

Predictable Cross-Industry Heterogeneity in Industry Dynamics

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A growing literature improves our understanding of industry competition and eventual industry outcomes by analyzing dynamic processes at work through the industry life cycle. Firm entry and exit, growth, and technological innovation are involved. One striking pattern is that, after an initial buildup, the number of firms in an industry often experiences a dramatic “shakeout” or drop-off and production ends up concentrated among few producers. Contrasting patterns also occur: some industries have little or no shakeout. Might these different outcomes be predictable?

Indeed, Joe S. Bain (1966) and Frederic L. Pryor (1972) showed evidence that industries with high or low concentration in one nation tend to have similar high or low concentration in all the industrialized nations they studied. In the words of Richard Schmalensee (1989, p. 992), this finding “suggests that similar processes operate to determine concentration levels everywhere....” Moreover, since national markets are somewhat independent, the finding suggests that concentration may be in part predictable based on traits of the technology, product, or market.

Common outcomes and predictability are important, because they underlie our ability to write down models of industries that explain structure and performance based on underlying traits. For example, Avner Shaked and John Sutton (1987) model a lower bound to industrial concentration as stemming from firms’ cost of advertising and technological requirements. If we can determine realistic models of how industry outcomes stem from such underlying

characteristics, we may be able to make reasonable a priori predictions of industry outcomes and advise accordingly on national and corporate policy.

One approach to extend this line of work is to examine the dynamic processes in industry competition. If underlying technological or other traits determine processes affecting firm entry, exit, growth, and concentration, empirical patterns should reflect this determinism in two ways. First, comparing the same industry across two or more countries, a similar competitive outcome should occur in all nations. To the extent such similarity arises, systematic causes, not differing national environments nor random successes and failures of firms, may drive industry outcomes. Second, correlated patterns of entry, exit, and other outcomes might be observed, and the observer might learn something by classifying types of competition into a small number of commonly-occurring groups.

I. Multi-Industry, Multi-Nation Competitive Analysis

Empirical analyses of competitive processes in industries are hindered by the lack of available competitive-level data. Data from government censuses of firms and many commercial datasets are available generally at 4-digit or more aggregated SIC levels. At these levels, most of the products made by companies are not substitutable; a customer would rarely if ever buy a hearse, bus, or military tank as a substitute for an automobile (all are in 1987 U.S. SIC 3711). Government and some commercial data sources also tend to recognize new industries only after substantial delay, making it impossible to analyze the important early years of competition.

Fortunately it has proved possible to piece together evidence that does not suffer unduly from these problems. Trade registers, industry associations, and books assembled by enthusiasts about particular products provide written records of which firms produced certain goods. The records often begin in the early years of an industry, and tend to be defined at the competitive

level. For example, lists of television manufacturers analyzed later in this paper are drawn from periodic editions of *Television Factbook* in the U.S. and *Kelly's Directory of Merchants, Manufacturers, and Shippers* in the U.K.¹

Kenneth L. Simons (2002) compares 18 competitive-level manufacturing industries in the U.S. and the U.K. (the two countries for which data collection was feasible) to analyze a range of industry outcomes. This is apparently the first such many-industry, multinational study of dynamics in the number of firms. It turns out that not only do industries have Bain and Pryor's common eventual concentration levels, but moreover they evolve through similar processes across both nations. Some but not all of the industries studied experienced severe shakeouts in their numbers of producers in the U.S. and the U.K. Using as a measure of severity of shakeout the percentage drop in number of firms from peak to eventual low over a common time period, a high and statistically significant correlation results in the severity of shakeouts in the U.S. and the U.K. The date of (or elapsed time until) the peak number of firms is also highly and significantly correlated. Thus, industries that ended up concentrated among a few producers in the U.S. ended up similarly concentrated in the U.K., and *vice versa*, and competitive processes played out on similar time scales in both nations.

Moreover a typology of most industries seems to be possible by classifying industries according to their degree of shakeout. Among the 18 industries, those with severe shakeouts experienced a dramatic decline in entry and an early-entry advantage manifested through low exit rates relative to later entrants. Industries with little or no shakeout, in contrast, experienced little or no drop in entry and little or no early-entry advantage. The evidence on the 18 industries therefore suggests that competitive processes generally fall along a spectrum from severe shakeout to no shakeout, and that in each case similar processes are at work regarding firm entry

and exit. Furthermore, patent data that pertain to technology specific to the product area (as opposed to technology more likely to pertain to new products) show extensive patenting dominated by early entrants in industries with substantial shakeouts, consistent with technological opportunity causing the early-entry advantage.

II. Television Manufacture²

To illustrate the findings in an industry at one extreme of the spectrum, consider the television receiver industry. Television manufacture began to take off in the 1930s in the U.K. and at the start of the 1940s in the U.S., but substantial production was delayed until after World War II. The number of television manufacturers in both countries began to rise thereafter as many firms began production. Figure 1 shows the changing number of manufacturers in the two countries. In the U.S. the number of manufacturers rose from 31 in 1947 to a peak of 92 in 1951, but then began to drop almost as rapidly. In the U.K. the number of manufacturers grew from 9 in 1947 to a peak of 36 in 1956 and 1957, and similarly plummeted.

