The Dynamic Role of Small Firms: Evidence from the U.S.

David B. Audretsch

This paper provides a conceptual and empirical account of the dynamic role of SMEs in the US economy. Evidence is provided to show that SMEs are important sources of employment growth and innovation. For example, the net employment gain during 1990-95 is shown to be greater among smaller firms than among larger firms. Furthermore, while large firms often produce a larger number of patents per firm, the patenting rate for small firms is typically higher than that for large firms when measured on a per-employee basis. It is noted that public policy is shifting away from traditional measures which were based on a static conception of industrial organization and thus emphasized anti-trust, regulation and public ownership solutions, towards measures which are geared towards supporting the dynamic role of SMEs. These measures focus on providing an enabling environment for enterprise start-ups, job creation, knowledge spillovers and technological change.

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David B. Audretsch
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Foreword

This paper was prepared for a project on the Role of Small & Medium Enterprises in East Asia. The project was organized by the World Bank Institute under the auspices of the Program for the Study of the Japanese Development Management Experience which is financed by the Human Resources Development Trust Fund established at the World Bank by the Government of Japan.

The principal objectives of this Program are to conduct studies on Japanese and East Asian development management experience and to disseminate the lessons of this experience to developing and transition economies. Typically, the experiences of other countries are also covered in order to ensure that these lessons are placed in the proper context. This comparative method helps identify factors that influence the effectiveness of specific institutional mechanisms, governance structures, and policy reforms in different contexts. A related and equally important objective of the Program is to promote the exchange of ideas among Japanese and non-Japanese scholars, technical experts and policy makers.

The papers commissioned for this project cover a number of important issues related to SME growth and performance in the region. These issues include: the productivity of small and medium enterprises, their adaptability to shocks and crises, their contribution to innovation and technological advance, their link to such features of the business environment as subcontracting and agglomeration, their impact on employment and equity, and their responsiveness to public policy.

Farrukh Iqbal, Program Manager
World Bank Institute

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David B. Audretsch*

Indiana University

1. Introduction

As recently as the 1980s, there were serious concerns about the ability of the United States to withstand competition in the global economy, to create jobs, and to continue to develop economically. Lester Thurow bemoaned that the United States was "losing the economic race,"[1] because, "Today it's very hard to find an industrial corporation in America that isn't in really serious trouble basically because of trade problems…. The systematic erosion of our competitiveness comes from having lower rates of growth of manufacturing productivity year after year, as compared with the rest of the world" (Thurow 1985, p. 23). W. W. Restow predicted a revolution in economic policy, concluding that, "The United States is entering a new political era, one in which it will be preoccupied by increased economic competition from abroad and will need better cooperation at home to deal with this challenge."[2] The influential study, *Made in America*, directed by the leaders of the MIT Commission on Industrial Productivity (Dertouzos and others 1989), even reached the conclusion that for the United States to restore its international competitiveness it had to adapt the types of economic policies targeting the leading corporations in Japan and Germany.

The 1990s proved those economists and scholars mistaken, or at least too zealous in their inclinations. The last decade has seen a remarkable reemergence of competitiveness, innovative activity, and job generation in the United States not seen in many years. Not only was this economic turnaround largely unanticipated by many scholars and members of the policy community, but what was even more surprising than the resurgence itself was the primary source of the resurgence; that is, small firms.

As scholars began the arduous task of documenting the crucial role played by small and medium enterprises (SMEs) in the United States as a driving engine of growth, job creation, and competitiveness in global markets (Audretsch 1995), policy makers responded with a bipartisan emphasis on policies to promote SMEs.[3] For example, in his 1993 State of the Union Address to the country, President Bill Clinton proposed, "Because small business has created such a high percentage of all the new jobs in our nation over the last 10 or 15 years, our plan includes the boldest targeted incentives for small business in history. We propose a permanent investment tax creditor the small firms in this country."[4] The Republican response to Clinton was, "We agree with the president that we have to put more people to work, but remember this: 80 to 85 percent of the new jobs in this country are created by small business. So the climate for starting and expanding businesses must be enhanced with tax incentives and deregulation, rather than imposing higher taxes and more governmental mandates."[5]

* I am particularly grateful to the insightful suggestions made by workshop participants and in particularl, by Farrukh Iqbal, Shujiro Urata, Migara De Silva, Al Berry, Christina Boari, Jeff Nugent, Bee Aw Roberts and Hideki Yamawaki. The workshop was organized by World Bank Institute in Chiang Mai, Thailand.

1. Lester Thurow, "Losing the Economic Race," *New York Review of Books*, September 1984, pp. 29-31.
2. W.W. Restow, "Here Comes a New Political Chapter in America," *International Herald Tribune*, 2 January 1987.
3. For example, U.S. News and World Report (16 August 1993) reported, "What do Bill Clinton, George Bush and Bob Dole have in common? All have uttered one of the most enduring homilies in American political discourse: That small businesses create most of the nation's jobs."
4. Cited from Davis, Haltiwanger, and Schuh (1996b, p. 298).
5. Representative Robert Michel, House Minority Leader, in the Republican Response to the 1993 State of the Union Address, cited from Davis, Haltiwanger,and Schuh (1996, p. 298).

One of the puzzles posed by the important contribution of small firms to the resurgence of the U.S. economy is that the share of economic activity, measured in terms of share of total establishments, employment, or output, has not dramatically increased over the last 20 years (Acs and Audretsch 1993). In fact, a meticulous comparison documenting the role of SMEs across a broad spectrum of countries revealed that the share of economic activity accounted for by SMEs is considerably less than in, for example, Japan, Germany, the United Kingdom, Italy, and The Netherlands.

If SMEs are so important to the U.S. economy, then how come SMEs account for such a small share of economic activity, at least relative to other economies? The answer to this question lies in a crucial distinction between the static role and the dynamic role of SMEs..

In the second section of this paper we contrast the static role and dynamic role of SMEs. In the third section we examine the policies that have contributed to promoting the dynamic contributions of SMEs. Finally, in the fourth section, a summary and conclusions are provided.

2. Evolution of SMEs

Static and Dynamic Context

Two disparate views about the impact of small firms on economic efficiency have emerged in the economics literature. On the one hand is the traditional, static, view in the field of industrial organization that views small firms as imposing excess costs on the economy as a result of a scale of production that is too small to be efficient. According to this traditional view, the inefficient scale of operations results in lower levels of productivity for small firms and lower wages for their workers. The shift in economic activity that has taken place over the previous two decades away from large corporations and toward new and small firms may be interpreted as causing a decrease in the standard of living of Americans. Shifting employment out of high-productivity and high-wage firms and into lower productivity and lower-wage (small) firms, according to this traditional view, reduces the well-being of the American population, and any policies that shift economic activity out of small firms and back into large corporations should be encouraged, since they will increase the American standard of living.

On the other hand is the nontraditional, dynamic, view. With the hindsight of some 15 years, it is clear that the dynamic view of small-firm efficiency is more consistent with not just the recent wave of theories about the evolutionary role of small and new firms, but also with the compelling empirical evidence that analyzes firms and industries through a dynamic lens (Caves 1998).

The purpose of this paper is to explain this dynamic role played by small firms in the U.S. economy. A particular emphasis is placed on the contribution of small firms to innovation, job generation, and international competitiveness.

Static Role

The static role of SMEs in the United States is documented in Table 1. The source of the data is the Longitudinal Establishment and Enterprise (LEEM) file, which is produced jointly by the U.S. Small Business Administration (SBA) and the U.S. Bureau of the Census. A more thorough and detailed explanation and documentation of the LEEM database can be found in Audretsch (1995).

