Firm Turnover in Imperfectly Competitive Markets

Marcus Asplund and Volker Nocke
Review of Economic Studies, 2006

Presented by
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Introduction

Relevant Question

What are the effects of market size and fixed costs on firm turnover and age distributions of firms within industries?

Motivation


- simultaneous firm entry and exit at industry level, and
- considerable variation in firm turnover across industries

To explain these cross-industry differences in firm turnover is one of the important research agendas
Introduction

This paper

- Considers observable ind. characteristics (FC and market size) as determinants of E/X rates in an imperfectly competitive industry
- Develops a stochastic dynamic model of a monopolistic industry and test its empirical implications

Main results

- The rate of firm turnover is increasing in market size, and the expected lifespan of firms is decreasing in market size
- An increase in FC leads to higher firm turnover and shorter expected lifespan of firms
Introduction

Mechanism: *price effect of competition*

- ↑ market size ⇒ under free-entry ↑ population of active firms ⇒ two opposing effects on firms’ profits:
  - larger sales (bc ↑ in market size)
  - lower price-cost margins (bc endogenous ↑ intensity of competition)
- in equilibrium, the net effect is positive for more efficient firms, but negative for less efficient firms
- the expected lifespan of firms is shorter, and the rate of firm turnover larger
Model

Environment

- Discrete time, infinite horizon model, $\delta$ discount factor
- Continuum of consumers and potential firms
- Each firm produces a unique differentiated product and hence faces a downward-sloping D curve
- Firms differ in their efficiency levels which evolves over time: $c_t \in [0, 1]$

$$c_t = \begin{cases} c_{t-1} & \text{with Pr: } \alpha \\ \sim G(\cdot) & \text{with Pr: } 1-\alpha \end{cases}$$

- $\phi$ fixed cost of production
- entrants pay $\epsilon$ sunk cost of entry $\Rightarrow$ draw $c_t \sim G(\cdot)$
- $\mu$ is the state of the ind. (measure on $[0, 1]$)
Model

Timing

- **Entry stage**: potential entrants decide whether to enter the market or take up the outside option (=0).
- **Learning stage**: entrants and incumbents observe \( c_t \)
- **Exit stage**: entrants and incumbents decide whether to leave the market forever
- **Output stage**: active firms pay the FC, decide production, and receive profits

They make assumptions directly on firms’ reduced-form eqlm. profit function:

\[
S \pi(c, \mu)
\]

where \( S \) is a measure of market size (i.e. mass of consumers)
Example 1 (linear demand model with a cont. of firms)

- Cont. (of mass $S$) of identical consumers with

$$U = \int_0^n \left( x(i) - x^2(i) - 2\sigma \int_0^n x(j)x(i) dj \right) di + H$$

where $H$ is a composite alternative good

- Linear D system $\Rightarrow$ in eqlm. each firm faces the same residual D curve $\Rightarrow$

$$S\pi(c, \mu) = \begin{cases} \frac{S[\bar{c}(\mu) - c]^2}{8} & \text{if } c \leq \bar{c}(\mu) \\ 0 & \text{otherwise} \end{cases}$$

where $\bar{c}(\mu) = \frac{1 + \sigma \int_0^\mu z\mu(dz)}{1 + \sigma \mu([0, \bar{c}(\mu)])}$

- Adding more active firms ($c < \bar{c}(\mu)$) reduces firms' gross profits ($\downarrow \bar{c}(\mu)$)

- Key result: if $\exists \mu$ to $\mu'$ which induces more intense competition, $\bar{c}(\mu') < \bar{c}(\mu) \Rightarrow \downarrow$ gross profit of more efficient firms by a larger total amount, but by a smaller fraction, than that of less efficient firms
Model

Assumptions

- **(MON)** $\pi(c, \mu)$ is strictly decreasing in $c$ on $[0, \bar{c}(\mu))$ and $\pi = 0$ for all $c \in [\bar{c}(\mu), 1]$, and define partial order of measures as:

  $\mu' \succeq \mu \iff \{\forall c \in [0, 1], \pi(c, \mu') \leq \pi(c, \mu)\}$

  $\mu' \succ \mu \iff \{\forall c \in [0, \bar{c}(\mu)], \pi(c, \mu') < \pi(c, \mu)\}$

  $\mu' \sim \mu \iff$ same degree of competition

Intuition: an increase in the population of firms should increase intensity of price competition implying a decrease in profits.

- **(DOM)** If $\mu'(0, z] \geq \mu(0, z]$ for all $z \in (0, 1) \Rightarrow \mu' \succeq \mu$ (if some $z >$).

  Intuition: any shift in the population towards more efficient firms increases competition intensity, decreases value of firms and entrants value.

- **(ORD)** The set of measures $(M, \succeq)$ is completely ordered.

- **(CON)** $\pi(c, \mu)$ is continuous.

