Research Issues Relating to Structure, Competition, and Performance of Small Technology-Based Firms

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ABSTRACT. The role that small firms play in industrial organization has evolved considerably since the second world war. This paper seeks to document how and why small business plays a very different role in industrial organization research today than it did some three decades ago.

1. Introduction

The most important development in the field of industrial organization is a shift in the framework for analyzing small business. While there were always a few studies around analyzing small business through a dynamic lens, a much more profound and comprehensive shift in the literature began in the later 1980s and early 1990s. The most salient characteristic feature of this literature was the introduction of a dynamic or evolutionary framework.

In the second section of this paper, the view of small business emerging from the static framework of the post-war industrial organization is described. This view identifies small business as being sub-optimal in terms of scale of production. The resulting impact on performance is negative, in terms of productivity and wages. The policy implication is that, at least in terms of economic efficiency, small business exerts a drag on economic welfare.

In the third section of the paper, the view of small business emerging from the dynamic framework of the last decade is introduced. This view provides a striking contrast to the role and contribution of small business. When viewed through the lens of a dynamic framework, small businesses are seen as an *agent of change*. The empirical evidence supporting this dynamic view of small business is presented in the fourth section. The implications for public policy towards business are presented in the fifth section. In particular, we find that the role of public policy towards business has shifted from constraining the power of large corporations to enabling the creation and commercialization of knowledge, particularly by small business. A summary and conclusions are provided in the final section.

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2. Small business in industrial organization: the static view

In linking entrepreneurship to economic growth, the obvious starting point is the theory of the firm. The field of economics that focuses the most on links between the organization of firms in industries and the resulting economic performance has been industrial organization. The ascendancy of industrial organization in the post-war period as an important and valued field economics came from the recognition not only by scholars but also by policy makers that industrial organization matters. The widespread fear vis-à-vis the Soviet Union pervasive throughout the United States at the end of the 1950s and early 1960s was not just that the Soviets might bury the Americans because they were the first into space with the launching of the *Sputnik*, but that the superior organization of industry facilitated by centralized planning was generating greater rates of growth in the Soviet Union. After all, the nations of Eastern Europe, and the Soviet Union in particular, had a "luxury" inherent in their systems of centralized planning -

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a concentration of economic assets on a scale beyond anything imaginable in the West, where the commitment to democracy seemingly imposed a concomitant commitment to economic decentralization.

Although there may have been considerable debate about what to do about the perceived Soviet threat some three decades ago, there was little doubt at that time that the manner in which enterprises and entire industries were organized mattered. And even more striking, when one reviews the literature of the day, there seemed to be near unanimity about the way in which industrial organization mattered. It is no doubt an irony of history that a remarkably similar version of the giantism embedded in Soviet doctrine, fueled by the writings of Marx and ultimately implemented by the iron fist of Stalin, was also prevalent throughout the West. This was the era of mass production when economies of scale seemed to be the decisive factor in dictating efficiency. This was the world the world so colorfully described by John Kenneth Galbraith (1956) in his theory of counterveiling power, in which the power of big business was held in check by big labor and by big government.

It became the task of the industrial organization scholars to sort out the issues involving this perceived trade-off between economic efficiency on the one hand and political and economic decentralization on the other. The scholars of industrial organization responded by producing a massive literature focusing on essentially three issues: (i)What are the economic gains to size and large-scale production? (ii) What are the economic welfare implications of having an oligopolistic market structure, i.e. is economic performance promoted or reduced in an industry with just a handful of large-scale firms? and (iii) Given the overwhelming evidence from (ii) that large-scale production resulting in economic concentration is associated with increased efficiency, what are the public policy implications?

A fundamental characteristic of the industrial organization literature was not only that it was obsessed with the oligopoly question but that it was essentially static in nature. There was considerable concern about what to do about the existing firms and industrial structure, but little attention was paid to where they came from and where they were going. Oliver Williamson's classic 1968 article in the *American Economic Review*, "Economies as an Antitrust Defense: The Welfare Tradeoffs," became something of a final statement demonstrating this seemingly inevitable tradeoff between the gains in productive efficiency that could be obtained through increased concentration and gains in terms of competition that could be achieved through decentralizing economic policies, such as antitrust. But it did not seem possible to have both, certainly not in Williamson's completely static model.

One of the most striking findings emerging in this static view of industrial organization is that small firms generally operate at a level of output that is too small to sufficiently exhaust scale economies, even when the standard definition of a small firm employing fewer than 500 employees is applied. A large number of studies found that because the minimum efficient scale (MES) of output, or the lowest level of output where the minimum average cost is attained, large-scale production is typically required to exhaust scale economies in manufacturing. Any enterprise or establishment that was smaller than required by the MES was branded as being *suboptimal* or inefficient, in that it produced at average costs in excess of more efficient larger firms. Weiss (Audretsch and Yamawaki, 1991, p. 403) assumed that "The term 'suboptimal' capacity describes a condition in which some plants are too small to be efficient".

The importance of scale economies in the typical manufacturing industry relegated most small firms to being classified as suboptimal. For example, Weiss (1964) found that suboptimal plants accounted for about 52.8 percent of industry value-off-shipments, Scherer (1973) found that 58.2 percent of value-of-shipments emanated from the suboptimal plants in twelve industries, and Pratten (1971) identified the suboptimal scale establishments accounting for 47.9 percent of industry shipments. After reviewing the literature on the extent of suboptimal firms, Weiss (in Audretsch and Yamawaki, 1991, p. xiv) concluded that, "In most industries the great majority of firms is suboptimal. In a typical industry there are, let's say, one hundred firms. Typically only about five to ten of them will be operating at the MES level of output, or anything like it."