Table 1. *LEEM Establishment Distribution by Firm Size and Establishment Industry: 1995*

	Establishment industry									
Firm size	*Agra-services*	*Mining*	*Construc-tion*	*Manufac-turing*	*TCPU*	*Whole-sale*	*Retail*	*FIRE*	*Services*	*Un-coded*
0	22,539	2,238	96,543	27,212	28,875	40,618	126,378	52,374	236,236	25,352
1–4	49,759	10,029	306,478	100,551	96,342	172,102	468,307	261,041	1,078,044	21,973
5–9	19,262	3,417	111,382	60,442	34,663	79,305	229,549	60,036	395,712	3,188
10–19	9,967	2,576	62,891	52,575	23,759	59,668	153,936	33,534	217,715	1,097
20–49	3,707	2,084	35,052	48,424	18,514	48,351	116,609	28,471	142,859	404
50–99	785	951	9,111	22,033	8,446	21,676	50,563	17,995	62,258	30
100–249	399	809	4,275	18,612	7,901	18,983	47,050	18,332	62,210	18
250–499	168	603	1,360	9,923	5,055	10,275	31,708	11,729		
500–999	214	625	931	8,376	4,683	9,302	29,065	12,139		
1000+	946	3,991	3,810	40,229	56,194	56,624	305,629	132,215		
Total	107,746	27,323	631,833	388,377	284,432	516,904	1,558,794	627,866	2,378,412	52,067

Source: Tabulations of the prototype Longitudinal Establishment and Enterprise (LEEM) file, a joint project of the Office of Economic Research, Office of Advocacy, Small Business Administration, and the Center for Economic Studies of the Bureau of the Census, U.S. Department of Commerce

According to the SBA, the definition of a small firm is one with fewer than 500 employees. In every major economic sector, most of the businesses are SMEs. For example, in manufacturing, only around 49,000 of the 388,000 businesses (establishments) are owned by large firms.

In Table 2 the distribution of employment by firm size is shown. Because a larger firm employs more people than a SME, the firm-size distribution measured by employment is not as skewed as in Table 1, where it is measured by the number of establishments. Still, most Americans work in SMEs. However, the share of employment accounted for by SMEs varies considerably across major economic sectors. For example, in construction only a small share of employment is in large firms. By contrast, in manufacturing around two-thirds of employment is in large corporations.

In Tables 1 and 2 establishments are classified according to the size of the enterprise to which they belong. Table 3 shows that if the establishments are classified according to establishment size, then an even greater share of establishments are accounted for by SMEs. Similarly, Table 4 shows that the employment share of SMEs is even greater if the employment were classified according to the size of the establishment and not the size of the enterprise.

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."

Table 2. *LEEM Employment Distribution by Firm Size and Establishment Industry: 1995*

Firm size	Agra-services	Mining	Construc-tion	Manufac-turing	TCPU	Whole-sale	Retail	FIRE	Services	Un-coded
	Establishment industry									
0	0	0	0	0	0	0	0	0	0	0
1–4	103,692	20,160	642,722	227,470	199,212	369,679	1,040,824	501,333	2,244,789	36,717
5–9	126,586	22,410	728,147	404,733	223,611	513,430	1,478,920	373,335	2,540,323	20,399
10–19	130,322	33,794	837,695	714,023	302,064	732,703	1,878,676	377,532	2,705,654	14,330
20–49	101,525	53,395	1,108,886	1,433,918	457,795	1,053,428	2,653,287	521,661	3,448,373	11,360
50–99	45,497	37,959	574,168	1,308,089	339,675	684,409	1,693,721	412,520	2,561,140	1,851
100–249	36,888	44,129	485,825	1,796,540	393,102	700,693	1,440,357	492,592	3,564,147	2,490
250–499	15,172	31,067	210,453	1,276,358	235,453	373,365	768,499	322,560	2,468,592	253
500–999	10,856	38,658	141,812	1,274,762	234,024	262,512	640,040	311,394	2,311,945	2,243
1000+	59,104	345,734	397,192	10,172,347	3,538,287	1,914,731	9,481,931	3,670,767	12,851,941	2,156
Total	629,642	627,306	5,036,900	18,608,240	5,923,233	6,604,950	21,076,255	6,983,694	34,696,904	91,799

Source: Tabulations of the prototype Longitudinal Establishment and Enterprise (LEEM) file, a joint project of the Office of Economic Research, Office of Advocacy, Small Business Administration, and the Center for Economic Studies of the Bureau of the Census, U.S. Department of Commerce

Table 3. *LEEM Establishments Classified by Firm Size and by Establishment Size*

	1990		1994		1995	
Employment size class	Number of establishments by firm size	Number of establishments by establishment size	Number of establishments by firm size	Number of establishments by establishment size	Number of establishments by firm size	Number of establishments by establishment size
0	592,101	619,153	655,566	694,967	658,365	695,344
1-4	2,393,133	2,679,308	2,520,339	2,838,407	2,564,626	2,882,658
5-9	969,135	1,237,084	981,598	1,285,158	996,956	1,298,392
10-19	598,851	769,619	608,316	799,077	617,718	817,335
20-49	415,667	508,292	438,295	526,365	444,475	543,906
50-99	174,448	175,357	192,803	177,913	193,848	185,259
100-249	160,002	97,709	178,683	101,940	178,589	107,308
250-499	94,725	24,323	105,074	25,657	105,392	27,194
500-999	82,052	9,590	87,258	9,765	91,039	10,333
1000+	645,902	5,581	697,125	5,808	722,746	6,025
Total	6,126,016	6,126,016	6,465,057	6,465,057	6,573,754	6,573,754

Source: Tabulations of the prototype Longitudinal Establishment and Enterprise (LEEM) file, a joint project of the Office of Economic Research, Office of Advocacy, Small Business Administration, and the Center for Economic Studies of the Bureau of the Census, U.S. Department of Commerce

Table 4. *LEEM Employment by Firm Size and by Establishment Size*

	1990		*1994*		*1995*	
Employment size class	*Number of establishments by firm size*	*Number of establishments. by establishment size*	*Number of establishments by firm size*	*Number of establishments by establishment size*	*Number of establishments by firm size*	*Number of establishments by establishment size*
1-4	5,108,303	5,843,895	5,311,360	6,127,769	5,386,598	6,192,612
5-9	6,242,213	8,158,925	6,325,466	8,485,239	6,431,894	8,574,605
10-19	7,534,444	10,343,097	7,537,382	10,738,355	7,726,793	10,992,228
20-49	10,401,095	15,375,515	10,364,280	15,905,109	10,753,628	16,435,592
50-99	7,295,147	12,027,638	7,321,621	12,224,648	7,659,029	12,755,332
100-249	8,268,752	14,610,283	8,590,755	15,276,124	8,956,763	16,070,791
250-499	5,272,697	8,306,581	5,523,148	8,757,727	5,701,772	9,280,853
500-999	4,807,014	6,550,174	5,128,503	6,661,977	5,228,246	7,019,910
1000+	38,495,464	12,209,021	40,584,831	12,510,398	42,434,190	12,956,990
Total	93,425,129	93,425,129	96,687,346	96,687,346	100,278,913	100,278,913

Source: Tabulations of the prototype Longitudinal Establishment and Enterprise (LEEM) file, a joint project of the Office of Economic Research, Office of Advocacy, Small Business Administration,and the Center for Economic Studies of the Bureau of the Census, U.S. Department of Commerce

The importance of scale economies in the typical manufacturing industry relegated most small firms to being classified as suboptimal.[6] For example, Weiss (1964) found that suboptimal plants accounted for about 52.8 percent of industry value-of-shipments, Scherer (1973) found that 58.2 percent of value-of-shipments emanated from the suboptimal plants in 12 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 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.”[7]

What are the economic welfare implications? Weiss (1979, p. 1137) argued that the existence of small firms that are suboptimal represented a loss in economic efficiency and therefore advocated any public policy that “…creates social gains in the form of less suboptimal capacity.” This actually translated into an ingenious 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 suboptimal scale small firms.

Wages and productivity would be expected to reflect the degree to which small firms are less efficient than larger firms. 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 nonwage compensation as well) to be positively related to firm size. Probably the most cited study is that of Brown, Hamilton, and Medoff

6. While it was acknowledged that small firms were able to avoid direct competition by occupying strategic niches, Weiss (Audretsch and Yamawaki 1991, p. 404) observed that, “The survival of smaller plants within any given industry may be due to their specialization in items with short production runs or to their service of small geographic markets within which their relatively small national market share is irrelevant. To the extent that such explanations hold, small plants are not necessarily suboptimal. However, such explanations seem unlikely to hold for a number of the industries where the percentage of suboptimal capacity is larger.”
7. Quotation from p. xiv of the Introduction in Audretsch and Yamawaki (1991).

