

Book Reviews

Zoltan J. Acs and David B. Audretsch, *Innovations and Small Firms*, Cambridge, MIT Press, 1990. ISBN 0-262-01113-1.

As someone who enjoys theory over data gathering, I seldom read a book about statistical trends from cover to cover. If I were going to read a book of that genre, I would like it to be comprehensive in scope. This is just such a book.

The book not only analyzes the statistical relationships between innovation and firm size (Chapter 3), but it also deals with other characteristics of small firms, including an explanation of why small firms dominate in some industries (Chapter 4), why market entry and innovation are (sometimes) associated (Chapter 5), and how flexible technology affects the size distribution of firms (Chapter 6). A final chapter speculates about intra-industry dynamics (Chapter 7). All this is preceded by a detailed discussion of strengths and weaknesses of the data used (Chapter 2). The review of existing theories that precedes the empirical work provides possible leads about the causal connections that can be tested. Some of the reviews are quite extensive particularly those about the entry and entry deterrence theories of competitive behavior (Chapter 5).

Overall, this book offers a most extensive empirical snapshot of small firms in U.S. industry in 1982. The main theme of the book is that the small firms are qualitatively different from large firms. This may seem trivial, except that authors go on to document how a small firm actually differs from a large one in respects other than merely the number of employees.

How much of what our common beliefs about small business are supported by the current data? This book provides some answers.

Let me turn to the most common belief about small business and whether any revision of our prior beliefs is required. First of all, we learn that, high market concentration has a negative effect on

large firms, but no effect on the innovative activities of small firms. In fact, innovation is greater when large firms are predominant in an industry. But, within an industry of a given size, small firms are more likely to be innovative than large ones. High innovative activity also seems to discourage the entry of small firms more than it discourages the entry of large firms. That is, high concentration is more accommodating to the entry of large firms while low concentration is more accommodating to small firms. As the authors point out, different behavior between firms of different sizes may be the cause of some of the inconsistencies among previous studies of the relationship between concentration and innovation.

I found the discussion about the effects of recent innovations in production technology interesting and informative. Besides the data and the empirical analyses, the technical explanation of the new, flexible-production technology is quite good. Although many of us may vaguely know what flexible-production is, very few of us know exactly what machines constitute the flexible-production system and what each machine does. This book explains what the machines do and what they are like.

The expression, "flexible-production system," seems to imply that even a small firm may produce as many varieties as large firms, thus leading to the conclusion that this technology benefits small firms (relatively) more than it benefits large firms. However, the knowledge of what constitutes a flexible-production system, along with the price of each component (also given in the book) suggests that it is expensive for small firms to take advantage of this new technology. This hypothesis is tested and not rejected.

Essentially, two sets of data are employed by this study: one of innovation activity and the other of the size distributions of firms. Both sets are from the U.S. Small Business Administration. I found the innovation data particularly interesting.

Innovations are identified by consulting industrial trade journals. The authors check for bias by comparing the trade journalists' listing of important innovations to other lists of innovations. They also compare the number of innovations to the number of patents for each industry.

In Chapter 3, the effect of market structure upon innovation is examined. Market structure is defined to mean industry concentration and firm size. The first topic is the well-known Schumpeterian hypothesis. The authors reject this hypothesis. They find that concentration has a negative effect upon innovative activity. The relationship of firm size to innovativeness is found to depend on other features of each industry. High capital intensity, high market concentration, high unionization are circumstances under which large firms are more innovative than small firms. In industries that are innovative compared to other industries small firms are more innovative than large firms. This result maybe explained, as the authors suggest, namely, that small firms are the innovative leaders in young industries.

Chapter 4 pinpoints exactly what factors cause an industry to be composed of predominantly small firms. Naturally, there are industries in which small firms are negligible, and they are not subject to these forces, at least in the same way. For instance, in the cigarette industry, small firms account for only 0.03 percent of industry sales. On the other hand, in the fur goods industry, small firms account for 94.03 percent of total sales. So what is the source of such a difference?

Regression analysis shows that the following variables (separately) have a negative effect upon the presence of small firms: the minimum efficient scale, that is, the amount of capital, per unit of labor required; a need for high advertising and R&D expenditure; a high ratio of innovative activity between large and small firms. "Thus, while small firms are at a disadvantage in industries where scale economies play an important role, they can compensate for the size-inherent disadvantages by pursuing a strategy of innovation" (p. 75). The result is supported by evidence when "small" is defined as "under 100" employees in size and also when "small" is defined as "under 500" employed.

Chapter 5 offers an account of what explains the difference between "birth" of firms and the

"net entry" increase of firms in any given industry. The former is based on the amount of new employment generated by a new firm in the industry, which also allows for breakdown into large and small firm births. The latter is the traditional measurement used as a proxy for entry into a industry which is actually the net increase in the number of firms in the industry. The major shortcoming of the "net entry" approach for the purposes of this study is that it does not account for the size of new firms entering. Lack of adjustment for firm size will overstate or understate entry activity depending on what the distribution of firm size actually is.