What are the economic welfare implications? Weiss (1979, p. 1137) argued that the existence of small firms which are sub-optimal represented a loss in economic efficiency and therefore advocated any public policy which ". . . creates social gains in the form of less sub-optimal capacity." This actually translated into an ingenuious argument against market power, since empirical evidence suggested that the price umbrella provided by monopoly power encouraged the existence of suboptimal capacity firms. Weiss (1979) went so far as to argue that the largest inefficiency associated with market power was not the higher prices charged to consumers but rather that it facilitated the existence of sub-optimal scale small firms.

Wages and productivity would be expected to reflect the degree to which small firms are less efficient than their larger counterparts. There is a large body of empirical evidence spanning a broad range of samples, time periods and even countries that has consistently found wages (and non-wage compensation as well) to be positively related to firm size. Probably the most cited study is that of Brown, Hamilton and Medoff (1990, pp. 88–89), who conclude that, "Workers in large firms earn higher wages, and this fact cannot be explained completely by differences in labor quality industry, working conditions, or union status. Workers in large firms enjoy better benefits and greater security than their counterparts in small firms. When these factors are added together, it appears that workers in large firms do have a superior employment package."

Seen through the static lens provided through traditional industrial organization and labor economics the economic welfare implications of the recent shift in economic activity away from large firms and towards small enterprises is unequivocal – overall economic welfare is decreased since productivity and wages will be lower in small than in large firms. As Weiss (1979) argued in terms of efficiency and Brown, Hamilton and Medoff (1990) in terms of employee compensation, the implication for public policy is to implement policies to shift economic activity away from small firms and towards larger enterprises.

3. Small firms in industrial organization: the dynamic view

Coase (1937) was awarded a Nobel Prize for explaining why a firm should exist. But why should more than one firm exist in an industry? One answer is provided by the traditional economics literature focusing on industrial organization. An excess level of profitability induces entry into the industry. And this is why the entry of new firms is interesting and important – because the new firms provide an equilibrating function in the market, in that the levels of price and profit are restored to the competitive levels. The new firms are about business as usual – they simply equilibrate the market by providing more of it.

An alternative explanation for the entry of new firms was provided for by Audretsch (1995), who suggests that new firms are not founded to be smaller clones of the larger incumbents but rather to serve as *agents of change* through innovative activity.

The starting most for most theories of innovation is the firm. In such theories the firms are exogenous and their performance in generating technological change is endogenous. For example, in the most prevalent model found in the literature of technological change, the model of the *knowledge production function*, formalized by Zvi Griliches (1979), firms exist exogenously and then engage in the pursuit of new economic knowledge as an input into the process of generating innovative activity.

The most decisive input in the knowledge production function is new economic knowledge. And as Cohen and Klepper (1991 and 1992) conclude, the greatest source generating new economic knowledge is generally considered to be R&D. Certainly a large body of empirical work has found a strong and positive relationship between knowledge inputs, such as R&D, on the one hand, and innovative outputs on the other hand.

The knowledge production function has been found to hold most strongly at broader levels of aggregation. The most innovative countries are those with the greatest investments to R&D. Little innovative output is associated with less developed countries, which are characterized by a paucity of production of new economic knowledge. Similarly, the most innovative industries, also tend

to be characterized by considerable investments in R&D and new economic knowledge. Not only are industries such as computers, pharmaceuticals and instruments high in R&D inputs that generate new economic knowledge, but also in terms of innovative outputs (Audretsch, 1995). By contrast, industries with little R&D, such as wood products, textiles and paper, also tend to produce only a negligible amount of innovative output. Thus, the knowledge production model linking knowledge generating inputs to outputs certainly holds at the more aggregated levels of economic activity.

Where the relationship becomes less compelling is at the disaggregated microeconomic level of the enterprise, establishment, or even line of business. For example, While Acs and Audretsch (1990) found that the simple correlation between R&D inputs and innovative output was 0.84 for four-digit standard industrial classification (SIC) manufacturing industries in the United States, it was only about half, 0.40 among the largest U.S. corporations.

The model of the knowledge production function becomes even less compelling in view of the recent wave of studies revealing that small enterprises serve as the engine of innovative activity in certain industries. These results are startling, because as Scherer (1991) observes, the bulk of industrial R&D is undertaken in the largest corporations; small enterprises account only for a minor share of R&D inputs. Thus the knowledge production function seemingly implies that, as the *Schumpeterian Hypothesis* predicts, innovative activity favors those organizations with access to knowledge-producing inputs – the large incumbent organization. The more recent evidence identifying the strong innovative activity raises the question, "Where do new and small firms get the innovation producing inputs, that is the knowledge?"

One answer, proposed by Audretsch (1995), is that, although the model of the knowledge production function may still be valid, the implicitly assumed unit of observation – at the level of the firm – may be less valid. The reason why the knowledge production function holds more closely for more aggregated degrees of observation may be that investment in R&D and other sources of new knowledge spills over for economic exploitation by third-party firms.

