Structure - Conduct - Performance and Industrial Dynamics

Marco Grazzi[1]

[1]LEM, Scuola Superiore Sant'Anna, Pisa

Scuola Superiore Sant'Anna
Doctoral Program in Economics

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di Studi Universitari e di Perfezionamento

Outline

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Introduction

- Empirically based discipline Vs. heroic assumptions.
- Limited data availability was a 'curse' for many empirical works in economics.

In concluding this paper, I am acutely conscious of the meagerness of reliable information presented. The paper is perhaps 5 per cent empirical information and 95 per cent speculation, some of it possibly tainted by wishful thinking. (Kuznets, 1955, p. 26)

- Nowadays it is possible to somehow revert the proportion.

I.O. Paradigms

	S-C-P	"New" IO	Ind. Dyn
Technology	Cost Function	Cost Func + R&D	Tech. Paradigm & Trajectories
Nature of Tech	Black Box	Black Box + contracts	Knowledge Capabilities
Actors	Firms	Firms	Firms, Univ.
Interactions	Competition (market)	Competition (market)	Competition Cooperation
Behaviors	Fixed Response	Strategic, game theor	Routines, adapt learning

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Outline of S-C-P

Basic Conditions
Costs; Demand; Technology

$\Downarrow$

Market Structure
Market Concentration; Product Differentiation; Barriers to entry;
Vertical Integration; Diversification

$\Downarrow$

Conduct
Pricing behavior; Product strategy & advertising; R&D; Investment

$\Downarrow$

Performance
Efficiency; Profitability; Technical progress

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Market Concentration

- Degree to which production in a particular market or industry is concentrated in the hands of a few large firms.
- Market (product, industry) Vs aggregate (nation, global) concentration
- Historical trends
  - Share of largest 200 corporations in 1929 $\sim 49\%$ (Berle and Means, 1932)
  - Aggregate concentration appears to have increased very little after 1929 (see data from Federal Trade Commission (FTC) and Census Bureau).

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Measures of concentration (I)

- Reciprocal of firm numbers: $1/n$
  - Drawback: a sales transfer will leave this index unchanged.
- Concentration Ratio: proportion of industry output accounted for by the r largest firms, r arbitrary number.

$$C_r = \sum_{i=1}^{r} \frac{x_i}{x} = \sum_{i=1}^{r} s_i \qquad (1)$$

  - Drawback: arbitrary selection of r AND only a single point on the concentration curve is taken

Measures of concentration (II)

Hirschman-Herfindhal index: unlike concentration ratio, it takes into account all points on the concentration curve, being the sum of squared market shares of the firms in the industry:

$$HH = \sum_{i=1}^{n} \left(\frac{x_i}{x} \right)^2 = \sum_{i=1}^{n} s_i^2 \tag{2}$$

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i \quad \sigma^2 = \frac{1}{n} \sum_{i=1}^{n} x_i^2 - \bar{x}^2 \tag{3}$$

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Measures of concentration (III)

Define a unit-free measure of the inequality in firm market shares as: $c = \sigma/\bar{x}$ (*coefficient of variation*)

Then, since

$$c^2 = \frac{1}{n} \sum_{i=1}^{n} n x_i^2 / \bar{x}^2 - 1 \tag{4}$$

it is possible to rearrange and write

$$HH = \frac{c^2 + 1}{n} \tag{5}$$

HH depends both on market share inequality (as c^2) and on firm numbers, n.

In monopoly is max: $HH = 1$ ($c^2 = 0, n = 1$); and is min ($HH = 0$) for the case of many small equally sized firms.

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Recent evidence on Concentration

- See Census of Manufacturers Concentration Ratios, US data.
  - ▸ Concentration ratios 2002

- Firms are assigned to industry (or product) on the basis of their main activity.

- Some 6 digit sectors
  - ▸ Soft drink manufacturing (312111): 4 largest 50%
  - ▸ Men's and boys' cut and sew apparel contractors (315211) and Women's (315212): differences between the two.
  - ▸ Electronic computer manuf (334111): concentrated

- Certainly concentration matters and varies a lot across sectors

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- Osiris database covers publicly quoted companies, in principle all over the world.