The data provided on firm distribution among industries, gross entry and gross exit support the author's case. Based on the existing theories of entry and entry deterrence, several hypotheses for determinants of entry are tested. For firms of all sizes, prior industry growth is found to promote entry while advertising intensity deters entry. Lagged profit and capital intensity are (quite surprisingly) not significant at explaining entry. Also, a high concentration industry or high innovative activity in an industry deters the entry of small firms, but not of large firms.

The main hypothesis tested in Chapter 6 is that the new flexible-production technology is what has promoted small firms compared to large firms. The respective share of the total machines accounted for by a selected group of special machines regresses on "change over time in the share of sales accounted for by small firms." The list of special machines includes programmable robots, numerically controlled machines, mechanical presses, transfer or station-type machines and automatic assembly machines. One suspects that there is some correlation between these variables. The authors provide a correlation matrix and, to our surprise, there is little, if any, statistical correlation! The amount of skilled labor is included in the regression also. The regression result shows both the adoption of programmable robots and numerically controlled machines and the amount of skilled labor have positive effects on the relative increase of small firms. The effect of mechanical presses and automatic assembly machines is insignificant, as is that of transfer or station-type machines. (Interesting, the [insignificant] coefficient was negative). Thus, only some of

the new production technologies have been beneficial to small firms. The authors also show that these production technologies have had the effect of decreasing the mean establishment size.

Two questions relating to industry dynamics are addressed in Chapter 7. The first question is how firm size *determines* growth. The empirical evidence shows that this relationship varies from industry to industry. The second question is exactly what determines the "turbulence" of an industry. Turbulence refers to the combined effect of all dynamic changes in the industry. Specifically, "turbulence" as a measure is defined as the sum of (the absolute values of) employment expansion, employment contraction, births of firms and deaths of firms adjusted for size by employment. Thus, any activity of the industry has the effect of increasing this number. Empirical results show that, at a definite level of small firm innovation, greater innovative activity by small firms is associated with less turbulence. The same factor may have a different effect on turbulence within small firms than within large firms. For example, capital intensity has a positive association with turbulence in small firms while overall there seems to be little systematic relationship.

In the final chapter, the authors discuss the current trend of government policy towards industries in view of the findings presented in this book. They argue that, given the critical roles that small firms play in innovative activity, small firms should be promoted and not driven out. Unfortunately, the antitrust policy, or should we say, the weak enforcement of antitrust policy has changed the market in the other direction. Firms are larger, and markets are more concentrated. These characteristics are detrimental to innovation and to the birth of new firms.

The result on innovation and firm size calls to mind the theories of Arrow¹ and Holmstrom². They suggested that monitoring costs or information transmission costs are the source of how firm size determines the "type" of innovation to be undertaken. They argue that "traditional" innovations are easier to evaluate and are better suited for large organizations where information must be transmitted through many people. Small organizations have the comparative advantage in "novel" innovations where researchers have fewer people to convince about the importance of the innova-

tions. These theories do not explain, however, why small firms should be more innovative. Presumably there is a qualitative difference between innovations across industries. Perhaps that difference has been picked up by some other variables in the analysis which were found to be significant, such as advertising and R&D expenditures.

The innovation data is an improvement over what has been available in the past. Still better data would allow more theories to be tested. The Arrow-Holmstrom hypothesis could be tested if there were data on the "type" of innovation. Such improved data might also be useful in explaining the difference between the number of patents and the number of innovations. A different explanation of this difference is that it depends on whether the innovations in the industry are predominantly process or primarily product innovations. It could be that process innovations are not as publicized in trade journals as are product innovations. The actual motivation for patenting, however, may not differ very much between the two. One explanation as to why small firms are innovative is that innovativeness depends on the age of the firm, which opens the door to the question of dynamics. Could one test Winters³ entrepreneurial and routinized regimes hypothesis using time series or age of the firm data? Does the high level of innovative activity promote entry of small firms? Or does the observed level high of innovative activity reflect the entry of small firms which happen to be innovative for other reasons? One can only hope that Acs and Audretsch continue their study of these questions.

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Notes

¹ Arrow, Kenneth J., 1983, 'Innovation in Large and Small Firms,' in Joshua Ronen (ed.), *Entrepreneurship*, Lexington, MA: Lexington Books.

² Holstrom, Bengt, 1989, 'Agency Cost and Innovation,' *Journal of Economic Behavior and Organization* 12, 305–327.

³ Winter, Sidney G., 1984, 'Schumpeterian Competition in Alternative Technological Regimes,' *Journal of Economic Behavior and Organization* 5, 287–320.

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