A large literature has emerged focusing on what has become known as the *appropriability problem*. The underlying issue revolves around how firms which invest in the creation of new economic knowledge can best appropriate the economic returns from that knowledge (Arrow, 1962). Audretsch (1995) proposes shifting the unit of observation away from exogenously assumed firms to individuals – agents with endowments of new economic knowledge. As J. de V. Graaf observed nearly four decades ago, "When we try to construct a transformation function for society as a whole from those facing the individual firms comprising it, a fundamental difficulty confronts us. There is, from a welfare point of view, nothing special about the firms actually existing in an economy at a given moment of time. The firm is in no sense a 'natural unit'. Only the individual members of the economy can lay claim to that distinction. All are potential entrepreneurs. It seems, therefore, that the natural thing to do is to build up from the transformation function of men, rather than the firms, constituting an economy. If we are interested in eventual empirical determination, this is extremely inconvenient. But it has conceptual advantages. The ultimate repositories of technological knowledge in any society are the men comprising it, and it is just this knowledge which is effectively summarized in the form of a transformation function. In itself a firm possesses no knowledge. That which is available to it belongs to the men associated with it. Its production function is really built up in exactly the same way, and from the same basic ingredients, as society's."

But when the lens is shifted away from focusing upon the firm as the relevant unit of observation to individuals, the relevant question becomes, *How can economic agents with a given endowment of new knowledge best appropriate the returns from that knowledge?*

The appropriability problem confronting the individual may converge with that confronting the firm. Economic agents can and do work for firms, and even if they do not, they can potentially be employed by an incumbent firm. In fact, in a model of perfect information with no agency costs, any positive economies of scale or scope will ensure that the appropriability problems of the firm and individual converge. If an agent has an

idea for doing something different than is currently being practiced by the incumbent enterprises – both in terms of a new product or process and in terms of organization – the idea, which can be termed as an innovation, will be presented to the incumbent enterprise. Because of the assumption of perfect knowledge, both the firm and the agent would agree upon the expected value of the innovation. But to the degree that any economies of scale or scope exist, the expected value of implementing the innovation within the incumbent enterprise will exceed that of taking the innovation outside of the incumbent firm to start a new enterprise. Thus, the incumbent firm and the inventor of the idea would be expected to reach a bargain splitting the value added to the firm contributed by the innovation. The payment to the inventor – either in terms of a higher wage or some other means of remuneration – would be bounded between the expected value of the innovation if it implemented by the incumbent enterprise on the upper end, and by the return that the agent could expect to earn if he used it to launch a new enterprise on the lower end. Or, as Frank Knight (1921, p. 273) observed more than seventy years ago, "The laborer asks what he thinks the entrepreneur will be able to pay, and in any case will not accept less than he can get from some other entrepreneur, or by turning entrepreneur himself. In the same way the entrepreneur offers to any laborer what he thinks he must in order to secure his services, and in any case not more than he thinks the laborer will actually be worth to him, keeping in mind what he can get by turning laborer himself."

Thus, each economic agent would choose how to best appropriate the value of his endowment of economic knowledge by comparing the wage he would earn if he remains employed by an incumbent enterprise, *w*, to the expected net present discounted value of the profits accruing from starting a new firm, π. If these two values are relatively close, the probability that he would choose to appropriate the value of his knowledge through an external mechanism such as starting a new firm, Pr(e), would be relatively low. On the other hand, as the gap between *w* and π becomes larger, the likelihood of an agent choosing to appropriate the value of his knowledge externally through starting a new enterprise becomes greater, or

$$\Pr(e) = f(\pi - w). \quad (1)$$

This model analyzing the decision of how best to appropriate the value of new economic knowledge confronting an individual economic agent seems useful when considering the actual decision to a new firm taken by entrepreneurs. For example, Chester Carlsson started Xerox after his proposal to produce a (new) copy machine was rejected by Kodak. Kodak based its decision on the premise that the new copy machine would not earn very much money, and in any case, Kodak was in a different line of business – photography. It is perhaps no small irony that this same entrepreneurial startup, Xerox, decades later turned down a proposal from Steven Jobs to produce and market a personal computer, because they did not think that a personal computer would sell, and, in any case, they were in a different line of business – copy machines (Carrol, 1993). After seventeen other companies turned down Jobs for virtually identical reasons, including IBM and Hewlett Packard, Jobs resorted to starting his own company, Apple computer.

Similarly, IBM turned down an offer from Bill Gates, "the chance to buy ten percent of Microsoft for a song in 1986, a missed opportunity that would cost $3 billion today." IBM reached its decision on the grounds that "neither Gates nor any of his band of thirty some employees had anything approaching the credentials or personal characteristics required to work at IBM."

Divergences in beliefs with respect to the value of a new idea need not be restricted to what is formally known as a product or even a process innovation. Rather, the fact that economic agents choose to start a new firm due to divergences in the expected value of an idea applies to the sphere of managerial style and organization as well. One of the most vivid examples involves Bob Noyce, who founded Intel. Noyce had been employed by Fairchild Semiconductor, which is credited with being the pioneering semiconductor firm. In 1957 Noyce and seven other engineers quit *en masse* from Schockley Semiconductor to form Fairchild Semiconductor, an enterprise that in turn is considered the start of what is today known as *Silicon Valley*. Although Fairchild Semiconductor had "possibly the most potent management and technical team ever assembled" (Gilder, 1989,

p. 89), "Noyce couldn't get Fairchild's eastern owners to accept the idea that stock options should be part of compensation for all employees, not just for management. He wanted to tie everyone, from janitors to bosses, into the overall success of the company . . . This management style still sets the standard for every computer, software, and semiconductor company in the Valley today . . . Every CEO still wants to think that the place is run the way Bob Noyce would have run it" (Cringley, 1993, p. 39). That is, Noyce's vision of a firm excluded the dress codes, reserved parking places, closed offices, and executive dining rooms, along with the other trappings of status that were standard in virtually every hierarchical and bureaucratic U.S. corporation. But when he tried to impress this vision upon the owners of Fairchild Semiconductor, he was flatly rejected. The formation of Intel in 1968 was the ultimate result of the divergence in beliefs about how to organize and manage the firm.