(1990, pp. 88–89). They 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." Indeed, Audretsch (1995) shows that the mean manufacturing wage in small firms that can be classified as being suboptimal is only 80.5 percent as high as their larger, optimal counterparts.

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 toward-s small enterprises is unequivocal. Overall economic welfare is decreased since productivity and wages will be lower in smaller than in larger 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 toward larger enterprises.

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?[8] 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). Audretsch shows how new firms entered the industry not simply to increase output by being a smaller replica of the large incumbent enterprises but by serving as *agents of change*. This suggested that small firms, at least in some situations, were not about being smaller clones of the larger incumbents but rather about serving as *agents of change* through innovative activity.

The starting point for most of these theories of innovation is the firm.[9] In such theories the firms are exogenous and their performance in generating technological change is endogenous.[10] For example, in the most prevalent model found in the literature of technological change, the model of the *knowledge production function*, formalized by 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. As Cohen and Klepper conclude, the greatest source generating new economic knowledge is generally considered to be R&D.[11]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.

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 lesser 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. Industries such as computers, pharmaceuticals, and instruments are not only high in R&D inputs that generate new economic

8. Coase (1937, p. 23) himself asked, "A pertinent question to ask would appear to be (quite apart from the monopoly considerations raised by Professor Knight), why, if by organizing one can eliminate certain costs and in fact reduce the cost of production, are there any market transactions at all? Why is not all production carried on by one big firm?"
9. See for reviews of this literature Baldwin and Scott (1987), Scherer (1991), and Dosi (1988).
10. See for example Scherer (1991), Cohen and Klepper (1991 and 1992), and Arrow (1962).
11. Cohen and Klepper (1991 and 1992).

knowledge but also in 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; that is, 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*.[12] The underlying issue revolves around how firms that 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; that is, agents with endowments of new economic knowledge. But when the lens is shifted away from focusing on 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 those economic agents do not, the economic agents 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 differently than is currently being practiced by the incumbent enterprises—both in terms of a new product or process and in terms of organization—then 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 on 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 by 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 is implemented by the incumbent enterprise on the upper end and by the return that the agent could expect to earn if the agent used it to launch a new enterprise on the lower end. Thus, each economic agent would choose how to best appropriate the value of this endowment of economic knowledge by comparing the

12. See Baldwin and Scott (1987).

wage the agent would earn if the agent 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, then the probability that the agent would choose to appropriate the value of this 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 this knowledge externally through starting a new enterprise becomes greater, or

$$Pr(e) = f(\pi - w)$$

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, owing 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 this 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 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 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 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 were to be built around a new idea (i.e., potential innovation), then 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 were to be 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 experience. 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 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 (i.e., its relative efficiency) but rather discovers this cost function 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. It has been referred to as the *Larackian* assumption that learning refers to adaptations made by the new enterprise. In this sense, those new firms 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."

Conversely, 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 the goods 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 . Hannan and 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).[13] While the 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 operating at a suboptimal scale of output.

Subsequent to entering an industry, an entrepreneur must decide whether to maintain its output by expanding, contracting, or simply exiting. 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 MES level of output increases.[14] The second strand of literature points to the role that the technological environment plays in shaping the decision to exit. As Dosi (1982) 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 (i.e., under the entrepreneurial

13. A similar startup size for new manufacturing firms has been found by Dunne, Roberts,and Samuelson (1989) for the United States, Mata (1994) and Mata and Portugal (1994) for Portugal, and Wagner (1994) for Germany.
14. For example, Weiss (1976, p. 126) argues that, "In purely competitive long-run equilibrium, no suboptimal capacity should exist at all."

regime). If new firms were to successfully learn and adapt, or are just plain lucky, then those firms will grow into viably sized enterprises. If not, then those firms will 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 ultimate 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.

That the role of SMEs seen through a dynamic lens is considerably different than through a static one is made clear in Table 5, which shows the percentage change between 1990 and 1995 in employment owing to new firms (births), exits (deaths), additional employment in existing firms (expansions), and decreases in employment in existing firms (contractions). For example, there was a 12.76 percent increase in employment owing to the birth of new firms in manufacturing between 1990 and 1995. However, employment change owing to births was considerably greater by SMEs than by large corporations. There were nearly one-third new jobs created by new firms with fewer than 20 employees. Similarly, there was an increase in employment of SMEs of 144.69 percent resulting from the startup of new firms.

However, there was also a considerable number of jobs lost as a result of firms going out of business, classified as deaths in Table 5. The overall employment birth rate of 12.76 percent in manufacturing was more than offset by a loss in employment owing to a death rate of 15.92 percent. Just as the birth rate is greater for smaller enterprises, so is the death rate. The share of 1990 employment lost owing to firms exiting was 12.79 percent for large corporations, 19.37 percent for enterprises having between 20 and 499 employees, and 28.69 percent for enterprises with fewer than 20 employees.

The expansion rate is also inversely related to firm size, with the smallest enterprises exhibiting an expansion rate of nearly one-third, while the large corporations exhibited an expansion rate of just over 10 percent. However, the contraction rate follows a different pattern than do the birth, death, and expansion rates. This is because the contraction rate is actually the greatest for large corporations and the lowest in enterprises with fewer than 20 employees. The high contraction rate for corporations, 16.62, percent reflects the high degree of corporate downsizing that has occurred in the 1990s.

The high degree of corporate downsizing combined with relatively low employment birth and expansion rates resulted in a net decrease in employment in large corporation of 8.47 percent between 1990 and 1995. At the same time, the high employment birth and expansion rates combined with lower death and contraction rates resulted in a net increase in employment, 21.25 percent for firms with fewer than 20 employees.

The dynamic pattern of employment creation in manufacturing is typical for the entire U.S. economy. In every major sector (1) the birth rate of SMEs exceeds that in large corporations, (2) the death rate of SMEs exceeds that of large corporations, (3) the expansion rate of SMEs exceeds that of large corporations, (4) the contraction rate of large corporations exceeds that of SMEs, and (5) the net employment gain is the greatest in SMEs.

Table 6 shows that while the numbers of enterprises and new enterprises have been growing over time, the rate of growth has been fairly constant. The dynamic contribution of SMEs documented in Table 4 does not seem to be restricted to just several years but is now characteristic of the U.S. economy.

Table 5. *1990-1995 Employment Changes by Establishment Change Type, Industry, and Firm Size (Base Year Method)*

Industry	Firm employment	1990 establishment employment	Births	Deaths	Expan-sions	Contrac-tions	Net
			(as a percentage of 1990 employment in same employment size category)				
Manufacturing	<20	1,354,055	30.38	–28.69	31.27	–11.72	21.25
	20–499	5,863,336	14.31	–19.37	18.67	–13.05	0.57
	500+	11,956,053	10.01	–12.79	10.93	–16.62	–8.47
	All	19,173,444	12.76	–15.92	14.73	–15.18	–3.61
Other productive	<20	2,559,336	38.51	–34.52	26.15	–14.39	15.75
	20–499	2,831,202	17.61	–25.47	14.54	–22.08	–15.41
	500+	1,127,345	20.49	–24.12	13.89	–24.22	–13.97
	All	6,517,883	26.32	–28.79	18.98	–19.43	–2.93
Distributive	<20	6,059,802	34.29	–33.39	20.65	–11.90	9.66
	20–499	9,075,659	27.57	–25.14	13.04	–14.82	0.65
	500+	11,054,412	31.74	–21.16	12.61	–14.41	8.79
	All	26,189,873	30.89	–25.37	14.62	–13.97	6.17
Services	<20	8,911,767	35.54	–27.36	27.20	–12.23	23.14
	20–499	13,467,494	30.79	–21.61	19.89	–15.82	13.24
	500+	19,164,668	28.88	–17.77	15.67	–14.91	11.87
	All	41,543,929	30.93	–21.07	19.51	–14.63	14.73
All	<20	18,884,960	35.17	–30.36	25.25	–12.38	17.68
	20–499	31,237,691	25.57	–22.56	17.18	–15.58	4.61
	500+	43,302,478	24.18	–17.42	13.53	–15.50	4.79
	All	93,425,129	26.87	–21.76	17.12	–14.89	7.34

Source: Tabulations of the prototype Longitudinal Establishment and Enterprise (LEEM) file, a joint project of the Office of Economic Research, Office of Advocacy, Small Business Administration, and the Center for Economic Studies of the Bureau of the Census, U.S. Department of Commerce

Table 7 shows that SMEs contribute not only the greatest amount of net employment creation but also the greatest amount of turbulence. The sum of employment creation plus destruction is identified as reallocation in Table 7.