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Main Assumptions \((\text{properties of a class of het. firms oligopoly models})\)

- **Ass. 1**: For \(\mu' > \mu\) the profit difference \(\pi(c, \mu) - \pi(c, \mu')\) is strictly decreasing in \(c\) on \([0, c(\mu))\)

- **Ass. 2**: For \(\mu' > \mu\) the profit ratio \(\frac{\pi(c, \mu')}{\pi(c, \mu)}\) is strictly decreasing in \(c\) on \([0, c(\mu))\)

- **Prop. 1**: Suppose \(c\) is the MC and firms compete either in P or Q:
  \[ S\pi(c, \mu) = (P(q(c, \mu, S)/S, \mu) - c)q(c, \mu, S) \]
  
  i) Ass. 1 holds iff eqlm output \(q(c, \mu, S)\) is decreasing in \(\mu\)
  
  ii) Ass. 2 holds iff eqlm price \(P(q(c, \mu, S)/S, \mu)\) is decreasing in \(\mu\)

Ass 1 holds in many models, but Ass 2 does not hold in the D-S monopolistic competition model.
Stationary Equilibrium (focus on $M>0, c^*<1$)

- Value of an incumbent firm of type $c$:
  \[
  V(c) = \max \{0, \bar{V}(c)\}
  \]
  \[
  \bar{V}(c) = [S \pi(c, \mu) - \phi] + \delta \left[ \alpha V(c) + (1 - \alpha) \int_0^1 V(z) G(dz) \right]
  \]

- Define the threshold $c^*$ as
  \[
  c^* = \begin{cases} 
  \sup\{c \in [0, 1] \mid V(c) > 0 \} & \text{if } V(1) = 0 \\
  1 & \text{if } V(1) > 0 
  \end{cases}
  \]

  as $V(c)$ is str $\downarrow$ on $[0, \min\{c^*, \bar{c}(\mu)\}] \Rightarrow \exists$ a threshold exit rule

- Value of an entrant:
  \[
  V^e = \int_0^1 V(c) G(dc) - \varepsilon
  \]
Stationary Equilibrium (focus on $M > 0, c^* < 1$)

Under Free Entry $\Rightarrow V^e = 0 \Rightarrow$

$$V(c) = \frac{S\pi(c, \mu) - \phi + \delta(1 - \alpha)\epsilon}{1 - \alpha\delta} \quad \text{if } c \leq c^*$$

in $c = c^*$

$$S\pi(c^*, \mu) - \phi + \delta(1 - \alpha)\epsilon = 0$$

Let $\overline{V}^e(x, \mu)$ be the value of a new entrant who uses exit policy $x$:

$$\overline{V}^e(x, \mu) = \int_0^x V(c) G(dc) - \epsilon$$

$\Rightarrow$ the free entry condition can be rewritten as

$$\overline{V}^e(c^*, \mu) = 0$$

and the condition for optimal exit as:

$$\frac{\partial \overline{V}^e(c^*, \mu)}{\partial x} = 0$$
Stationary Equilibrium

\[ \overline{V}^e(x; \mu) \]

\[ \overline{V}^e(x; \mu') \]

\[ \overline{V}^e(x; \mu) \]

**FIGURE 1**

The effect of a decrease in the distribution of firms \((\mu' \prec \mu)\) on the value of an entrant with exit policy \(x\)
Stationary Equilibrium (focus on \( M > 0, c^* < 1 \))

- Invariant measures of firms efficiencies at stage 4:
  \[
  \mu[c^*, M][0, z]) = \frac{M}{(1 - \alpha)(1 - G(c^*))} G(\min\{z, c^*\})
  \]
  has the shape of dist. \( G(\cdot) \), is truncated at equilibrium exit policy \( c^* \), and is scaled by a factor

- Turnover:
  \[
  \theta = \frac{M}{\mu[0, 1]} = \frac{(1 - \alpha)(1 - G(c^*))}{G(c^*)} \quad \text{decreasing in } c^*
  \]

- Share of active firms whose age is less than \( a \):
  \[
  A(a/c^*) \equiv 1 - (1 - G(c^*)\theta)^a \quad \text{str} \downarrow \text{in } c^*
  \]

- Prop. 4: \( \epsilon \uparrow \Rightarrow c^* \uparrow \Rightarrow \theta \downarrow \) (shift of the age dist. of firms towards older firms, and total mass of active firms \( \mu \) and entrants \( M \) decrease)
Model

- **Prop. 5**: If Ass. 1 holds \( \Rightarrow an \uparrow \phi \Rightarrow \downarrow c^* \Rightarrow \uparrow \theta \) (shift of the age dist. of firms towards younger firms, and \( \mu \) and \( \downarrow M \))

Impact of market size changes on turnover and age dist. of firms:

- **Prop. 6**: If Ass. 2 holds \( \Rightarrow an \uparrow S \Rightarrow \downarrow c^* \Rightarrow \uparrow \theta \) (shift of the age dist. of firms towards younger firms, and \( \uparrow \mu \) and \( \downarrow M \))

Empirical Application: Hairdressers salons in Sweden

- Test the comparative dynamics properties of the model: Impact of observables FC, entry costs and S on age distribution of firms
- Idea: examine the age distribution of firms that compete in the same sector but in different geographical markets.
Empirical Application

Hairdressers salons in Sweden

- Take: land rents (proxy of FC) and population (proxy of market size)
Empirical Application

Hairdressers salons in Sweden

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<thead>
<tr>
<th>Least squares regressions</th>
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<tr>
<td></td>
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<tr>
<td>ln(MSIZE)</td>
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<td>ln(RENT)</td>
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<td>ln(POPDENSITY)</td>
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<td>POPGROWTH</td>
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<td>YOUNGPOP</td>
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<td>Constant</td>
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Sample | MSIZE < 75,000 | MSIZE < 75,000 | MSIZE < 75,000 |
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<td>Test 2</td>
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<td>Test 3</td>
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Age of firm related to market size and fixed costs. Robust standard errors in brackets. Observations clustered by market. Test 1 is the P-value of the restriction ln(MSIZE) = ln(RENT) = 0. Test 2 is the P-value of the restriction ln(POPDENSITY) = POPGROWTH = 0. Test 3 is the P-value of the restriction MOBILITY = YOUNGPOP = 0.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.
Final Remarks

- Develops a stochastic dynamic model of a monopolistic industry to analyze the connection between market size and fixed costs and firm turnover and age distribution of firms.

- Test some empirical implications of the model.