The key development at Intel was the microprocessor. When long time IBM employee Ted Hoff approached IBM and later DEC with his new microprocessor in the late 1960s, "IBM and DEC decided there was no market. They could not imagine why anyone would need or want a small computer; if people wanted to usecomputer, they could hook into time-sharing systems" (Palfreman and Swade, 1991, p. 108).

The model proposed by Audretsch (1995) refocuses the unit of observation away from firms deciding whether to increase their output from a level of zero to some positive amount in a new industry, to individual agents in possession of new knowledge that, due to uncertainty, may or may not have some positive economic value. It is the uncertainty inherent in new economic knowledge, combined with asymmetries between the agent possessing that knowledge and the decision making vertical hierarchy of the incumbent organization with respect to its expected value that potentially leads to a gap between the valuation of that knowledge.

How the economic agent chooses to appropriate the value of his knowledge, that is either within an incumbent firm or by starting or joining a new enterprise will be shaped by the knowledge conditions underlying the industry. Under the routinized technological regime the agent will tend to appropriate the value of his new ideas within the boundaries of incumbent firms. Thus, the propensity for new firms to be started should be relatively low in industries characterized by the routinized technological regime.

By contrast, under the entrepreneurial regime the agent will tend to appropriate the value of his new ideas outside of the boundaries of incumbent firms by starting a new enterprise. Thus, the propensity for new firms to enter should be relatively high in industries characterized by the entrepreneurial regime.

Audretsch (1995) suggests that divergences in the expected value regarding new knowledge will, under certain conditions, lead an agent to exercise what Albert O. Hirschman (1970) has termed as *exit* rather than *voice*, and depart from an incumbent enterprise to launch a new firm. But who is right, the departing agents or those agents remaining in the organizational decision making hierarchy who, by assigning the new idea a relatively low value, have effectively driven the agent with the potential innovation away? *Ex post* the answer may not be too difficult. But given the uncertainty inherent in new knowledge, the answer is anything but trivial *a priori*.

Thus, when a new firm is launched, its prospects are shrouded in uncertainty. If the new firm is built around a new idea, i.e., potential innovation, it is uncertain whether there is sufficient demand for the new idea or if some competitor will have the same or even a superior idea. Even if the new firm is formed to be an exact replica of a successful incumbent enterprise, it is uncertain whether sufficient demand for a new clone, or even for the existing incumbent, will prevail in the future. Tastes can change, and new ideas emerging from other firms will certainty influence those tastes.

Finally, an additional layer of uncertainty pervades a new enterprise. It is not known how competent the new firm really is, in terms of management, organization, and workforce. At least incumbent enterprises know something about their underlying competencies from past experience. Which is to say that a new enterprise is burdened with uncertainty as to whether it can produce and market the intended product as well as sell it. In both cases the degree of uncertainty will typically exceed that confronting incumbent enterprises.

This initial condition of not just uncertainty, but greater degree of uncertainty vis-à-vis incumbent enterprises in the industry is captured in the theory of firm selection and industry evolution proposed by Boyan Jovanovic (1982). Jovanovic presents a model in which the new firms, which he terms *entrepreneurs*, face costs that are not only random but also differ across firms. A central feature of the model is that a new firm does not know what its cost function is, that is its relative efficiency, but rather discovers this through the process of learning from its actual post-entry performance. In particular, Jovanovic (1982) assumes that entrepreneurs are unsure about their ability to manage a new-firm startup and therefore their prospects for success. Although entrepreneurs may launch a new firm based on a vague sense of expected post-entry performance, they only discover their true ability – in terms of managerial competence and of having based the firm on an idea that is viable on the market – once their business is established. Those entrepreneurs who discover that their ability exceeds their expectations expand the scale of their business, whereas those discovering that their post-entry performance is less than commensurate with their expectations will contact the scale of output and possibly exit from the industry. Thus, Jovanovic's model is a theory of *noisy selection*, where efficient firms grow and survive and inefficient firms decline and fail.

The role of learning in the selection process has been the subject of considerable debate. On the one hand is what has been referred to as the *Larackian* assumption that learning refers to adaptations made by the new enterprise. In this sense, those new firms that are the most flexible and adaptable will be the most successful in adjusting to whatever the demands of the market are. As Nelson and Winter (1982, p. 11) point out, "Many kinds of organizations commit resources to learning; organizations seek to copy the forms of their most successful competitors."

On the other hand is the interpretation that the role of learning is restricted to discovering if the firm has the *right stuff* in terms of the goods it is producing as well as the way they are being produced. Under this interpretation the new enterprise is not necessarily able to adapt or adjust to market conditions, but receives information based on its market performance with respect to its *fitness* in terms of meeting demand most efficiently vis-à-vis rivals. The theory of organizational ecology proposed by Michael T. Hannan and John Freeman (1989) most pointedly adheres to the notion that, "We assume that individual organizations are characterized by relative inertia in structure." That is, firms learn not in the sense that they adjust their actions as reflected by their fundamental identity and purpose, but in the sense of their perception. What is then learned is whether or not the firm has the right stuff, but not how to change that stuff.

The theory of firm selection is particularly appealing in view of the rather startling size of most new firms. For example, the mean size of more than 11,000 new-firm startups in the manufacturing sector in the United States was found to be fewer than eight workers per firm (Audretsch, 1995). While the minimum efficient scale (MES) varies substantially across industries, and even to some degree across various product classes within any given industry, the observed size of most new firms is sufficiently small to ensure that the bulk of new firms will be operating at a suboptimal scale of output. Why would an entrepreneur start a new firm that would immediately be confronted by scale disadvantages?