Analysis of SMEs through a dynamic framework reveals that their impact is considerably more significant than when analyzed through a static framework.

Table 6. *Change in the Number of U.S. Businesses with Employees, Fiscal Years 1982–1995 (Thousands)*

Year	*Firms at end of each year*	*Successor firms*	*New firms*	*Sum: new and successor*	*Terminations*	*Net rate of growth (percent)*
1995	6,057	164	819	983	871	1.09
1994	5,992	137	807	944	803	2.40
1993	5,851	136	776	911	801	1.93
1992	5,741	138	737	875	819	0.95
1991	5,687	140	724	864	818	0.84
1990	5,639	146	769	915	846	1.27
1989	5,568	153	743	896	826	1.10
1988	5,513	153	755	907	752	1.71
1987	5,420	163	775	939	717	3.64
1986	5,230	175	741	916	801	1.70
1985	5,142	166	722	888	746	2.67
1984	5,009	164	691	855	687	3.54
1983	4,837	171	633	804	720	1.26
1982	4,777	185	595	781	707	1.55

Source: Adapted by U.S. Small Business Administration, Office of Advocacy, from data provided by the U.S. Department of Labor, Employment and Training Administration, based upon state employment security agencies' quarterly reports, 1995.

Table 7. *Establishment Employment Flows by Initial Year Establishment Size Classification: 1994–1995 [Percent change in establishment jobs (based on mean employment in size class)].*

Initial establishment employment	*1994 employment*	*Net*	*Creation*	*Destruction*	*Reallocation*
1–4	6,127,769	18.2	36.2	–17.9	54.1
5–19	19,223,594	5.0	20.8	–15.8	36.6
20–49	15,905,109	3.5	17.5	–14.0	31.5
50–99	12,224,648	3.2	15.9	–12.7	28.6
100–499	24,033,851	2.1	13.5	–11.5	25.0
500–999	6,661,977	–0.6	10.2	–10.8	21.0
1,000–4,999	9,934,405	–0.9	8.0	–8.9	16.9
5,000+	2,575,993	1.5	10.1	–8.5	18.6
Total	96,687,346	3.6	16.6	–13.0	29.6

(continued on the following page)

Mean establishment employment	*1994 Employment*	*Net*	*Creation*	*Destruction*	*Reallocation*
1–4	7,125,242	4.4	33.4	–29.0	62.4
5–19	19,087,849	3.4	20.1	–16.7	36.7
20–49	15,683,617	4.1	17.6	–13.6	31.2
50–99	12,073,947	4.7	16.4	–11.7	28.1
100–499	23,798,729	4.0	13.8	–9.8	23.6
500–999	6,571,009	2.6	11.1	–8.6	19.7
1,000–4,999	9,818,110	2.2	9.0	–6.8	15.9
5,000+	2,528,843	1.1	7.3	–6.1	13.4
Total	96,687,346	3.6	16.6	–13.0	29.6

Source: Tabulations of the prototype Longitudinal Establishment and Enterprise (LEEM) file, a joint project of the Office of Economic Research, Office of Advocacy, Small Business Administration, and the Center for Economic Studies of the Bureau of the Census, U.S. Department of Commerce.

Innovation

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, 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 databases measuring new product and process introductions in the market, indicated something quite different. In a series of studies, Acs and Audretsch (1987, 1988, and 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.

As Table 8 shows, the relative innovative advantage of small and large firms varies 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.

Table 8. *Number of Innovations for Large and Small Firms in the Most Innovative Industries*

Industry	*Total innovations*	*Large-firm innovations*	*Small-firm innovations*
Electronics computing equipment	395	158	227
Process control instruments	165	68	93
Radio and TV communication equipment	157	83	72
Pharmaceutical preparations	133	120	72
Electronic components	128	54	73
Engineering and scientific instruments	126	43	83
Semiconductors	122	91	29
Plastics products	107	22	82
Photographic equipment	88	79	9
Office machine	77	67	10
Instruments to measure electricity	77	28	47
Surgical appliances and supplies	67	54	13
Surgical and medical instrument	66	30	36
Special industry machinery	64	43	21
Industrial controls	61	15	46
Toilet preparations	59	41	18
Valves and pipe fittings	54	20	33
Electric housewares and fans	53	47	6
Measuring and controlling devices	52	3	45
Food products machinery	50	37	12
Motors and generators	49	39	10
Plastic materials and resins	45	30	15
Industrial inorganic chemicals	40	32	8
Radio and TV receiving sets	40	35	4
Hand and edge tools	39	27	11
Fabricated platework	38	29	9
Fabricated metal products	35	12	17
Pumps and pumping equipment	34	18	16
Optical instruments and lenses	34	12	21
Polishes and sanitation goods	33	13	19
Industrial trucks and tractors	33	13	20
Medicinal and botanicals	32	27	5
Aircraft	32	31	1
Environmental controls	32	22	10

Note: Large and small-firm innovations do not always sum to total innovations because several innovations could not be classified according to firm size.

Source: Audretsch (1995).

Audretsch (1995) 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; that is, the routinized and entrepreneurial technological regimes. According to Winter (1984, p. 297), “An entrepreneurial regime is one that is favorable to innovative entry and unfavorable to innovative activity by established firms; a routinized regime is one in which the conditions are the other way around.”

New Firm Startups

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. 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).[15] 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.[16] 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.

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15. The country studies included in Geroski and Schwalbach (1991) also indicate considerable ambiguities between measures reflecting the extent of scale economies and capital intensity on the one hand, and entry rates on the other.
16. While the concept of technological regimes does not lend itself to precise measurement, the major conclusion of Acs and Audretsch (1988 and 1990) was that the existence of these distinct regimes can be inferred by the extent to which small firms are able to innovate relative to the total amount of innovative activity in an industry. That is, when the small-firm innovation rate is high relative to the total innovation rate, the technological and knowledge conditions are more likely to reflect the entrepreneurial regime. The routinized regime is more likely to exhibit a low small-firm innovation rate relative to the total innovation rate.

Survival

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 is 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; and 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, Portugal, and Guimaraes 1995; Mata 1994), Germany (Wagner 1994), and Canada (Baldwin and Gorecki 1991; Baldwin 1995, and 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 a barrier to entry barrier but rather a barrier to survival. The answer to these 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.

Growth

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 (Sutton 1997). 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 and 1994; Mata 1994; Audretsch 1995). However, for larger firms, particularly those having attained the MES level of output, the evidence suggests that firm growth is unrelated to size and age.

An important finding of Audretsch (1991 and 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 produce the goods 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 there is a viable demand? The answer is that 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.

Dynamic Contribution of SMEs

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 many new firms entering the industry and many firms exiting out of the industry. But is this motion horizontal, in that the bulk of firms exiting are composed 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 startling result just discussed 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? The evolutionary view of the process of industry evolution is that new firms typically start at a very small scale of output and are motivated by the desire to appropriate the expected value of new economic knowledge. But, depending on 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, then 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 on 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 toward 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, 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.

3. Determinants of SME Dynamism

Enabling Environment

As Table 8 shows, the evidence revealing small enterprises to be the engine of innovative activity in certain industries, despite an obvious lack of formal R&D activities, raises the question, *Where do new and small firms get the innovation producing inputs; that is, the knowledge?* The answer proposed by Audretsch (1995) is from other, third-party, firms or research institutions, such as universities. Economic knowledge may *spill over* from the firm or research institution creating it for application by other firms (Acs, Audretsch, and Feldman 1992).