- 3 digit industries

- Ideally, the measure ought to be calculated on the universe of firms in a given sector. Short of that, and given the biases associated with the lower size bound, we consider concentration in the *upper tail* of the distribution.

$$D_{20}^4(t) = \frac{C_4}{C_{20}} \qquad t = 1982, ..., 2005 \qquad (6)$$

- C_4 and C_{20} are the sums of the market shares of the top 4 and top 20 firms in each sector, respectively. If a sector is highly concentrated, D_{20}^4 would be near to 1, while it would be $1/5$ if all firms were identical.

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- The *shapes* of the distributions change a good deal, while the *means* of the distributions vary much less.
- The modal value of the concentration rates falls from the mid-80's to the mid-90's, remaining roughly stable thereafter.
- The upper tail gets fatter. An increasing number of sectors displays $D_{20}^4(t)$ statistics above 0.7, meaning that the first four firms in the "world", as defined in the Osiris dataset, in a particular sector, accounts for more than 70% of the top 20 firms in the same sectoral data record.
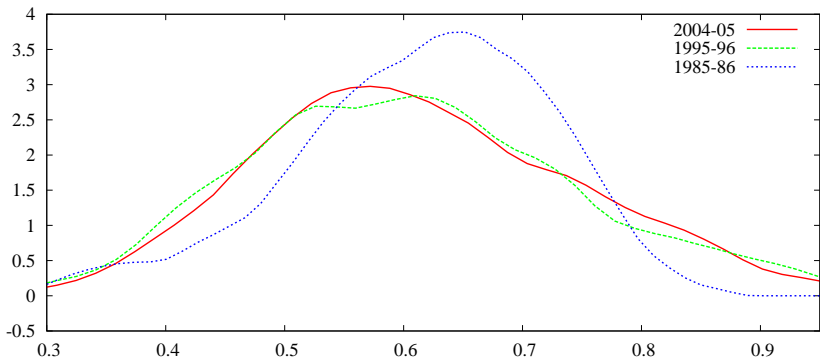- Note also that the lower tail seems to be remarkably stable over the last two decades.

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Figure: Probability densities of the sectoral concentration index D_{20}^4 in terms of total sales, different years (kernel estimates). The support of these densities is [0.3 0.95]. World's largest firms Osiris (2005) database.

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Economies of scale (I)

- Product specific economies of scales
  - ▸ are associated with the volume of output of any single product made and sold (from OECD).
  - ▸ Such economies *generally arise by avoiding the costs of interrupting production and re-tooling* that is required in order to produce different products with the same machinery and equipment.
  - ▸ An essentially product specific economy of scale stressed by Adam Smith comes from *division of labor*: with larger output workers can specialize.
  - ▸ Stigler's "The division of labour is limited by the extent of the market"
  - ▸ Fall in unit cost due to learning by doing

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Economies of scale (II)

- Plant specific economies of scales
  - ▶ Plant specific economies of scale are associated with the total output (frequently encompassing many products) of an entire plant or plant complex. Economies of scope may be embodied as part of plant economies as the costs of common overheads, e.g., head office administration and accounting costs, are spread across multiple products (from OECD).
  - ▶ In chemical and metallurgical type industries the most important economies of scale at the *plant-specific* level come from expanding the size of the individual processing units.
  - ▶ The output tends (whitin physical limits) to be roughly proportional to the volume of the unit, while the amount of material required for construction is more closely proportional to the surface area of the unit's reaction chambers
    - ★ So called two-third rule. Area of a sphere or cylinder varies as the two-thirds power of volume, the cost of constructing process industry plants can be expected to rise as the 2/3 power of their output capacity

Economies of scope

- Economies of scope exist when it is cheaper to produce two products together (joint production) than to produce them separately.
- See Chandler's "Scale and Scope"

Vertical Integration & Boundaries of the firm

- What determines which operations are performed internally and which outside the firms?
- Coase (The nature of the firm, 1937) observed that the distinguished mark of a "firm" is the "suppression of the price mechanism".
- Resource allocation in the market is normally guided through prices, but within the firm the job is done through decisions of managers.
- Activities are collected in "firms" when transaction costs incurred in using the price mechanism exceed the cost of organizing internally.
- Arora, Fosfuri and Gambardella's "Markets for Technology"
  - IPR facilitates the emergence of markets for technology
  - i.e. Biotech firms that only do R&D to patent and license
  - i.e. The design of the chip is outsourced

Technical change and boundaries of the firm

- Did technological revolutions had any relevant impact on the (horizontal and vertical) boundaries of the firm? (Dosi, Gambardella, Grazzi and Orsenigo)

- If the markets for technology paradigm applies extensively to most (beyond high tech only) sectors one should expect a shift (downsizing) of the firm size distribution. More exchanges in the market than within the firm.