The drop in the number of firms in the U.S. coincides with a leveling-off of sales, while in the U.K. sales grew rapidly through 1959, two years after the shakeout began. In both countries, the number of firms continued to fall despite demand growth that yielded greater unit sales in the 1970s and 1980s. Market saturation presumably enhanced competition, but more than demand change caused the contraction of the number of firms.

A. Equivalent Competitive Processes

In both nations the number of firms rose and declined in an almost identical pattern, with the U.S. drop-off some six years ahead of the U.K. The percentage drop in number of firms was nearly identical in the two countries, 88% and 87%. An initial period of high entry preceded

much-reduced entry in both countries: in 1948 through 1951 or 1957 in the U.S. or U.K. respectively entry averaged 28.3 or 4.6 firms per year, but subsequently entry fell to 5.0 or 0.4 per year in the next five years and 1.0 or 0.9 per year thereafter through 1989.³ Exit rates among U.S. manufacturers averaged 11.2% per year in 1948-1950, 13.7% in 1951-55 (the initial five years of the shakeout), 10.2% in 1956-60, 10.4% in 1961-70, and 6.5% in 1971-88 (unweighted averages). Among U.K. manufacturers exit rates averaged 9.4% in 1947-51, 6.6% in 1952-56, 8.2% in 1957-61 (the initial five years of the shakeout), 12.2% in 1962-66, 8.2% in 1967-76, and 14.3% in 1977-88. These figures imply that in both countries reduced entry combined with continued exit was primarily responsible for the decline in the number of firms; variation in exit rates had relatively little impact.⁴

In both nations early entrants exited relatively infrequently. The median firm entered in 1949 in the U.S. and 1953 in the U.K. Firms entering in this year or later had an exit rate 1.67 or 1.93 times that of earlier entrants, in the U.S. or U.K. respectively, over the years 1948 through 1989. This late entry disadvantage is statistically significant at the .01 level (two-tailed) in exponential hazard regressions.⁵

In both nations firms made large improvements in productivity and product quality. In the U.S., labor productivity in radio and television manufacture combined grew about 5% per year from 1958 through 1980, with television prices declining similarly, and in the U.K. the real price of color televisions fell fairly steadily about 8% per year from 1968 through 1981. Televisions steadily gained reliability (in early years repairs had to be made every few months), plus product features such as improved picture tubes and sound systems, automated and improved tuning, and remote controls.

Process and product improvements were competitively important and were dominated by the leading manufacturers. For the U.S., Steven Klepper and Simons (1997) show that leading, early-entering firms dominated both product and process innovations. For the U.K., patent records show that noted early entrants dominated patenting, led by the firms Marconi E.M.I., Pye, Baird, Murphy, and Mullard. Both country's producers eventually succumbed to foreign firms, which were first to heavily use integrated circuits and remained 1-2 generations ahead in this technology, resulting in fewer set breakdowns and more efficient production.

B. Mode of Technological Competition

A U.K. committee set up in 1943 urged enactment of a 405-line screen standard, which it was hoped would establish a *de facto* worldwide standard and aid U.K. firms' exports. The U.K. enacted this standard, but other nations proceeded to adopt standards with greater resolutions. The U.K. broadcast standard remained anomalous through 1964, when some U.K. broadcasts began using the internationally common PAL 625-line color standard. Hence through 1964 and longer, many of the electronic circuits in U.K. televisions differed from those used in other nations. This helped isolate the U.K. market from import competition, which became significant in the early 1960s in the U.S. but not until 1970 in the U.K.

The establishment of a dominant product design, color broadcast standards combined with the 21-inch picture tube, has been blamed for the industry's shakeout (James Utterback and Fernando Suárez, 1993). Firms that took advantage of the standard design were deemed better able to compete. This explanation seems to be incorrect. U.S. color broadcast standards were approved by the Federal Communications Commission in 1953, just after the shakeout began, and leading firms invested in color set production, but color sales failed to materialize until the 1960s. In the U.K. color broadcasts began seven years after the shakeout started. In both nations

screen sizes other than 21 inches were always common, and the 21-inch size did not remain a dominant standard.

The implementation of any one technology does not seem to have triggered the industry's shakeout. Technological analyses such as Arnold (1985) and Klepper and Simons (1997) failed to uncover an exceptional technological change at the times of the shakeouts. Moreover, if a radical technology was so important that U.S. firms had to successfully adopt it or die in the mid-1950s, surely U.K. firms would have scrambled to adopt the technology, but the U.K. shakeout did not begin until six years later.

Instead, technology mattered to competition in another way. Firms had to keep up with the technological frontier to remain competitive, and this required large research and engineering budgets. The literature suggests that only firms with large output chose to make such expenditures, for only they could expect to sell enough units to reap a substantial return from their investments. This seemingly propelled a rich-get-richer mechanism in which a few early entrants grew large and dominated both innovation and market share.