That knowledge spillover is barely dispute. However, the geographic range of such knowledge spillovers is greatly contested. In disputing the importance of knowledge externalities in explaining the geographic concentration of economic activity, Krugman (1991) and others do not question the existence or importance of such knowledge spillovers.[17] In fact, they argue that such knowledge externalities are so important and forceful that there is no compelling reason for a geographic boundary to limit the spatial extent of the spillover. According to this line of thinking, the concern is not that knowledge does not spill over but that it should stop spilling over just because it hits a geographic border, such as a city limit, state line, or national boundary.

A recent body of empirical evidence clearly suggests that R&D and other sources of knowledge not only generate externalities, but studies by Audretsch and Feldman (1996), Almeida and Kogut (1997), Jaffe (1989), Audretsch and Stephan (1996), Feldman (1994a and 1994b), and Jaffe, Trajtenberg, and Henderson (1993) suggest that such knowledge spillovers tend to be geographically bounded within the region where the new economic knowledge was created. That is, new economic knowledge may spill over but the geographic extent of such knowledge spillovers is limited (Prevenzer 1997).

Krugman (1991, p. 53) has argued that economists should abandon any attempts at measuring knowledge spillovers because "...knowledge flows are invisible, they leave no paper trail by which they may be measured and tracked." But as Jaffe, Trajtenberg, and Henderson (1991, p. 578) point out, "knowledge flows do sometimes leave a paper trail," in particular in the form of patented inventions and new product introductions.

The innovations from Table 8 can be classified according to the four-digit SIC industry of the new product and the city where the innovating establishment was located. We adapt either the Consolidated Metropolitan Statistical Area (CMSA) or the Metropolitan Statistical Area (MSA) as the spatial unit of observation. The analysis here is based on 3969 new manufacturing product innovations for which the address of the innovating establishment could be identified.

The most innovative city in the United States was New York. Seven hundred and thirty-five, or 18.5 percent, of the total number of innovations in the country were attributed to firms in the greater New York City area. Four hundred and seventy-seven (12.0 percent) were attributed to San Francisco, California, and 345 (8.7 percent) to the Boston, Massachusetts, area and 333 (8.4 percent) to the Los Angeles, California, area. In total, 1,890, or 45 percent of the innovations, took place in those four consolidated metropolitan areas. In fact, all but 150 of the innovations included in the data base are attributed to metropolitan areas. That is, less than 4 percent of the innovations occurred outside of metropolitan areas. This contrasts with the 70 percent of the population that resided in those areas.

Of course, simply comparing the absolute amount of innovative activity across cities ignores the fact that some cities are simply larger than others. Cities vary considerably in size, and we expect that city scale will have an impact on innovative output. Table 9 presents the number of innovations normalized by the size of the geographic unit. Population provides a crude but useful measure of the size of the geographic unit. Cities in Table 9 are ranked in descending order by innovation rate or the number of innovations per 100,000 population. While New York has the highest count of innovation, it has the third

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17. Macki (1996) points out that these views are not original with Krugman (1991).

highest innovation rate. The most innovative city in the United States, on a per capita measure of city size, was San Francisco, with an innovation rate of 8.90, followed by Boston, with an innovation rate of 8.69. By contrast, the mean innovation rate for the entire country is 1.75 innovations per 100,000 population. The distribution of innovation rates is considerably skewed. Only 14 cities are more innovative than the national average. Clearly, innovation appears to be a large city phenomenon.

Table 9. *Counts of Innovation Normalized by Population*

Consolidated metropolitan statistical area	*Innovations (1982)*	*1980 population (thousands)*	*Innovations per 100,000 population*
San Francisco - Oakland	477	5368	8.886
Boston - Lawrence	345	3972	8.686
New York - Northern New Jersey	735	17539	4.191
Philadelphia - Wilmington	205	5681	3.609
Dallas - Fort Worth	88	2931	3.002
Hartford	30	1014	2.959
Los Angeles - Anaheim	333	11498	2.896
Buffalo - Niagara	35	1243	2.816
Cleveland - Akron	77	2834	2.717
Chicago - Gary	203	7937	2.558
Providence - Pawtucket	25	1083	2.308
Portland - Vancouver	25	1298	1.926
Cincinnati - Hamilton	30	1660	1.807
Seattle - Tacoma	37	2093	1.768
Pittsburgh	42	2423	1.733
Denver - Boulder	28	1618	1.731
Detroit - Ann Arbor	68	4753	1.431
Houston - Galveston	39	3101	1.258
Miami - Fort Lauderdale	13	2644	0.492

Source: 1980 Population is from the Statistical Abstract. Innovation data from Feldman and Audretsch (1999).

Studies identifying the extent of knowledge spillovers are based on the knowledge production function. Jaffe (1989), and Audretsch and Feldman (1996), and Feldman and Audretsch (1999) modified the knowledge production function approach to a model specified for spatial and product dimensions:

$$I_{si} = IRD^{\beta_1} \; UR_{si}^{\beta_2} \; (UR_{si} \; GC_{si}^{\beta_3}) \; \varepsilon_{si} \qquad (1)$$

where I is innovative output, *IRD* is private corporate expenditures on R&D, *UR* is the research expenditures undertaken at universities, and *GC* measures the geographic coincidence of university and corporate research. The unit of observation for estimation was at the spatial level s, a state, and industry level i. Estimation of equation (1) essentially shifted the knowledge production function from the unit of observation of a firm to that of a geographic unit.

Implicitly contained within the knowledge production function model is the assumption that innovative activity should take place in those regions where the direct knowledge-generating inputs are the greatest, and where knowledge spillovers are the most prevalent. Audretsch and Feldman (1996) and Audretsch and Stephan (1996) link the propensity for innovative activity to cluster together to industry specific characteristics, most notably the relative importance of knowledge spillovers.

To actually measure the extent to which innovative activity in a specific four-digit SIC industry is concentrated within a geographic region, Audretsch and Feldman (1996) calculate gini coefficients for the geographic concentration of innovative activity. The gini coefficients are weighted by the relative share of economic activity located in each state. Computation of weighted gini coefficients enables us to control for size differences across states. The gini coefficients are based on the share of activity in a state and industry relative to the state share of the national activity for the industry. Of course, as Jaffe, Trajtenberg, and Henderson (1993) point out, one obvious explanation why innovative activity in some industries tends to cluster geographically more than in other industries is that the location of production is more concentrated spatially. Thus, in explaining why the propensity for innovative activity to cluster geographically varies across industries, we need first to explain, and then control for, the geographic concentration of the location of production.

There are three important tendencies emerging. First, there is no obvious simple relationship between the gini coefficients for production and innovation. Second, the gini coefficient of the number of innovations exceeds that of value added and employment in those industries exhibiting the greatest propensity for innovative activity to cluster spatially. By contrast, the gini coefficients of innovative activity for most industries is less than that for value added and employment.

Third, those industries exhibiting the greatest propensity for innovative activity to cluster are high-technology industries. There are, however, several notable exceptions. For example, in motor vehicle bodies, which is certainly not considered to be a high-technology industry, the geographic concentration of production of innovative activity is the seventh greatest. One reason may be the high degree of geographic concentration of production, as evidenced by gini coefficients for value added (0.9241) and employment (0.8089) that actually exceed that of innovative activity (0.6923). This points to the importance of controlling for the geographic concentration of production in explaining the propensity for innovative activity to spatially cluster. And finally, the gini coefficient for value added exceeds that for employment in virtually every industry.

Audretsch and Feldman (1996) measure three different types of new economic knowledge: industry R&D, university R&D, and skilled labor. A key assumption they make in examining the link between knowledge spillovers in an industry and the propensity for innovative activity to cluster is that knowledge externalities are more prevalent in industries where new economic knowledge plays a greater role.

One obvious complication in testing for this link is that innovative activity will be more geographically concentrated in industries where production is also geographically concentrated, simply because the bulk of firms are located within proximity. Even more problematic, though, is the hypothesis that new economic knowledge will tend to shape the spatial distribution of production as well as that of innovation. Indeed, we found that a key determinant of the extent to which the location of production is geographically concentrated is the relative importance of new economic knowledge in the industry. But even after controlling for the geographic concentration of production, the results suggest that industries in which knowledge spillovers are more pervasive—that is where industry R&D, university research and skilled labor are the most important—have a greater propensity for innovative activity to cluster than industries where knowledge externalities are less important.