- Apparently this is not the case, at least in US, Italy and other countries

Table: Employment share per size cohort, percentages.

Country	Year	0-9	10-19	20-99	100-499	500+
	1972	13.4	8.6	19.3	12.2	46.5
	1977	13.2	8.4	18.5	12.4	47.5
	1982	16.5	9.5	19.8	13.0	41.3
	1988	12.6	8.3	19.2	14.5	45.5
USA	1992	12.3	8.0	18.4	14.3	47.0
	1997	11.6	7.6	18.1	14.5	48.2
	1999	11.1	7.3	17.8	14.1	49.7
	2000	10.8	7.3	17.8	14.3	49.9
	2003	11.0	7.3	17.8	14.5	49.3

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Stochastic determinants of market structure (I)

(think of yesterday's seminar: Gibrat's Law)

- Fundamental to this approach is the idea that the actual process of concentration change reflects the net effect of a multitude of uncertain influences.
- Chance plays a crucial role in explaining concentration change, but such change is not random but is subject to general rules.
- For the time being neglect entries, exits, mergers: number of firm is given.
- *Law of proportionate effect*: each of these firms faces a given probability distribution of proportionate growth which is independent of firm size.
  - ▶ Chance that each firm will grow by *p* per cent does not depend on current size.
  - ▶ *Equiproportionate* growth in probability, of course realization for each firm will not be equal.

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Stochastic determinants of market structure (II)

- The law is of proportionate rather than absolute growth;
- Gibrat process gives rise to a tendency for concentration to increase persistently over time, by increasing the *inequality* (of course, the other leverage, n, is fixed)
- Example: 128 firms (no entry) initial number of employees 100. In each period: keep same size with prob. .5, grow by a factor of 11/10 with prob .25, and decline by 10/11 with prob. .25.

		Number of Employees			
	83	91	100	110	121
Year 0			128		
Year 1		32	64	32	
Year 2	8	32	48	32	8

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Stochastic determinants of market structure (III)

- Since firm, whatever their size, have the same chances of *proportionate* growth or decline, there is a tendency for large firms to grow by larger absolute amounts
- That is the distribution becomes skewed
- As time goes, the FSD asymptotically approaches a *lognormal* distr

$$\varepsilon_t = \frac{x_t - x_{t-1}}{x_{t-1}} \quad \varepsilon_t \sim (m, s^2) \tag{7}$$

If this holds at all points in time and ε are independent of each other and of the x then, by Central Limit Th, $log x_{t(t\to\infty)}$ will be normally distributed with mean mt and variance $s^2 t$

Notice. Since variance of the log.s of firm size increases with t, so does market concentration (given fixed n)

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Stochastic determinants of market structure (IV)

- Important to notice the neutrality of the process with respect to firm size. Proportionate growth shocks independent of firm size ⇒ concentration IS NOT an outcome of large firm advantage.

- In this setting, concentration increase stochastically even when unit costs are similar for all firms (this challenges the scale economies view).

- Policy implications. *laissez-faire* policies may not be sufficient to protect the competitiveness of the economy. (yet process of firms entry may alleviate the intensity)

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Plan of the talk

1. I.O. Paradigms

2. Structure
   - Concentration
   - The Determinants of Market Structure
   - Stochastic determinants of market structure

3. Conduct
   - Oligopoly Pricing

4. Performance

Economic Theories of Oligopoly Pricing

- Basic difficulty facing an oligopolist is uncertainty about rival actions and reactions.
- Cournot competition: firms choose their profit-maximizing quantity of output, assuming that the quantities marketed by rivals are fixed
- Bertrand competition: set the price and let buyers decide
- Contributions of game theory
- Imperfect Information and Uncertainty
- Collusion/Antitrust

Market Structure and Performance

- Within this paradigm, the classical testable hp has been that, given pricing behavior under oligopoly (monopoly), the average profit in highly concentrated industries will tend to be significantly higher than that of firms in less concentrated market structure.

