Using Scanner Data To Answer Food Policy Questions

Conference

Wednesday, June 1 - Thursday, June 2, 2011

Economic Research Service
1800 M Street, NW
Waugh Auditorium
Washington, DC
Price and Variety in Supermarkets: Can Store Competition Hurt Consumers?

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ERS Scanner Data Conference - June 1, 2011
Traditionally, most of the IO literature (theoretical or empirical) has focused on prices.

This paper:
Competition when firms (retailers) choose jointly prices and product variety
I look at the Supermarket Industry, particularly relevant to study product variety

Why?

- Consumers buy bundles
- Costly to visit multiple stores
- Huge demand spillovers
Preview results:

- Data Patterns
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1. Competition increases store variety by 9% - New result! (theory has ambiguous predictions)
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Introduction

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- Simple theoretical model of retailer competition that explains the previous patterns
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- Welfare Analysis: structural model of consumer behavior. Competition found to make the consumer better off.
Variety / Quality competition:

Free Entry and inefficiency
Mankiw and Whinston (1986), Berry and Waldfogel (1999)

Store Choice Models
Nielsen Store level scanner data on **Beverages** (prices and quantities for each store/week/product)

April 2002 - April 2006

707 markets of small dimension

Orange: Towns with two supermarkets
Blue: Towns with one supermarket
**Empirical Strategy:**
Compare variety and prices from monopolist stores with those of in a duopoly (controlling for factors - observed and unobserved - that may affect both the market structure and the decisions of the firms)
Variety (i.e. **number of different products**) in a typical store over time:
Construct a price index for each store (using the 164 UPCs present in each store):

(with sales and without)
## Observable differences?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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</thead>
<tbody>
<tr>
<td>lnVariety</td>
<td>-0.0850***</td>
<td>-0.0146***</td>
<td>-0.00921***</td>
</tr>
<tr>
<td>lnregprice</td>
<td>(0.00480)</td>
<td>(0.00160)</td>
<td>(0.00134)</td>
</tr>
<tr>
<td>lnprice</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>monopolist</td>
<td>-0.0850***</td>
<td>-0.0146***</td>
<td>-0.00921***</td>
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<td>(0.00480)</td>
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<td>(0.00134)</td>
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<tr>
<td>Quarter F.E.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>N</td>
<td>10789</td>
<td>10789</td>
<td>10789</td>
</tr>
<tr>
<td>R-sq</td>
<td>0.214</td>
<td>0.155</td>
<td>0.149</td>
</tr>
</tbody>
</table>

**Table:** Linear Regressions of Variety and Prices on a monopolist dummy. It includes as controls: population, income, education, household size, age (coefficients not reported)

In the paper: further analysis (including more flexible controls and Propensity Score Matching)
Unobservable differences?
A small set of markets (6%) observe change in structure. Allows controlling for market unobserved characteristics (constant over time):

<table>
<thead>
<tr>
<th>Model</th>
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<tbody>
<tr>
<td>InVariety</td>
<td>lnregprice</td>
<td>lnprice</td>
<td></td>
</tr>
<tr>
<td>Monopolist</td>
<td>-0.0164*</td>
<td>-0.00924**</td>
<td>-0.00674*</td>
</tr>
<tr>
<td></td>
<td>(0.00637)</td>
<td>(0.00331)</td>
<td>(0.00278)</td>
</tr>
<tr>
<td>Store Size</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Market F.E.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Quarter F.E.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>N</td>
<td>10789</td>
<td>10789</td>
<td>10789</td>
</tr>
<tr>
<td>R-sq</td>
<td>0.266</td>
<td>0.031</td>
<td>0.139</td>
</tr>
</tbody>
</table>

**Table:** Linear Regressions of Variety and Prices on a monopolist dummy including Market Fixed Effects
In some of the duopoly markets, both stores belong to the same chain. Duopoly markets with low competition intensity.