An implication of the theory of firm selection is that new firms may begin at a small, even suboptimal, scale of output, and then if merited by subsequent performance expand. Those new firms that are successful will grow, whereas those that are not successful will remain small and may ultimately be forced to exit from the industry if they are operating at a suboptimal scale of output.

Subsequent to entering an industry, an entrepreneur must decide whether to maintain its output expand, contract, or exit. Two different strands of literature have identified several major influences shaping the decision to exit an industry. The first, and most obvious strand of literature suggests that the probability of a business exiting will tend to increase as the gap between its level of output and the minimum efficient scale (MES) level of output increases. The second strand of literature points to the role that the technological environment plays in shaping the decision to exit. As Dosi (1988) and Arrow (1962) argue, an environment characterized by more frequent innovation may also be associated with a greater amount of uncertainty

regarding not only the technical nature of the product but also the demand for that product. As technological uncertainty increases, particularly under the entrepreneurial regime, the likelihood that the business will be able to produce a viable product and ultimately be able to survive decreases.

An important implication of the dynamic process of firm selection and industry evolution is that new firms are more likely to be operating at a suboptimal scale of output if the underlying technological conditions are such that there is a greater chance of making an innovation, that is under the entrepreneurial regime. If new firms successfully learn and adapt, or are just plain lucky, they grow into viably sized enterprises. If not, they stagnate and may ultimately exit from the industry. This suggests, that entry and the startup of new firms may not be greatly deterred in the presence of scale economies. As long as entrepreneurs perceive that there is some prospect for growth and ultimately survival, such entry will occur. Thus, in industries where the MES is high, it follows from the observed general small size of new-firm startups that the growth rate of the surviving firms would presumably be relatively high.

At the same time, those new firms not able to grow and attain the MES level of output would presumably be forced to exit from the industry, resulting in a relatively low likelihood of survival. In industries characterized by a low MES, neither the need for growth, nor the consequences of its absence are as severe, so that relatively lower growth rates but higher survival rates would be expected. Similarly, in industries where the probability of innovating is greater, more entrepreneurs may actually take a chance that they will succeed by growing into a viably sized enterprise. In such industries, one would expect that the growth of successful enterprises would be greater, but that the likelihood of survival would be correspondingly lower.

4. The empirical evidence

Not only was the large corporation thought to have superior productive efficiency, but conventional wisdom also held the large corporation to serve as the engine of technological change and innovative activity. After all, Schumpeter (1942, p. 106), "What we have got to accept is that the large-scale establishment has come to be the most powerful engine of progress." A few years later, John Kenneth Galbraith (1956, p. 86) echoed Schumpeter's sentiment when he lamented, "There is no more pleasant fiction than that technological change is the product of the matchless ingenuity of the small man forced by competition to employ his wits to better his neighbor. Unhappily, it is a fiction."

Knowledge regarding both the determinants and the impact of technological change has been largely shaped by measurement. Measures of technological change have typically involved one of the three major aspects of the innovative process: (1) a measure of inputs into the process, such as R&D expenditures, or the share of the labor force accounted for by employees involved in R&D activities; (2) an intermediate output, such as the number of inventions that have been patented; or (3) a direct measure of innovative output.

The earliest sources of data, R&D measured, indicated that virtually all of the innovative activity was undertaken by large corporations. As patent measures became available, the general qualitative conclusions did not change, although it became clear that small firms were more involved with patent activity than with R&D. The development of direct measures of innovative activity, such as data bases measuring new product and process introductions in the market, indicated something quite different. In a series of studies, Acs and Audretsch (1987, 1988, 1990) found that while large firms in manufacturing introduced a slightly greater number of significant new innovations than small firms, small-firm employment was only about half as great as large-firm employment, yielding an average small-firm innovation rate in manufacturing of 0.309, compared to a large-firm innovation rate of 0.202. The relative innovative advantage of small and large firms was found to vary considerably across industries. In some industries, such as computers and process control instruments, small firms provide the engine of innovative activity. In other industries, such as pharmaceutical products and aircraft, large firms generate most of the innovative activity. Knowledge regarding both the determinants and the impact of technological change has been largely shaped by measurement.

Acs and Audretsch (1988, 1990) concluded that some industries are more conducive to small-firm innovation while others foster the innovative activity of large corporations corresponds to the notion of distinct technological regimes – the routinized and entrepreneurial technological regimes.

Empirical evidence in support of the traditional model of entry, which focuses on the role of excess profits as the major incentive to enter, has been ambiguous at best, leading Geroski (1991, p. 282) to conclude, "Right from the start, scholars have had some trouble in reconciling the stories told about entry in standard textbooks with the substance of what they have found in their data. Very few have emerged from their work feeling that they have answered half as many questions as they have raised, much less that they have answered most of the interesting ones."

Perhaps one reason for this trouble is the inherently static model used to capture an inherently dynamic process. Manfred Neumann (1993, pp. 593–594) has criticized this traditional model of entry, as found in the individual country studies contained in Geroski and Schwalbach (1991), because they "are predicated on the adoption of a basically static framework. It is assumed that startups enter a given market where they are facing incumbents which naturally try to fend off entry. Since the impact of entry on the performance of incumbents seems to be only slight, the question arises whether the costs of entry are worthwhile, given the high rate of exit associated with entry. Geroski appears to be rather skeptical about that. I submit that adopting a static framework is misleading . . . In fact, generally, an entrant can only hope to succeed if he employs either a new technology or offers a new product, or both. Just imitating incumbents is almost certainly doomed to failure. If the process of entry is looked upon from this perspective the high correlation between gross entry and exit reflects the inherent risks of innovating activities . . . Obviously it is rather difficult to break loose from the inherited mode of reasoning within the static framework. It is not without merit, to be sure, but it needs to be enlarged by putting it into a dynamic setting."

