

Predictable Cross-Industry Heterogeneity in Industry Dynamics

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ABSTRACT. Technological change affects industry dynamics, by influencing whether an industry experiences a shakeout and attains a concentrated market structure. Decades-long competitive processes are similar for matched industries in different nations, indicating that competitive processes — not just eventual concentration levels — arise systematically from causes that might be traced. The television manufacturing industry in the United States and the United Kingdom is used to illustrate common processes at work.

Key words: industry evolution, shakeout, technological change, television receivers

JEL Classification: L10, O33, L63

Edwin Mansfield (1962) was one of the first researchers to link empirical facts on dynamics of small and large firms' entry, exit, growth, and mobility to underlying technological change. His subsequent work greatly improved understanding of decisions to conduct R&D, and of the spread of technology, among firms of differing size and nature. It is natural to return with the spirit of his methods and the wisdom of four decades' research to analyze the apparently central role of technology in the dynamics of industries.

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.

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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.

1. 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 (unpublished manuscript) 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.

2. 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