data on firms’ profits is reduced, decreasing the DB’s *entry barrier effect* and benefiting consumers.
- When $c$ is sufficiently high, firms have no advantage from buying consumer data, and we obtain the standard Salop (1979) outcome.
Conclusions

- We analyze how a DB influences a downstream market with endogenous entry.
- The DB softens downstream competition in two ways:
  - **The DB reduces firms’ entry**, decreasing consumer surplus as market concentration increases.
  - The DB creates **local data-monopolies** by making informed firms compete against uninformed ones.
- Selling data through TIOLI offers instead of auctions reduces consumer harm and can limit the *entry barrier effect*.
- Policies that increase consumer privacy awareness benefit consumers, as privacy reduces the DB’s *entry barrier effect*. 
Thank you for your attention!
Extension 1 - Summary of results

<table>
<thead>
<tr>
<th>Selling mechanism</th>
<th>firms served in equilibrium</th>
<th>Total amount of data sold in equilibrium</th>
<th>Share of identified consumers</th>
<th>Share of entering firms with respect to the standard Salop model</th>
<th>Consumer surplus with respect to the standard Salop model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auction with reserve prices</td>
<td>n/2</td>
<td>3/7</td>
<td>42.85%</td>
<td>1/2</td>
<td>--</td>
</tr>
<tr>
<td>Auction without reserve prices</td>
<td>n/2</td>
<td>2/3</td>
<td>66.67%</td>
<td>5/9</td>
<td>--</td>
</tr>
<tr>
<td>Take It Or Leave It offers</td>
<td>n</td>
<td>if $n &lt; n^*$: 3/2</td>
<td>100%</td>
<td>1/2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>if $n \geq n^*$: $\approx 31/50$</td>
<td>$\approx 62%$</td>
<td>$\approx 3/4$</td>
<td>+</td>
</tr>
</tbody>
</table>
We find $d_H^* = \frac{6}{7n}$. 