III. Causes of Competitive Dynamics

Industries with shakeouts are somewhat well understood, but why does entry decline only slightly or not at all in industries with little or no shakeout? In these industries late-entering firms do not suffer a competitive disadvantage. With little opportunity for technological improvement, or if relevant research and engineering outputs can readily be licensed and sold to other firms, there is no requirement for within-firm innovation. Persistent continued entry might then be explained, despite profit margins already driven down by entry, by sufficient market growth or by incumbent firms frequently exiting to pursue alternative market opportunities.

Alternatively, a late-entrant advantage or some other process yet to be uncovered could yield continued entry.

Whatever the reasons, a spectrum or dichotomy of industry dynamics seemingly applies to most industries. This remarkable finding cannot be dismissed on the basis of minimal attention to firm size or concentration, for the limited attention is due merely to limited available data, and robust and meaningful industry processes related to size and concentration have been uncovered. Nor can industry dynamics be dismissed as a minor research topic, for static outcomes result through dynamic processes, and we must uncover how industry outcomes result. If researchers can determine with greater certainty what underlying industry traits most frequently cause different processes of industry dynamics, we might predict industry outcomes *a priori* with some accuracy, as well as design more appropriate corporate and national policy.

REFERENCES

- Arnold, Erik.** Competition and technological change in the television industry: An empirical evaluation of theories of the firm. London: Macmillan, 1985.
- Bain, Joe S.** International differences in industrial structure. New Haven: Yale University Press, 1966.
- Klepper, Steven and Simons, Kenneth L.** “Technological Extinctions of Industrial Firms: An Enquiry into their Nature and Causes.” Industrial and Corporate Change, March 1997, 6(2), pp. 379-460
- _____. “Dominance by Birthright: Entry of Prior Radio Producers and Competitive Ramifications in the U.S. Television Receiver Industry.” Strategic Management Journal, October-November 2000, 21(10-11), pp. 997-1016.
- Pryor, Frederic L.** “An International Comparison of Concentration Ratios.” Review of Economics and Statistics, May 1972, 54(2), pp. 130-40.
- Schmalensee, Richard.** “Inter-Industry Studies of Structure and Performance,” in R. Schmalensee and R. Willig, eds., Handbook of Industrial Organization, vol. 2. Amsterdam: Elsevier, 1989, pp. 951-1009.
- Shaked, Avner and Sutton, John.** “Product Differentiation and Industrial Structure.” Journal of Industrial Economics, December 1987, 36(2), pp. 131-46.
- Simons, Kenneth L.** “Product Market Characteristics and the Industry Life Cycle.” Unpublished manuscript, Royal Holloway, University of London, 2002.
- Utterback, James, and Fernando Suárez.** “Innovation, Competition, and Industry Structure.” Research Policy, 1993, 22, pp. 1-21.

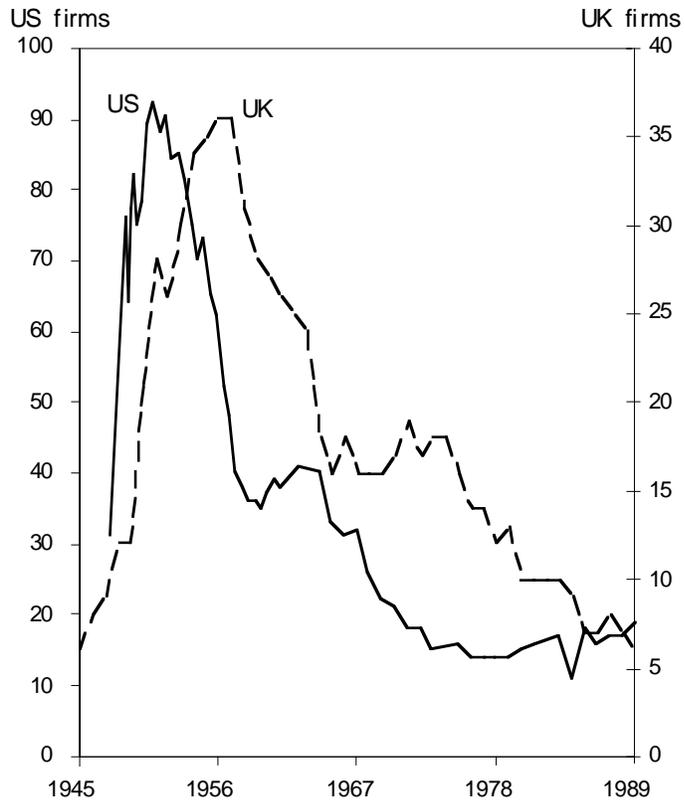


Figure 1. U.S. and U.K. Television Manufacturers, 1945-1989

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¹ For a deeper exploration of the U.S. data see Klepper and Simons (2000).

² Data sources for this section are available from the author's web page.

³ Moreover, among the few late entrants, many were overseas producers that established U.S. or U.K. production to avoid trade barriers.

⁴ In both countries the brief increase in number of firms during the middle of the shakeout occurred when color television sales took off.

⁵ Significant multiples of 1.58 and 1.71 likewise result in Cox regressions controlling for years of experience as a television manufacturer.