EC2212 Industrial Growth
and Competition

Lecture 9

Firm size and age affect growth, and thus the firm size distribution.

Measures of Firm Size

- Different measures for different purposes
  - Financial or stock market value
  - Employees
  - Productive capacity
  - Value of production
  - Value added of production (output – inputs)
- Highly correlated
- Employees, production main focus today

No Equilibrium Firm Size

- Size changes gradually
  - No instant expansion to a desired size
  - Finance, hiring, training, purchase & set-up of equipment and operating methods take time
- Firm size apparently unlimited
  - U-shaped long run cost curves of firms are mythical
  - May be U-shaped short run curves, long run curves for a particular plant
  - Multi-product firms can keep expanding, reorganizing
  - Witness IBM, General Motors, Microsoft, etc.

Limits to Firm Growth

- Penrose (1959), *The Theory of the Growth of the Firm*
- No equilibrium amount of output
- Optimal growth rate instead
- Growth is limited
  - Managerial limits to expansion activities
  - Training of new employees by old
  - E.g., convex costs of growth, g'>0, g''>0

Simple Representations of Growth

- Gibrat's "law"
  - All firms have same probability distribution for % growth (at a given time)
  - E.g., firms with 10 vs. 10,000 employees have same chance to grow 50% or more in a year
- Modifications:
  - Serial correlation
  - Merger
  - Effects of firm size, age, skill, technology, ...

Observed Growth of Firms & Plants

- Examine patterns for US plants
- Patterns are similar for firms
- Relation between % growth and age, size
- (Ignoring many other correlates of growth.)
- Dunne, Roberts, and Samuelson (1989)

Average Five-Year Growth Rates among Surviving Plants

Age (years)	Plant Size (# of employees)				
	5-19	20-49	50-99	100-249	250+
1-5	61%	30%	19%	13%	7%
6-10	34%	14%	7%	1%	-1%
11-15	31%	6%	-1%	-2%	-2%

Average Five-Year Exit Rates

Age (years)	Plant Size (# of employees)				
	5-19	20-49	50-99	100-249	250+
1-5	41%	40%	39%	33%	23%
6-10	35%	27%	28%	25%	16%
11-15	30%	21%	23%	21%	13%

Average Five-Year Growth Rates, with Exit = -100% Growth

Age (years)	Plant Size (# of employees)				
	5-19	20-49	50-99	100-249	250+
1-5	-6%	-22%	-28%	-24%	-18%
6-10	-13%	-17%	-23%	-24%	-17%
11-15	-9%	-16%	-24%	-22%	-15%

Observed Growth of Firms in an Industry

- Measure size within the product industry
- Growth limited by market size
- Size at time of entry
  - Entrants at different times have similar sizes?
  - Or does initial size grow/fall over time? Why?
- Which firms grows how much, which exit?
- Hence how does size distribution evolve?

Size 1 Year After Entry, US Tires

Entry Year	No. firms by Initial capitalization (US $)						Total Firms
	?	J	K	L	M	N	
1905-09	17	2	6	2	2	3	32
1910-14	29	20	19	20	18	4	110
1915-19	23	1	13	33	25	8	103
1920-24	69	7	15	48	33	10	182
1925-29	19	0	3	12	7	0	41
1930-80	21	0	4	11	14	23	73
Total	178	30	60	126	99	48	541

J=$2,500-9,999 K=$10,000-49,999 L=50,000-199,999 M=200,000-999,999 N=$1M+

Not adjusted for inflation. Some firms are multi-product firms. Median shaded.

Size Distribution, US Tires

	No. firms by Capitalization (US $)						Total
Year	?	J	K	L	M	N	Firms
1910	14	1	10	14	6	4	49
1920	59	9	23	53	51	35	230
1930	16	1	6	19	27	28	97
1940	6	0	3	10	10	23	52
1950	7	0	2	3	8	21	41
1960	3	0	2	4	2	28	39
1970	3	0	1	1	1	18	24
1980	7	0	0	1	3	18	29

J=$2,500-9,999 K=$10,000-49,999 L=50,000-199,999 M=200,000-999,999 N=$1M+

Not adjusted for inflation. Some firms are multi-product firms. Median shaded.

Firm Size Distributions

- How many firms are of each size
- Used to calculate measures of concentration
  - N-firm concentration ratio: Σs_i, N largest firms
  - Herfindahl index: Σs_i^2, all firms
- Affected by
  - Entry and exit (and sizes of entrants & exitors)
  - Growth

Skew Size Distributions Result

- Gibrat's law + entry yields skew size distribution
  - Ijiri and Simon (1977), *Skew Distributions and the Sizes of Business Firms* (with Bonini)
  - Who produces each new unit of output?
    - Probability α of production by a new firm
    - Otherwise, probability proportionate to firm size
- Skew distribution (many small firms, few large) results as # of draws $\rightarrow \infty$

Skew Distributions: A General Phenomenon

- Ijiri & Simon point out generality:
  - Sizes of business firms (Fortune 500)
  - Populations of cities
  - How often words appear in a book
- Same principle works in each case
  - New entities appear with some probability
  - Likelihood of next appearance proportionate to number of past appearances

You Have Learned

- Penrose's theory of limited firm growth
- Gibrat's "law": growth independent of size
- Growth faster for younger, smaller plants
- Within industry: entry, exit, growth
  - Entry size grew somewhat in tires
  - Surviving firms' median size grew in tires
- Evolution of skew size distributions