Still, one of the most startling results that have emerged in empirical studies is that entry by firms into an industry is apparently not substantially deterred or even deterred at all in capital-intensive industries in which scale economies play an important role (Audretsch, 1995). While studies have generally produced considerable ambiguity concerning the impact of scale economies and other measures traditionally thought to represent a *barrier to entry*, Audretsch (1995) found conclusive evidence linking the technological regime to startup activity. New-firm startup activity tends to be substantially more prevalent under the entrepreneurial regime, or where small enterprises account for the bulk of the innovative activity, than under the routinized regime, or where the large incumbent enterprises account for most of the innovative activity. These findings are consistent with the view that differences in beliefs about the expected value of new ideas are not constant across industries but rather depend on the knowledge conditions inherent in the underlying technological regime.

Geroski (1995) and Audretsch (1995) point out that one of the major conclusions from studies about entry is that the process of entry does not end with entry itself. Rather, it what happens to new firms subsequent to entering that sheds considerable light on industry dynamics. The early studies (Mansfield, 1962; Hall, 1987; Dunne, Roberts and Samuelson, 1989; Audretsch, 1991) established not only that the likelihood of a new entrant surviving is quite low, but that the likelihood of survival is positively related to firm size and age. More recently, a wave of studies have confirmed these findings for diverse countries, including Portugal (Mata et al., 1994; Mata, 1994), Germany (Wagner, 1994), and Canada (Baldwin and Gorecki, 1991; Baldwin, 1995; Baldwin and Rafiquzzaman, 1995).

Audretsch (1991), Audretsch and Mahmood (1995) shifted the relevant question away from *Why does the likelihood of survival vary systematically across firms? to Why does the propensity for firms to survive vary systematically across industries?* The answer to this question suggests that what had previously been considered to pose a barrier to entry may, in fact, constitute not an entry barrier but rather a barrier to survival. The answer to this questions suggests that what had previously been considered to pose a barrier to

entry may, in fact, constitute not an entry barrier but rather a barrier to survival.

What has become known as *Gibrat's Law*, or the assumption that growth rates are invariant to firm size, has been subject to numerous empirical tests. Studies linking firm size and age to growth have also produced a number of stylized facts (Wagner, 1992). For small and new firms there is substantial evidence suggesting that growth is negatively related to firm size and age (Hall, 1987; Wagner, 1992, 1994; Mata, 1993; Audretsch, 1995). However, for larger firms, particularly those having attained the minimum efficient scale (MES) level of output, the evidence suggests that firm growth is unrelated to size and age.

An important finding of Audretsch (1991, 1995) and Audretsch and Mahmood (1995) is that although entry may still occur in industries characterized by a high degree of scale economies, the likelihood of survival is considerably less. People will start new firms in an attempt to appropriate the expected value of their new ideas, or potential innovations, particularly under the entrepreneurial regime. As entrepreneurs gain experience in the market they learn in at least two ways. First, they discover whether they possess *the right stuff*, in terms of producing goods and offering services for which sufficient demand exists, as well as whether they can product that good more efficiently than their rivals. Second, they learn whether they can adapt to market conditions as well as to strategies engaged in by rival firms. In terms of the first type of learning, entrepreneurs who discover that they have a viable firm will tend to expand and ultimately survive. But what about those entrepreneurs who discover that they are either not efficient or not offering a product for which their is a viable demand? The answer is, *It depends – on the extent of scale economies as well as on conditions of demand*. The consequences of not being able to grow will depend, to a large degree, on the extent of scale economies. Thus, in markets with only negligible scale economies, firms have a considerably greater likelihood of survival. However, where scale economies play an important role the consequences of not growing are substantially more severe, as evidenced by a lower likelihood of survival.

What emerges from the new evolutionary theories and empirical evidence on the economic role of new and small firms is that markets are in motion, with a lot of new firms entering the industry and a lot of firms exiting out of the industry. But is this motion horizontal, in that the bulk of firms exiting are comprised of firms that had entered relatively recently, or vertical, in that a significant share of the exiting firms had been established incumbents that were displaced by younger firms? In trying to shed some light on this question, Audretsch (1995) proposes two different models of the evolutionary process of industries over time. Some industries can be best characterized by the model of the conical revolving door, where new businesses enter, but where there is a high propensity to subsequently exit from the market. Other industries may be better characterized by the metaphor of the forest, where incumbent establishments are displaced by new entrants. Which view is more applicable apparently depends on three major factors – the underlying technological conditions, scale economies, and demand. Where scale economies play an important role, the model of the revolving door seems to be more applicable. While the rather starting result discussed above that the startup and entry of new businesses is apparently not deterred by the presence of high scale economies, a process of firm selection analogous to a revolving door ensures that only those establishments successful enough to grow will be able to survive beyond more than a few years. Thus the bulk of new entrants that are not so successful ultimately exit within a few years subsequent to entry.

There is at least some evidence also suggesting that the underlying technological regime influences the process of firm selection and therefore the type of firm with a higher propensity to exit. Under the entrepreneurial regime new entrants have a greater likelihood of making an innovation. Thus, they are less likely to decide to exit from the industry, even in the face of negative profits. By contrast, under the routinized regime the incumbent businesses tend to have the innovative advantage, so that a higher portion of exiting businesses tend to be new entrants. Thus, the model of the revolving door is more applicable under technological conditions consistent with the routinized regime, and the metaphor of the forest, where the new entrants displace the incumbents

– is more applicable to the entrepreneurial regime.

