The Slow Growth of New Plants: Learning about Demand?

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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.
  – Das, Roberts, Tybout (2007)
  – Foster, Haltiwanger, Syverson (2008)

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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).

Variable	Entrant	Young	Medium	Exit
TFPQ	0.013	0.004	-0.004	-0.018
	(0.005)	(0.006)	(0.006)	(0.005)
Demand	-0.550	-0.397	-0.316	-0.339
	(0.022)	(0.024)	(0.026)	(0.021)

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.

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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.

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Summary Statistics

Industry	Average No. Plants/Yr	Avg. Entry Rate	Avg. Exit Rate
Boxes	962	12.4	12.2
Bread	126	7.6	18.9
Carbon Black	23	4.8	13.4
Coffee	76	9.1	15.6
Concrete	3041	26.6	21.8
Flooring	17	18.7	11.9
Block Ice	28	24.5	26.5
Processed Ice	129	23.1	27.7
Plywood	52	7.4	10.3
Sugar	33	3.9	17.0

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Estimating Idiosyncratic Plant-Level Demand

Estimate Product Demand Curves:

$$\ln q_{it} = \alpha_o + \alpha_1 \ln p_{it} + \sum \alpha_t YEAR_t + \alpha_2 \ln(INCOME_{mt}) + \eta_{it}$$

Plant Demand:

$$\hat{\delta}_{it} = \hat{\eta}_{it} + \hat{\alpha}_2 \ln(INCOME_{mt})$$

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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.

Variable	Entrant	Young	Medium	Old	Exit
Demand	-0.318	-0.176	-0.150	Excl.	-0.183
	(0.034)	(0.035)	(0.038)		(0.031)
Demand x MU	0.106	0.132	0.237	0.530	-0.283
	(0.038)	(0.041)	(0.045)	(0.026)	(0.042)

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Dynamic Model

Production Function: $q_t = A_t x_t$

Demand Curve: $q_t = \theta_t Age_t^{\phi} Z_t^{\gamma} p_t^{-\eta}$

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: $\pi_t = p_t A_t x_t - c_t x_t - f$

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Estimating Model

Demand Equation:

$$\ln q_{t+1} = \rho \ln q_t + \phi \ln Age_{t+1} - \rho\phi \ln Age_t$$
$$+ \gamma \ln Z_{t+1} - \rho\gamma \ln Z_t - \eta \ln p_{t+1} + \rho\eta \ln p_t + \upsilon_{t+1}$$

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

Parameter	Coefficient	S E
γ	0.795	(0.014)
Young dummy	-0.066	(0.031)
Medium dummy	-0.025	(0.026)
ρ	0.366	(0.085)
λ_1	0.651	(0.051)
λ_2	0.548	(0.063)
η	-1.808	(0.082)
Competitors Price	0.338	(0.073)
δ	0.893	(0.026)
Inverse Mills Ratio, Demand	-0.022	(0.009)
Inverse Mills Ratio, EE	0.026	(0.005)

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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

Variable	Young	Medium	Old
Demand Shock	-0.575	-0.287	Excl.
	(0.020)	(0.029)	
Active Accumulation	-0.617	-0.271	Excl.
	(0.017)	(0.025)	
Passive Accumulation	-0.066	-0.025	Excl.
	(0.031)	(0.026)	

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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.

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