A growing literature suggests that *who* innovates and *how much* innovative activity is undertaken is closely linked to the phase of the industry life cycle. Audretsch and Feldman (1996) suggest an additional key aspect to the evolution of innovative activity over the industry life cycle: *where* that innovative activity takes place. The theory of knowledge spillovers, derived from the knowledge production function, suggests that the propensity for innovative activity to cluster spatially will tend to be the greatest in industries where *tacit knowledge* plays an important role, and because it is tacit knowledge, as opposed to *information*, which can only be transmitted informally, and typically demands direct and repeated contact. The role of tacit knowledge in generating innovative activity is presumably the greatest during the early stages of the industry life cycle, before product standards have been established and before a dominant design has emerged.

The stage of the industry life cycle has been typically measured by tracking the evolution of an industry starting with its incipiency, based on a wave of product innovations. But the measures of geographic concentration and dispersion, for both innovation and the location of production, documented in the previous section, are available only for one point of time. That is, these measures provide a snapshot at a single point in time for each industry. Thus, the life cycle stage of each industry at this point in time needs to be measured. More specifically, industries that are highly innovative and where that innovative activity tends to come from small firms are better characterized as being in the introduction stage of the life cycle. Industries that are highly innovative and where the large firms tend to generate that innovative activity are better characterized by the growth stage of the life cycle. Industries that are low innovative and where large firms have a higher propensity to innovate are better characterized by the mature stage of the life cycle. And finally, industries that are low innovative and where small firms have a higher propensity to innovate are best characterized by the declining stage of the life cycle. The higher propensity to innovate of small enterprises vis-à-vis their larger counterparts may reflect the seeds of the introductory phase of the life cycle of new products emerging in what would otherwise be a declining industry.

This framework was used to classify 210 four-digit SIC industries into those four stages of the life cycle. High innovative industries were rather arbitrarily defined as those industries exhibiting innovative activity in excess of the mean. Low innovative industries were similarly defined as those industries with innovative rates less than the mean. The innovation rate is defined as the number of innovations divided by the number of employees in the industry (measured in thousands). The innovation rate is used rather than the absolute number of innovations to control for the size of the industry. That is, if two industries were to exhibit the same number of innovations but one industry were twice as large as the other, then it will have an innovation rate one-half as large as the other industry. To measure the relative innovative advantage of large and small firms, the small-firm innovation rate is compared to the large-firm innovation rate, where the small-firm innovation rate is defined as the number of innovations made by firms with fewer than 500 employees divided by small-firm employment and the large-firm innovation rate is defined as the number of innovations made by firms with at least 500 employees divided by large-firm employment.

By using this classification system, 62 of the industries were classified as being in the introductory stage of the life cycle (defined as highly innovative, and the small firms have the innovative advantage), 32 industries were classified as being in the growth stage of the life cycle (defined as highly innovative, and the large firms have the innovative advantage), 64 industries were defined in the mature stage of the life cycle (defined as low innovative, and the large firms have the innovative advantage), and 52 were defined in the declining stage of the life cycle (defined as low innovative, and the small firms have the innovative advantage).

The results provide considerable evidence suggesting that the propensity for innovative activity to spatially cluster is shaped by the stage of the industry life cycle. On the one hand, new economic knowledge embodied in skilled workers tends to raise the propensity for innovative activity to spatially cluster throughout all phases of the industry life cycle. On the other, certain other sources of new economic knowledge, such as university research, tend to elevate the propensity for innovative activity to cluster during the introduction stage of the life cycle but not during the growth stage, but then again during the stage of decline.

Perhaps most striking is the finding that greater geographic concentration of production actually leads to more, and not less, dispersion of innovative activity. Apparently, innovative activity is promoted by knowledge spillovers that occur within a distinct geographic region, particularly in the early stages of the industry life cycle, but as the industry evolves toward maturity, decline may be dispersed by additional increases in concentration of production that have been built up within that same region. That is, the evidence suggests that what may serve as an *agglomerating influence* in triggering innovative activity to spatially cluster during the introduction and growth stages of the industry life cycle may later result in a *congestion effect*, leading to greater dispersion in innovative activity. In any case, the results of this paper suggest that the propensity for an innovative cluster to spatially cluster is certainly shaped by the stage of the industry life cycle.

Despite the general consensus that has now emerged in the literature that knowledge spillovers within a given location stimulate technological advance, there is little consensus as to exactly how this occurs. The contribution of the knowledge production function approach was simply to shift the unit of observation away from firms to a geographic region. But does it make a difference how economic activity is organized within the black box of geographic space? Political scientists and sociologists have long argued that the differences in the culture of a region may contribute to differences in innovative performance across regions, even holding knowledge inputs such as R&D and human capital constant. For example, Saxenian (1994) argues that a culture of greater interdependence and exchange among individuals in the Silicon Valley, California, region has contributed to a superior innovative performance than is found around Boston's Route 128, where firms and individuals tend to be more isolated less interdependent.

In studying the networks in California's Silicon Valley, Saxenian (1990, pp. 96–97) emphasizes that it is the communication between individuals that facilitates the transmission of knowledge across agents, firms, and even industries, and not just a high endowment of human capital and knowledge in the region: "It is not simply the concentration of skilled labor, suppliers and information that distinguish the region. A variety of regional institutions—including Stanford University, several trade associations and local business organizations, and a myriad of specialized consulting, market research, public relations, and venture capital firms—provide technical, financial, and networking services which the region's enterprises often cannot afford individually. These networks defy sectoral barriers: individuals move easily from semiconductor to disk drive firms or from computer to network makers. They move from established firms to startups (or vice versa) and even to market research or consulting firms, and from consulting firms back into startups. And they continue to meet at trade shows, industry conferences, and the scores of seminars, talks and social activities organized by local business organizations and trade associations. In these forums, relationships are easily formed and maintained, technical and market information is exchanged, business contacts are established, and new enterprises are conceived.…This decentralized and fluid environment also promotes the diffusion of intangible technological capabilities and understandings."[18]

While many social scientists tend to avoid attributing differences in economic performance to cultural differences, there has been a series of theoretical arguments suggesting that differences in the underlying structure between regions may account for differences in rates of growth and technological change. In fact, a heated debate has emerged in the literature about the manner in which the underlying economic structure within a geographic unit of observation might effect economic performance. One view, which Glaeser and others (1992) attribute to the Marshall-Arrow-Romer externality, suggests that an increased concentration of a particular industry within a specific geographic region facilitates knowledge spillovers across firms. This model formalizes the insight that the concentration of an industry within a city promotes knowledge spillovers between firms and therefore facilitates innovative activity. An important assumption of the model is that knowledge externalities with respect to firms exist, but only for firms within the same industry. Thus, the relevant unit of observation is extended from the firm to the region in the tradition of the Marshall-Arrow model, and in subsequent empirical studies, but spillovers are limited to occur within the relevant industry.

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18. Saxenian (1990, pp. 97-98) claims that even the language and vocabulary used by technical specialists is specific to a region, "...a distinct language has evolved in the region and certain technical terms used by semiconductor production engineers in Silicon Valley would not even be understood by their counterparts in Boston's Route 128."

By contrast, restricting knowledge externalities to occur only within the industry may ignore an important source of new economic knowledge: inter-industry knowledge spillovers. Jacobs (1969) argues that the most important source of knowledge spillovers are external to the industry in which the firm operates and that cities are the source of considerable innovation because the diversity of these knowledge sources is greatest in cities. According to Jacobs it is the exchange of complementary knowledge across diverse firms and economic agents that yields a greater return on new economic knowledge. She develops a theory that emphasizes that the variety of industries within a geographic region promotes knowledge externalities and ultimately innovative activity and economic growth.