Why is the general shape of the firm-size distribution not only strikingly similar across virtually every industry – that is, skewed with only a few large enterprises and numerous small ones – but has persisted with tenacity not only across developed countries but even over a long period of time? The evolutionary view of the process of industry evolution is that new firms typically start at a very small scale of output. They are motivated by the desire to appropriate the expected value of new economic knowledge. But, depending upon the extent of scale economies in the industry, the firm may not be able to remain viable indefinitely at its startup size. Rather, if scale economies are anything other than negligible, the new firm is likely to have to grow to survival. The temporary survival of new firms is presumably supported through the deployment of a strategy of compensating factor differentials that enables the firm to discover whether or not it has a viable product.

The empirical evidence supports such an evolutionary view of the role of new firms in manufacturing, because the post-entry growth of firms that survive tends to be spurred by the extent to which there is a gap between the MES level of output and the size of the firm. However, the likelihood of any particular new firm surviving tends to decrease as this gap increases. Such new suboptimal scale firms are apparently engaged in the selection process. Only those firms offering a viable product that can be produced efficiently will grow and ultimately approach or attain the MES level of output. The remainder will stagnate, and depending upon the severity of the other selection mechanism – the extent of scale economies – may ultimately be forced to exit out of the industry. Thus, the persistence of an asymmetric firm-size distribution biased towards small-scale enterprise reflects the continuing process of the entry of new firms into industries and not necessarily the permanence of such small and suboptimal enterprises over the long run. Although the skewed size distribution of firms persists with remarkable stability over long periods of time, a constant set of small and suboptimal scale firms does not appear to be responsible for this skewed distribution. Rather, by serving as agents of change, new firms provide an essential source of new ideas and experimentation that otherwise would remain untapped in the economy.

5. The public policy response

The policy response to this new view of the knowledge production function has been to shift away from targeting outputs to inputs. In particular, this involves the creation and commercialization of knowledge. Examples include the promotion of joint R&D programs, education and training programs, and policies to encourage people to start new firms. As Saxenian (1985, p. 102) points out, "Attracting high-tech has become the only development game of the 1980s." Justman (1995) and Justman and Teubel (1986) show how investment in infrastructure provide an important source of growth.

The provision of venture and informal capital to facilitate the creation and growth of new firms has replaced concern about the market power of existing ones in policy debates (Hughes, 1997; Mason and Harrison, 1997). The lack of finance capital for new ventures has been blamed for the inability of Germany and France to shift economic activity into new industries that generate high-wage employment. One of the most repeated phrases on the pages of the business news over the last few years has been "Put Bill Gates in Europe and it just wouldn't have worked out."[1]

Policy efforts to address the most pressing contemporary economic problems have focused on enablement rather than constraint. Emphasis on enabling firms and individuals to create and commercialize new knowledge is not restricted to any single country or set of countries. Laura Tyson (1994), former chair of the Council of Economic Advisors in the Clinton Administration, recently emphasized the importance of government policies to promote entrepreneurship and new-firm startups in the former Soviet Union. Similarly, as unemployment in Germany surpassed four million, and stood at nearly eleven percent of the labor force, it is not surprising the Chancellor Helmut Kohl would undertake action to spur the creation of new jobs. What is more surprising is the main emphasis announced by the Chancellor in the *Initiatives for Investment and Employment*[2] in 1996 on new and small firms. The first and main point of the Chancellor's Program consists of a commitment

to the "creation of new innovative firms."[3] The rationale underlying this policy approach by the Chancellor is stated in the Program: "New jobs are created mainly in new firms and in small- and medium-sized enterprises."[4]

Audretsch and Feldman (1996) argue that industrial policies targeting the production and commercialization of new economic knowledge will have a greater impact on particular regions and not diffuse rapidly across geographic space. They point out that knowledge spillovers are a key source of new knowledge generating innovative activity, but due to the tacit nature of that knowledge, knowledge flows tend to be geographically bounded. Although the cost of transmitting information has become invariant to distance, the cost of transmitting knowledge, and especially tacit knowledge, rises with distance. By creating regions of knowledge-based economic activities, government policies can generate highly concentrated innovative clusters.

As long as the major policy issue was restricting large, oligopolistic firms in command of considerable market power, a federal or national locus of control was appropriate. This is because the benefits and costs derived from that market power are asymmetric between the local region where the firm is located and the national market, where the firm sells its product. Not only was production concentrated in one or just several regions, but the workers along with the ancillary suppliers also tended to be located in the same regions. These workers as well as the community at large share the fruits accruing from monopoly power. Systematic empirical evidence (Weiss, 1966) shows that wages are positively related to the degree of market power held by a firm, even after controlling for the degree of unionization. Higher profits resulting from market power are shared by labor. Workers and firms in the region have the same interest.

As Olson (1982) shows, relatively small coalitions of economic agents benefiting from some collective action tend to prevail over a large group of dispersed economic agents each incurring a small cost from tat action. The costs or organizing and influencing policy are relatively low for the small coalition enjoying the benefits but large for the group of dispersed economic agents. Government policies to control large oligopolistic firms with substantial market power were not likely to be successful if implemented on the local level. Rather, as Olson (1982) predicts, a regional locus of policy towards business tends to result in the capture of policy by the coalition of local interests benefiting from that policy. Only by shifting the locus of policy away from the region to the national level can the capture of policy by special interest groups be minimized. This is because the negative effects of market power in the form of higher prices are spread throughout the national market while the benefits accruing from that power are locally concentrated.

