The Slow Growth of New Plants: Learning about Demand?
Disclaimer

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Outline of Presentation

• Motivation
• Descriptive exercises
• Structural model
• Structural exercises
• Conclusion

*It takes a long time for new businesses to reach a point where they have built enough relationship-specific capital to expect to sell at the same price the same amount of output as their more established competitors.*
Motivation

• Large literature finds considerable differences between entrants and incumbents in the same industry.

• Size heterogeneity is one of the best documented.
  – New plants are small plants & convergence is slow.
    • Dunne, Roberts, Samuelson (1988) “…entrants tend to be smaller than existing producers….an entrant produces, on average, 35.2% of the average output level of all incumbent firms in the industry…” this climbs to 54% after 5 years, 92% after 10 years, and 127% after 15 years.
Possible Explanations

• Supply side: early work explored productivity/cost differences as explanation.
  – Jovanovic (1982) “Firms differ in size not because of the fixity of capital, but because some discover that they are more efficient than others.”
  – FHK: entering plants are less productive than incumbents but eventually become as productive suggestive of learning by doing.

• Demand side: new work incorporates demand in analysis of productivity and selection.
  – Foster, Haltiwanger, Syverson (2008)
Foster, Haltiwanger, Syverson (2008)

• In our earlier paper examined selection dynamics and had disentangled supply side and demand side impacts.
• TFPQ versus TFPR
• Results:
  – New plants’ TFPQ is just as high, even slightly higher, than older plants’ TFPQ.
  – New plants’ prices are slightly lower.
  – Idiosyncratic demand factors seem to be driving size differences.
Supply-side vs. Demand-side

- Regression of fundamentals and plant age dummies (and industry-year effects).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Entrant</th>
<th>Young</th>
<th>Medium</th>
<th>Exit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFPQ</td>
<td>0.013</td>
<td>0.004</td>
<td>-0.004</td>
<td>-0.018</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Demand</td>
<td>-0.550</td>
<td>-0.397</td>
<td>-0.316</td>
<td>-0.339</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.024)</td>
<td>(0.026)</td>
<td>(0.021)</td>
</tr>
</tbody>
</table>
Demand Side

• Dynamic demand-side forces take time to play out.
  – Growth of a customer base
  – Building a reputation
  – Uncertainty about demand may create option value of waiting to expand

• Customer Learning
  – Details of product attributes
  – Quality and quantity of bundled services
  – Consistency of operations
  – Longevity
Demand Side –con’t

• Demand-side analog to learning by doing.
  – Demand accumulation by doing, endogenous or active demand accumulation, experience.

• Contrast with learning by being.
  – Demand accumulation by being, exogenous or passive demand accumulation, age.

• New producers charge lower prices as part of demand accumulation by doing.
Examples of Models

• Some consistent stories
  – Caminal and Vives (1999): market share acts a signal to consumers. Firms have an incentive to set prices low to boost market share.
  – Radner (2003): when customers face an attention budget and only make decisions infrequently increasing market penetration by lowering prices represents a kind of investment.
Data and Sample

- Census of Manufactures (CM)
  - 1977-1997 with ~ 17,000 plant-year obs
  - Including product supplement data
- 10 Products
  - Boxes, White Pan Bread, Carbon Black
  - Roasted Coffee Beans, Oak Flooring, Block Ice, Processed Ice, Hardwood Plywood, Raw Cane Sugar
- Entry and Exit measures are for the entire CM.
- Exclude lower quality data (AR, outliers) and data for plants that do not have a majority of their revenue from product in question.
# Summary Statistics

<table>
<thead>
<tr>
<th>Industry</th>
<th>Average No. Plants/Yr</th>
<th>Avg. Entry Rate</th>
<th>Avg. Exit Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boxes</td>
<td>962</td>
<td>12.4</td>
<td>12.2</td>
</tr>
<tr>
<td>Bread</td>
<td>126</td>
<td>7.6</td>
<td>18.9</td>
</tr>
<tr>
<td>Carbon Black</td>
<td>23</td>
<td>4.8</td>
<td>13.4</td>
</tr>
<tr>
<td>Coffee</td>
<td>76</td>
<td>9.1</td>
<td>15.6</td>
</tr>
<tr>
<td>Concrete</td>
<td>3041</td>
<td>26.6</td>
<td>21.8</td>
</tr>
<tr>
<td>Flooring</td>
<td>17</td>
<td>18.7</td>
<td>11.9</td>
</tr>
<tr>
<td>Block Ice</td>
<td>28</td>
<td>24.5</td>
<td>26.5</td>
</tr>
<tr>
<td>Processed Ice</td>
<td>129</td>
<td>23.1</td>
<td>27.7</td>
</tr>
<tr>
<td>Plywood</td>
<td>52</td>
<td>7.4</td>
<td>10.3</td>
</tr>
<tr>
<td>Sugar</td>
<td>33</td>
<td>3.9</td>
<td>17.0</td>
</tr>
</tbody>
</table>
Estimating Idiosyncratic Plant-Level Demand

Estimate Product Demand Curves:

$$\ln q_{it} = \alpha_o + \alpha_1 \ln p_{it} + \sum \alpha_t \text{YEAR}_t + \alpha_2 \ln (INCOME_{it}) + \eta_{it}$$

Plant Demand:

$$\hat{\delta}_{it} = \hat{\eta}_{it} + \hat{\alpha}_2 \ln (INCOME_{it})$$
Idiosyncratic Plant-Level Demand

• Idiosyncratic plant-level demand is the logged output for that plant when controlling for plant-level prices and aggregate demand shocks.