The extent of regional specialization versus regional diversity in promoting knowledge spillovers is not the only dimension over which there has been a theoretical debate. A second controversy involves the degree of competition prevalent in the region, or the extent of local monopoly. The Marshall-Arrow-Romer model predicts that local monopoly is superior to local competition because it maximizes the ability of firms to appropriate the economic value accruing from their innovative activity. By contrast, Jacobs (1969) and Porter (1990) argue that competition is more conducive to knowledge externalities than is local monopoly.[19] It should be emphasized that by local competition Jacobs does not mean competition within product markets as has traditionally been envisioned within the industrial organization literature. Rather, Jacobs is referring to the competition for the new ideas embodied in economic agents. Not only does an increased number of firms provide greater competition for new ideas, but, in addition, greater competition across firms facilitates the entry of a new firm specializing in some particular and new product niche. This is because the necessary complementary inputs and services are likely to be available from small specialist niche firms but not necessarily from large vertically integrated producers.

The first important test of the specialization versus diversity theories to date has focused not on the gains in terms of innovative activity, but rather in terms of employment growth. Glaeser and others (1992) employ a data set on the growth of large industries in 170 cities between 1956 and 1987 to identify the relative importance of the degree of regional specialization, diversity, and local competition ply in influencing industry growth rates. The authors find evidence that contradicts the Marshall-Arrow-Romer model but is consistent with the theories of Jacobs. However, their study provided no direct evidence as to whether diversity is more important than specialization in generating innovation.

Feldman and Audretsch (1999) identify the extent to which the organization of economic activity is either concentrated, or alternatively consists of diverse but complementary economic activities, and how this composition influences innovative output. We ask the question, *Does the specific type of economic activity undertaken within any particular geographic concentration matter?* To consider this question they link the innovative output of product categories within a specific city to the extent to which the economic activity of that city is concentrated in that industry or, conversely, diversified in terms of complementary industries sharing a common science base.

To systematically identify the degree to which specific industries share a common underlying science and technology base, we rely upon a deductive approach that links products estimated from their closeness in technological space. They use the responses of industrial R&D managers to a survey by Levin and others (1987). To measure the significance of a scientific discipline to an industry, the question was asked, *How relevant were the basic sciences to technical progress in this line of business over the past 10–15 years?* The survey uses a Likert scale of 1 to 7, from least important to most important, to assess the relevance of basic scientific research in biology, chemistry, computer science, physics, math, medicine, geology, mechanical engineering, and electrical engineering. Any academic discipline with a rating greater than 5 is assumed to be relevant for a product category. For example, basic scientific research in medicine, chemistry, and chemical engineering is found to be relevant for product innovation in drugs (SIC 2834).

19 Porter (1990) provides examples of Italian ceramics and gold jewelry industries in which numerous firms are located within a bounded geographic region and compete intensively in terms of product innovation rather than focusing on simple price competition.

They then used cluster analysis to identify six groups of industries that rely on similar rankings for the importance of different academic disciplines. Those six groups reflect distinct underlying common scientific bases.

Table 10 presents the prominent cities within each science-based industrial cluster. Again, the listing of prominent cities recalls the well known association between cities and industries. For example, Atlanta, Georgia, was a prominent center for innovation that used the common science base of agra-business. While the national innovation rate was 20.34 innovations per 100,000 manufacturing workers, agra-business in Atlanta was almost five times as innovative. A chi-squared test of the independence of location of city and science-based industrial activity reveals that neither the distribution of employment nor the distribution of innovation is random. Industries that rely on a common science base exhibit a tendency to cluster together geographically with regard to the location of employment and the location of innovation. We conclude that the distribution of innovation within science-based clusters and cities appears to reflect the existence of science-related expertise.

Table 10. *Innovation in Science-Based Industry Clusters*

Cluster	*Prominent cities*	*Mean industry innovations per 100,000 workers*
Agra-business	Atlanta	92.40
	Dallas	41.15
	Chicago	33.03
	St. Louis	91.74
Chemical engineering	Dallas	38.09
	Minneapolis	66.67
	San Francisco	43.89
	Wilmington	85.47
Office machinery	Anaheim-Santa Ana	92.59
	Minneapolis	31.86
	Rochester	72.20
	Stanford	68.40
Industrial machinery	Anaheim-Santa Ana	54.95
	Cincinnati	66.01
	Cleveland	141.51
	Passaic, NJ	90.90
High-tech computing	Boston	73.89
	Houston	62.08
	San Jose	44.88
	Minneapolis	181.74
Biomedical	Boston	38.71
	Cleveland	68.76
	Dallas	35.22
	New York	188.07

To test the hypothesis that the degree of specialization, or alternatively diversity, as well as the extent of local competition within a city shapes the innovative output of an industry, we estimate a model where the dependent variable is the number of innovations attributed to a specific four-digit SIC industry in a particular city. To reflect the extent to which economic activity within a city is specialized, we include as an explanatory variable a measure of industry specialization, which was used by Glaeser and others (1992) and is defined as the share of total employment in the city accounted for by industry employment in the city, divided by the share of U.S. employment accounted by that particular industry. This variable reflects the degree to which a city is specialized in a particular industry relative to the degree of economic activity in that industry that would occur if employment in the industry were randomly distributed across the United States. A higher value of this measure indicates a greater degree of specialization of the industry in that particular city. Thus, a positive coefficient would indicate that increased specialization within a city is conducive to greater innovative output and would support the Marshall-Arrow-Romer thesis. A negative coefficient would indicate that greater specialization within a city impedes innovative output and would support Jacobs' theory that diversity of economic activity is more conducive to innovation than is specialization of economic activity.

To identify the impact of an increased presence of economic activity in complementary industries sharing a common science base on the innovative activity of a particular industry within a specific city, a measure of the presence of science-based related industries is included. This measure is constructed analogously to the index of industry specialization and is defined as the share of total city employment accounted for by employment in the city in industries sharing the science base divided by the share of total U.S. employment accounted for by employment in that same science base. This variable measures the presence of complementary industries relative to what the presence would be if those related industries were distributed across the United States. A positive coefficient of the presence of science-based related industries would indicate that a greater presence of complementary industries is conducive to greater innovative output and would lend support for the diversity thesis. By contrast, a negative coefficient would suggest that a greater presence of related industries sharing the same science base impedes innovation and would argue against Jacobs' diversity thesis.

The usual concept of product market competition in the industrial organization literature is typically measured in terms of the size-distribution of firms. By contrast, Jacobs' concept of *localized competition* emphasizes instead the extent of competition for the ideas embodied in individuals. The greater the degree of competition among firms, the greater will be the extent of specialization among those firms and the easier it will be for individuals to pursue and implement new ideas. Thus the metric relevant to reflect the degree of localized competition is not the size of the firms in the region relative to their number (because, after all, many if not most manufacturing product markets are national or at least inter-regional in nature) but rather the number of firms relative to the number of workers. In measuring the extent of localized competition we again adopt a measure used by Glaeser and others (1992), which is defined as the number of firms per worker in the industry in the city relative to the number of firms per worker in the same industry in the United States. A higher value of this index of localized competition suggests that the industry has a greater number of firms per worker relative to its size in the particular city than it does elsewhere in the United States. Thus, if the index of localized competition exceeds one then the city is locally less competitive than in other U.S. cities.

In Feldman and Audretsch (1999) the regression model is estimated on the basis of the 5,946 city-industry observations for which data could be collected. The Poisson regression estimation method is used because the dependent variable is a limited dependent variable with a highly skewed distribution. By focusing on innovative activity for particular industries at specific locations, we find compelling evidence that specialization of economic activity does not promote innovative output. Rather, the results indicate that diversity across complementary economic activities sharing a common science base is more conducive to innovation than is specialization. In addition, the results indicate that the degree of local competition for new ideas within a city is more conducive to innovative activity than is local monopoly.

Public Policy Measures that Affect SMEs

Globalization combined with the telecommunications revolution has drastically reduced the cost of transporting not just material goods but also information across geographic space. High wages are increasingly incompatible with information-based economic activity, which can be easily transferred to a lower cost location. By contrast, the creation of new ideas on the basis of tacit knowledge cannot easily be transferred across distance. Thus, the comparative advantage of the high-cost countries of North America and Western Europe is increasingly based on knowledge-driven innovative activity. The spillover of knowledge from the firm or university creating that knowledge to a third-party firm is essential to innovative activity. Such knowledge spillovers tend to be spatially restricted. Thus, an irony of globalization is that even as the relevant geographic market for most goods and services becomes increasingly global, the increased importance of innovative activity in the leading developed countries has triggered a resurgence in the importance of local regions as a key source of comparative advantage.