- Two empirical works by Bain (QJE 1951, and Barriers to new competition (book) 1956) found support to this hp

- Manufact industries with 8-firm concentration ratios bigger than 70% average profit is 12.1% Vs industries with 8-firm concentr. ratios lower than 70% average profit is 6.9%.

- Many empirical works followed. Most found that that industry profits, variously measured, rise with industry concentration, variously measured.

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Some critical thoughts on the SCP

- However, recent work has shown that most of the correlation between profitability and concentration found by Bain (and followers) was almost surely spurious; being the result of aggregating a positive relationship between sellers' market shares and profitability to the industry level.
- Really hard to measure profitability and marginal cost.
  - ▶ True, but the change of theory/paradigm does not help
- Structure (and also Conduct and Performance) might be endogenous
  - ▶ This is true! (Yet in social sciences everything that is of some interest is endogenous)
- Hard to identify the causal nexus
  - ▶ The dominance of the estimated relationship between market share and profitability poses a theoretical challenge, since it is consistent with diverse alternative hp concerning the profitability of individual firms

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Cross-Section Studies (I)

- Bain's initial claims of statistically significant profit-concentration relation, became widely accepted, and replicated both in US and other countries.
- Weiss (1971, 1974). Data for 399 census industries, for 1963.
- Dependent variable is Profitability as Price-Cost Margin (PCM):
  - ▶ Ideally one would like to obtain data on PCM and other profit measures segregated for each industry in which the companies operate.

$$PCM = \frac{TS - CM - CL}{TS} \tag{8}$$

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Cross-Section Studies (II)

- The most basic and standard regression setting is as follows:

$$PCM = constant + \beta CR4 + controls \qquad (9)$$

- PCM were positively and significantly associated to with seller concentration CR4

- Until early '80s most scholars accepted the positive associations found between concentration and profitability as supporting the conduct hp

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Cross-Section Studies (III)

- Suppose that pricing conduct is unaffected by concentration, but that individual firm profits are positively associated with market share.
- Average profit level in concentrated industries will be higher because:
  1. large firms in high-concentr industry have high profits as a result of their large market share
  2. large firms profits get more weight in calculating industry profitability.
- Then, a positive profit-market share relation at the firm level will imply positive profit-industry concentr, even if higher concentration has no effect on conduct
- Empirical work by Ravenscraft (1983) showing that PCM were positively associated to market share, but if anything, *negatively* with seller concentration.

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Time Series Studies

- Until the 1980s nearly all statistical studies of SCP used cross section of industries or firms.
- At any particular time, many industries are in "disequilibrium" with entries, exits, etc.
- Such deviation from long-run equilibrium enter the residual error term and might substantially bias the results.
- Great promise of time series data in permitting analyses of dynamic structure-performance relationship.

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Persistence of profits above the norm (I)

- Dennis Mueller seminal work (Economica, 1977)
- (in a nutshell) His research question is: There must almost certainly be some tendency for relatively high profits to fall and low profits to rise. But can we expect high profits to fall to competitive levels, and how long must we wait?
- Evidence: Profitability differences among firms tend to persist over long periods for the US
  - However, important international differences appear. i.e. rates of convergence are faster in Japan than in US, and faster in France and Germany relative to UK.

Persistence of profits above the norm (II)

The author also raises (and addresses) a number of issues he is aware of.

- Risk: it could be argued that the persistently higher profits that some firms earned are warranted by the substantially higher risks involved in the activity
  - ► check for mean-variance in profits of this firms. Not riskier
- The choice of the sample or time period
  - ► US Compustat was (still is) state of the art for firm data
  - ► No oddities in the time period (24 years, starting in 1949)
- Superior talent. Firms with continually high profits possess superior managerial talent
  - ► Such hp is inconsistent with the competitive environment, at least in its most general form
  - ► Even more importantly, superior talent hp make sense only for traditional entrepreneurial firms, which is not the case in Compustat

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Main References

- Roger Clarke "Industrial Economics", Blackwell
- Scherer - Ross "Industrial Market Structure and Economic Performance"

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