• There is a lot of dispersion in this measure of demand. Our measure implies that within a given year and product, a plant can sell three times the output of another plant that is just 1 standard deviation lower in the demand distribution.
Plant-Level Demand and Firm Type

- Regression of demand and plant age dummies and interacted with firm type.

<table>
<thead>
<tr>
<th>Variable</th>
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<th>Young</th>
<th>Medium</th>
<th>Old</th>
<th>Exit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand</td>
<td>-0.318</td>
<td>-0.176</td>
<td>-0.150</td>
<td>Excl.</td>
<td>-0.183</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.035)</td>
<td>(0.038)</td>
<td></td>
<td>(0.031)</td>
</tr>
<tr>
<td>Demand x MU</td>
<td>0.106</td>
<td>0.132</td>
<td>0.237</td>
<td>0.530</td>
<td>-0.283</td>
</tr>
<tr>
<td></td>
<td>(0.038)</td>
<td>(0.041)</td>
<td>(0.045)</td>
<td>(0.026)</td>
<td>(0.042)</td>
</tr>
</tbody>
</table>
Dynamic Model

Production Function: \( q_t = A_t x_t \)

Demand Curve: \( q_t = \theta_t A e^{\phi Z_t} p_t^{-\eta} \)

Evolution: \( Z_t = (1 - \delta) Z_{t-1} + (1 - \delta) R_{t-1} \)

Initialization: \( Z_{0e} = (K_{0e})^{\lambda_1} \left( \frac{K_{0s(e)} + K_{0e}}{K_{0e}} \right)^{\lambda_2} \)

Profits: \( \pi_t = p_t A_t x_t - c_t x_t - f \)
Estimating Model

Demand Equation:

\[
\ln q_{t+1} = \rho \ln q_t + \phi \ln A_\text{g}e_{t+1} - \rho \phi \ln A_\text{g}e_t \\
+ \gamma \ln Z_{t+1} - \rho \gamma \ln Z_t - \eta \ln p_{t+1} + \rho \eta \ln p_t + \nu_{t+1}
\]

Euler Equation:

\[
E[\varepsilon_{t+1}] = \frac{C_t}{R_t} - \left(1 - \frac{1}{\eta}\right) - \frac{\beta(1-\delta)\gamma}{\eta} \frac{R_{t+1}}{Z_{t+1}} - \beta(1-\delta) \left(\frac{C_{t+1}}{R_{t+1}} - \left(1 - \frac{1}{\eta}\right)\right) = 0
\]
Estimation – con’t

- Replace Age with dummies
- Add fully-interacted product-year effects
- Add local income in product market
- Add average price of local competitors
- Assume Beta=0.98
- Add selection correction to both eqs
- Jointly estimate the demand and Euler equation using GMM.
## Learning with Depreciation Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coefficient</th>
<th>S E</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma$</td>
<td>0.795</td>
<td>(0.014)</td>
</tr>
<tr>
<td>Young dummy</td>
<td>-0.066</td>
<td>(0.031)</td>
</tr>
<tr>
<td>Medium dummy</td>
<td>-0.025</td>
<td>(0.026)</td>
</tr>
<tr>
<td>$\rho$</td>
<td>0.366</td>
<td>(0.085)</td>
</tr>
<tr>
<td>$\lambda_1$</td>
<td>0.651</td>
<td>(0.051)</td>
</tr>
<tr>
<td>$\lambda_2$</td>
<td>0.548</td>
<td>(0.063)</td>
</tr>
<tr>
<td>$\eta$</td>
<td>-1.808</td>
<td>(0.082)</td>
</tr>
<tr>
<td>Competitors Price</td>
<td>0.338</td>
<td>(0.073)</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.893</td>
<td>(0.026)</td>
</tr>
<tr>
<td>Inverse Mills Ratio, Demand</td>
<td>-0.022</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Inverse Mills Ratio, EE</td>
<td>0.026</td>
<td>(0.005)</td>
</tr>
</tbody>
</table>
Decomposing Demand Shocks

\[ DSHK_t = \phi \ln Age_t + \gamma \ln Z_t + \varepsilon_t \]

- Calculate demand shock as the residual from the structural model.
- Calculate its components using the estimates from the structural model.
- Run three regressions each with similar format to that in very first table.
## Decomposing Demand Shocks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Young</th>
<th>Medium</th>
<th>Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Shock</td>
<td>-0.575</td>
<td>-0.287</td>
<td>Excl.</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.029)</td>
<td></td>
</tr>
<tr>
<td>Active Accumulation</td>
<td>-0.617</td>
<td>-0.271</td>
<td>Excl.</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.025)</td>
<td></td>
</tr>
<tr>
<td>Passive Accumulation</td>
<td>-0.066</td>
<td>-0.025</td>
<td>Excl.</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.026)</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

• It takes a long time for entering plants to grow to the size of incumbents.
• The demand side plays are larger part in the persistence of the size gap than does the supply side.
• Our model allowed for both active and passive demand accumulation by establishments.
• In active demand accumulation, establishments set prices low to build up future demand. In passive demand accumulation, establishments existence builds up future demand.
• We found that active demand accumulation dominates. A 10% cut in prices in current year, means that a plant will be able to sell 4% more output at any given price in the next period.