As the comparative advantage in Western Europe and North America has become increasingly based on new knowledge, public policy toward business has responded in two fundamental ways. The first has been to shift the policy focus away from the traditional triad of policy instruments essentially constraining the freedom of firms to contract; that is, regulation, competition policy, or antitrust in the United States and public ownership of business. The policy approach of constraint was sensible as long as the major issue was how to restrain footloose multinational corporations in possession of considerable market power. This is reflected by the waves of deregulation and privatization along with the decreased emphasis of competition policy throughout the Organisation for Economic Co-operation and Development (OECD). Instead, a new policy approach is emerging that focuses on enabling the creation and commercialization of knowledge. Examples of such policies include encouraging R&D, venture capital, and new-firm startups.

The second fundamental shift involves the locus of such enabling policies, which are increasingly at the state, regional, or even local level. The downsizing of federal agencies charged with the regulation of business in the United Sates has been interpreted by many scholars as the eclipse of government intervention. But to interpret deregulation, privatization, and the increased irrelevance of competition policies as the end of government intervention in business ignores an important shift in the locus and target of public policy. The last decade has seen the emergence of a broad spectrum of enabling policy initiatives that fall outside of the jurisdiction of the traditional regulatory agencies. Sternberg (1996) documents how the success of a number of different high-technology clusters spanning a number of developed countries is the direct result of enabling policies, such as the provision of venture capital or research support. For example, the Advanced Research Program in Texas has provided support for basic research and the strengthening of the infrastructure of the University of Texas, which has played a central role in developing a high-technology cluster around Austin (Feller 1997). 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 a spectrum of industrial collaborators.

Such enabling policies that are typically implemented at the local or regional level are part of a silent policy revolution currently underway. The increased importance of innovative regional clusters as an engine of economic growth has led policy makers to abandon the policy cry frequently heard two decades ago, *Should we break up, regulate, or simply take over General Motors, IBM, and U.S. Steel*, for a very different contemporary version, *How can we grow the next Silicon Valley?*

One of the most important policies to promote SMEs at the federal level has been the Small Business Innovation Research (SBIR) program. The U.S. Congress enacted the SBIR in 1984. The Program provides a mandate that each participating government agency must spend a share of its research budget on contracts to small firms. This includes the major federal agencies, such as the Department of Defense, the National Institutes of Health, the National Science Foundation, Department of Energy, and the

National Aeronautics and Space Administration. The Small Business Innovation Development Act of 1982[20] required that agencies with extramural R&D budget of $100 million or more set aside not less than 0.2 percent of that amount for the SBIR program. In addition, the Act provided for annual increases up to a ceiling of not less than 1.25 percent of the agencies' budgets. The amount of awards will total over $1.4 billion in 1999.

The SBIR consists of three phases. Phase I is oriented toward determining the scientific and technical merit along with the feasibility of a proposed research idea. Phase II extends the technological idea and emphasizes commercialization. Phase III involves additional private funding for the commercial application of a technology. Under the Small Business Research and Development Enhancement Act of 1992, funding in Phase I was increased to $100,000, and in Phase II to $750,000.

The SBIR was an offshoot of the Small Business Investment Company (SBIC) program, which provided more than $3 billion to young firms between 1958 and 1969. During this period this amounted to more than three times the total amount of private venture capital.

The SBIR represents about 60 percent of all public SME finance programs. Taken together, the public SME finance is about two-thirds as large as private venture capital. In 1995 the sum of equity financing provided through and guaranteed by public programs financing SMES was $2.4 billion, which amounted to more than 60 percent of the total funding disbursed by traditional venture funds in that year. Equally as important, the emphasis on SBIR and most public funds is on early stage finance, which is generally ignored by private venture capital. Some of the most innovative American companies received early stage finance from SBIR, including Apple Computer, Chron, Compaq, and Intel.

While systematic evidence has been compiled indicating that SMEs receiving SBIR support exhibit greater rates of growth than those that do not, there is also evidence suggesting that the SBIR alters the career choices of scientists and engineers. In particular, the evidence suggests that (1) a significant number of the firms would not have been started in the absence of SBIR, (2) a significant number of other firms are started because of the demonstration effect by the efforts of scientists to commercialize knowledge, (3) as a result of the demonstration effect by SBIR-funded commercialization, a number of other scientists alter their careers to include commercialization efforts, and (4) technology-based entrepreneurs start firms because they have ideas that they think are potentially valuable and not start firms and then search for useful ideas or products. This is reflected by the fact that not a single respondent on either the survey or from the case studies suggested that they would have tried to start the firm with a different idea in the absence of SBIR funding. However, once the firm exists, one-quarter of the respondents and one-sixth of the case studies indicated that they would have tried to continue the firm with a different idea in the absence of SBIR funding. These different results may suggest that the SBIR has a greater impact on commercializing ideas that otherwise would not find their way into the market on potential entrepreneurs than on existing small firms.

4. Conclusions

When viewed through the static lens provided by industrial organization, small firms place an efficiency burden on the economy. Their small scale of production inflicts a substantial loss in terms of higher production costs. However, when viewed through a more evolutionary lens, such static losses in production efficiency are more than offset in gains in dynamic efficiency. The greatest contribution to economic efficiency by small firms is dynamic and evolutionary in nature: Small firms serve as agents of change.

In the current debate on the relationship between employment and wages, it is typically argued that the existence of small firms that are suboptimal within the organization of an industry represents a loss in economic efficiency. However, this argument is based on a static analysis. When viewed through a

20. Public Law 97-219, 22 July 1982.

dynamic lens a different conclusion emerges. One of the most striking results in the new literature is the finding of a positive impact of firm age on productivity and employee compensation, even after controlling for the size of the firm. Given the strongly confirmed stylized fact linking both firm size and age to a negative rate of growth (that is, the smaller and younger a firm the faster it will grow but the lower is its likelihood of survival), this new finding linking firm age to employee compensation and productivity suggests that not only will some of the small and suboptimal firms of today become the large and optimal firms of tomorrow, but there is at least a tendency for the low productivity and wage of today to become the high productivity and wage of tomorrow.

The public policies emerging in the post-war period dealing with business have been shaped by the static view of industrial organization and therefore are essentially constraining in nature. There were three general types of public policies towards business: antitrust (competition policy), regulation, and public ownership. All three of those policy approaches toward the firm in the market restricted the firm's freedom to contract. While specific policy approaches tended to be more associated with one country than with others, such as antitrust in the United States or public ownership in France and Sweden, all developed countries shared a common policy approach of intervening to restrain what otherwise was perceived as too much market power held by firms. Public policies constraining the freedom of the firm to contract were certainly consistent with the *Weltanschauung* emerging from the theories and empirical evidence regarding the firm in the market during the post-war period. Left unchecked, the large corporation in possession of market power would allocate resources in such a way as to reduce economic welfare. Through state intervention the Williamsonian tradeoff between efficiency on the hand and fairness on the other would be solved in a manner that presumably would be more socially satisfying.

More recently the relevant policy question has shifted away from *How can the government constrain firms from abusing their market power?* to *How can governments create an environment fostering the success and viability of firms?* The major issues of the day have shifted away from concerns about excess profits and abuses of market dominance to the creation of jobs, growth, and international competitiveness. The concern about corporations is now more typically not that they are too successful and powerful but that they are not successful and powerful enough. Thus, the government policies of the 1990s have increasingly shifted away from *constraining* to *enabling*. Public policy in the United States is increasingly fostering efforts to create new firms to promote job creation and economic growth within their jurisdictions. 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 is anything but new. Before the country was even half a century old, Alexis de Tocqueville, in 1835, reported, "What astonishes me in the United States is not so much the marvelous grandeur of some undertakings as the innumerable multitude of small ones."[21]

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21. Quoted from *Business Week*, Bonus Issue, 1993, p. 12.

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