Starting in the Carter Administration in the late 1970s and continuing into the Administrations of presidents Reagan, Bush and Clinton, antitrust has been de-emphasized and a twenty year wave of deregulation has led to a downsizing and even closure of a number of the former regulatory agencies.

Many economists interpret the downsizing of the federal agencies charged with the regulation of business as the eclipse of government intervention. But to interpret the retreat of the federal government as the end of public intervention is to confuse the downsizing of government with a shifting of the locus of government policy away from the federal to the local level. The last decade has seen the emergence of a set of enabling policy initiatives at the local level. This new type of industrial policy is decentralized and regional in nature. As Sternberg (1996) emphasizes in his review of successful technology policies in the four leading technological countries, the most important industrial policies in the last decades have been local not national. They have occurred in locations such as Research Triangle (Link, 1995), Austin, Texas and Cambridge (U.K.). Sternberg (1996) shows how the success of a number of different high-technology clusters spanning the four most technologically advanced countries is the direct result of enabling policies undertaken at the regional level.

Eisnger asks the question, "Do American States Do Industrial Policy?" in a 1990 article published in the *British Journal of Political Science*. Lowery and Gray (1990) confirm Eisinger's affirmative answer by analyzing the impact of state industrial policy in the United States. They develop a new data set on gross state product and a new measure

of state industrial policy activism. Their results suggest that the implementation of industrial policy at the state level tends to promote growth. For example, Feller (1997, p. 289) points out that "in theory and implementation, state technology development programs – as in Texas, Ohio, New York, New Jersey, and Pennsylvania – may be viewed as bands on a wide spectrum from basic research to product development, with the ends reflecting quite divergent state strategies . . ." The Advanced Research Program in Texas has provided support for basic research and the strengthening of the university infrastructure, which played a central role in recruiting MCC and Sematech and developing a high-tech cluster around Austin. The Thomas Edison Centers in Ohio, the Advanced Technology Centers in New Jersey, and the Centers for Advanced Technology at Case Western Reserve University, Rutgers University and the University of Rochester have supported generic, precompetitive research. This support has generally provided diversified technology development involving a mix of activities encompassing generic research, applied research, and manufacturing modernization through a broad spectrum of industrial collaborators spanning technology-intensive multinational corporations, regional manufactures and new-firm startups.

This shift in the locus of policy is the result of two factors. First, because the source of comparative advantage is knowledge, which tends to be localized in regional clusters, public policy requires an understanding of region-specific characteristics and idiosyncrasies. As Sternberg (1996) concludes, regional strengths provide the major source of innovative clusters. The second factor is that the motivation underlying government policy is now growth and the creation of (high-paying) jobs, largely through the creation of new firms. These new firms are typically small and pose no oligopolistic threat in national or international markets. There are no external costs imposed on consumers in the national economy in the form of higher prices as in the case of a large oligopolistic corporation in possession of market power. There is no reason that the promotion of local economies imposes a cost on consumers in the national economy, so that localized industrial policy is justified and does not result in any particular loss incurred by agents outside of the region.

6. Conclusions

While traditional theories suggest that entrepreneurship will retard economic growth, new theories suggest exactly the opposite – that entrepreneurship will stimulate and generate growth. The reason for these theoretical discrepancies lies in the context of the underlying theory. In the traditional theory, new knowledge plays no role; rather, static efficiency, determined largely by the ability to exhaust scale economies dictates growth. By contrast, the new theories are dynamic in nature and emphasize the role that knowledge plays. Because knowledge is inherently uncertain, asymmetric and associated with high costs of transactions, divergences emerge concerning the expected value of new ideas. Economic agents therefore have an incentive to leave an incumbent firm and start a new firm in an attempt to commercialize the perceived value of their knowledge. Entrepreneurship is the vehicle by which (the most radical) new ideas are sometimes implemented.

While this policy emphasis on small and new firms as engines of dynamic efficiency may seem startling after decades at looking to the corporate giants to bestow efficiency, it is anything but new. Before the country was even half a century old, Alexis de Tocqueville, in 1935, reported, "What astonishes me in the United States is not so much the marvellous grandeur of some undertakings as the innumerable multitude of small ones."

Notes

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[1] "Where's the Venture Capital?" *Newsweek*, 31 October, 1994, p. 44. Similar sentiment was expressed by Joschka Fischer, parliamentary leader of the Green Party in Germany, who laments, "A company like Microsoft would never have a chance in Germany" ("Those German Banks and Their Industrial Treasures," *The Economist*, 21 January, 1994, 77–78).

[2] This was announced as the Akrionsprogramm fuer Investitionen und Arbeitsplaetze ("Soziale Einschnitte und Steuerreform sollen Wirtschaftswachstum anregen: Bundesregierung beschliesst Aktionsprogramm fuer Investiitionen und Arbeitsplaetze," *Der Tagesspiegel*, 31 January, p. 1).

[3] The original text of the *Aktionsprogramm* states, "Offensive

für unternehmerische Selbständigkeit und innovationsfähigkeit" ("Ein Kraftakt zu Rettung des Standorts Deutschland," *Frankfurter Allgemeine*, 31 January, 1996, p. 11).

[4] "Ein Kraftakt zu Rettung des Standorts Deutschland," *Frankfurter Allgemeine*, 31 January, 1996, p. 11. The original text reads, "Neue Arbeitsplätze entstehen zumeist in neugegründeten Unternehmen und im Mittelstand."

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