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<td></td>
<td>lnVariety</td>
<td>lnregprice</td>
<td>Inprice</td>
</tr>
<tr>
<td>Monopolist</td>
<td>-0.0939***</td>
<td>-0.0178***</td>
<td>-0.0112***</td>
</tr>
<tr>
<td></td>
<td>(0.00568)</td>
<td>(0.00177)</td>
<td>(0.00148)</td>
</tr>
<tr>
<td>Same Chain duopolists</td>
<td>-0.0555***</td>
<td>-0.0199***</td>
<td>-0.0121***</td>
</tr>
<tr>
<td></td>
<td>(0.0122)</td>
<td>(0.00380)</td>
<td>(0.00317)</td>
</tr>
<tr>
<td>Quarter F.E.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>N</td>
<td>10789</td>
<td>10789</td>
<td>10789</td>
</tr>
<tr>
<td>R-sq</td>
<td>0.216</td>
<td>0.157</td>
<td>0.150</td>
</tr>
</tbody>
</table>

**Table:** Separate effect of 2-store markets with no competition
Consumers:

1) Maximize utility: buy one of two goods: $A$ and $B$ or none (with $u_o = 0$)

2) $u = v - p$ where $v_{ij} \in \{v_L, v_H\}$
   
   Heterogeneous preferences: half prefer good $A$, and the remaining prefer good $B$.

3) One store visit

4) Informed about assortment but not prices before visiting the store

   *This assumption reflects the fact that assortment is usually a quarter decision while prices change every week.*
Firms:
1) Maximize profits.

2) In the first stage, choose the set of products to sell \((q \in \{A, B, (A, B)\})\).
Then, compete in prices (knowing the assortment of the rival)

3) To carry a second product, a firm will have to pay a fix (storage) cost \(F\).

\[\Rightarrow\] Competition induces higher Variety and Prices in equilibrium
**Intuition?**

- Each Store compares benefits of increasing variety with costs
- Duopolist stores benefit more from increasing variety because of the Business Stealing Effect
- Increase in Variety allows increase in Prices (on average consumers find products available for which they are willing to spend more money)
- Monopolist stores do not find it profitable to increase variety (even though it allows higher prices) because of the higher storage costs
Are consumers better-off in cities with supermarket competition? (I abstract away from any other impact of competition, e.g.: service,...)

Need to learn how consumers choose stores
A Consumer Choice Model

\[ U_{ijt} = \sum_c (\theta_{ic} \ast E(V_{ijct})) + \gamma_{ij} + u_{ijt} \]

Consumer \( i \) utility of going to store \( j \) at time \( t \) depends on 3 components:
1) utility from the bundle chosen
2) utility derived from store characteristics (distance, taste for store music, parking lot,...)
3) random shock (logit)

Also...model product choice to compute \( E(V_{ijct}) \) exactly...
The utility of the bundle depends on the products purchased and the prices paid. Let $\Omega_{cjt}$ denote the set of products available at store $j$, category $\hat{c}$. Then:

$$V_{ijct} = \max_{b \in \Omega_{cjt}} (\delta_ib - \alpha_{ic}p_{jbt} + e_{ibt}, 0)$$

$$E (V_{ijct}) \equiv E (V_{ijct}(\Omega_{jct}, p_{jct})) = \int_{e,p} V_{ijct} dF(e, p)$$
**Estimation**

Use sample of 5345 Households (Nielsen Homescan) matched with the store level data. I observe choices (store and products) and non-choices! (not always available)

Recover consumer preferences (for products and store characteristics) using Maximum Simulated Likelihood
Counterfactual experiment:

\[ p_D \rightarrow p_M \text{  and  } \Omega_D \rightarrow \Omega_M \]

and compute consumer new choices (of store and products)

Use predicted causal effect of competition estimated from first part of the paper.
<table>
<thead>
<tr>
<th></th>
<th>Duopolist (real)</th>
<th>Monopolist (counterfactual)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Consumers</strong></td>
<td>2.97</td>
<td>2.83</td>
</tr>
<tr>
<td>Low Inc, small size</td>
<td>1.75</td>
<td>1.65</td>
</tr>
<tr>
<td>Low Inc, big size</td>
<td>5.02</td>
<td>4.83</td>
</tr>
<tr>
<td>Med Inc, small size</td>
<td>1.79</td>
<td>1.68</td>
</tr>
<tr>
<td>Med Inc, big size</td>
<td>4.72</td>
<td>4.52</td>
</tr>
<tr>
<td>High Inc, small size</td>
<td>2.36</td>
<td>2.24</td>
</tr>
<tr>
<td>High Inc, big size</td>
<td>5.04</td>
<td>4.84</td>
</tr>
</tbody>
</table>

**Table:** Welfare simulation
The impact of competition may not be so clear when price is not the only variable of choice.

Implications for Merger Analysis, Entry simulation, etc.

Careful:
- Only looking at move from 1 to 2 stores (not clear how the effect extends beyond)
- Only looking at Beverages/Supermarkets