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1. Introduction

Economic growth has been a major preoccupation of economists, dating back at least to Adam Smith. William Stanley Jevons, for example, posited a growth theory based on the activity of sunspots. Robert Solow took a less exotic approach to explaining economic growth. Writing in the post-war era, Solow was awarded the Nobel Prize for his model of economic growth based on what became termed as the neoclassical production function. In the Solow model two key factors of production – physical capital and (unskilled) labor were econometrically linked to explain economic growth.[1]

While economic growth policy seemingly fell squarely within the domain of macroeconomics, the primacy of capital as a factor of production had implications at the microeconomic level for the organization of both the enterprise and the industry or market. There were both theoretical arguments and empirical insights suggesting that the organization of economic activity to efficiently utilize the factor of physical capital might, in fact, not be consistent with the assumptions needed for perfect competition, and therefore economic welfare. In particular, capital seemed to be deployed most efficiently in large organizations capable of exhausting significant economies of scale, resulting in a concentrated industry or market, consisting of just a few main producers. The emergence and ascendancy of the applied field of industrial organization in economics reflected the importance of this concern.

During the post-war period a generation of scholars galvanized the field of industrial organization by developing a research agenda dedicated to identifying the issues involving this perceived trade-off between economic efficiency on the one hand and political and economic decentralization on the other (Scherer, 1970). Scholarship

in industrial organization generated a massive literature focusing on essentially three issues: (i) What are the gains to size and large-scale production? (ii) What are the economic welfare implications of having an oligopolistic or concentrated market structure, i.e. is economic performance promoted or reduced in an industry with just a handful of large-scale firms? and (iii) Given the overwhelming evidence that large-scale production resulting in economic concentration is associated with increased efficiency, what are the public policy implications?

A generation of scholars had systematically documented and supported the conclusion of Joseph A. Schumpeter (1942, p. 106): 'What we have got to accept is that the large-scale establishment or unit of control has come to be the most powerful engine of progress' and in particular of Oliver Williamson's classic 1968 article 'Economies as an Antitrust Defense: The Welfare Tradeoffs', published in the *American Economic Review*, became something of a final statement demonstrating what appeared to be an inevitable trade-off between the gains in productive efficiency that could be obtained through increased concentration and gains in terms of competition, and implicitly democracy, that could be achieved through decentralizing policies. But it did not seem possible to have both, certainly not in Williamson's completely static model.

It would be a mistake to think that knowledge was not considered as a factor influencing economic growth prior to the 'new endogenous growth theory'. As already explained, one of the main conclusions of the Solow model was that the traditional factors of capital and labor were inadequate in accounting for variations in growth performance. Indeed, it was the residual, attributed to reflect technological change that typically accounted for most of the variations in economic growth.

Still, the introduction of knowledge into macroeconomic growth models was formalized by Romer (1986) and Lucas (1988). Romer's (1986) critique of the Solow approach was not with the basic model of the neoclassical production function, but rather what he perceived to be omitted from that model – knowledge. Not only did Romer (1986), along with Lucas (1988) and others argue that knowledge was an important factor of production, along with the traditional factors of labor and capital, but because it was endogenously determined as a result of externalities and spillovers, it was particularly important.

That entrepreneurship in the form of new and small enterprises could play an important role in a knowledge-based economy seems to be contrary to many of the conventional theories of innovation. This conventional wisdom had been shaped largely by scholars such as Alfred Chandler (1977), Joseph Schumpeter (1942) and John Kenneth Galbraith (1962) who had convinced a generation of scholars and policy makers that innovation and technological change lie in the domain of large corporations and that small business would fade away as the victim of its own inefficiencies.

At the heart of this conventional wisdom was the belief that monolithic enterprises exploiting market power were the driving engine of innovative activity. Galbraith (1956, p. 86) echoed Schumpeter's conclusion: '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.'

The conventional wisdom about small and new firms was that they were burdened with a size inherent handicap in terms of innovative activity. Because they had a deficit of resources required to generate and commercialize ideas, this

conventional wisdom viewed small enterprises as being largely outside of the domain of innovative activity and technological change. Thus, even after David Birch (1981) revealed the startling findings from his study that small firms provided the engine of job creation for in the U.S., most scholars still assumed that, while small businesses may create the bulk of new jobs, innovation and technological change remained beyond their sphere.

The purpose of this paper is to suggest that a more recent literature has emerged which identifies how and why entrepreneurship in the form of new and small firms is a driving engine of industrial restructuring and economic growth. The starting point of this literature is the consideration of entrepreneurial opportunities and how they relate to opportunities generated by incumbent corporations. Entrepreneurship is distinguished from incumbent organizations with respect to both opportunity creation and exploitation. According to the *Knowledge Spillover Theory of Entrepreneurship* (Audretsch, Keilbach and Lehmann, 2006), entrepreneurial opportunities are not exogenous to the economy, but rather systematically created by incumbent organizations investing in new knowledge and ideas but unable to fully commercialize that new knowledge.

Thus, while Romer and others in the endogenous growth literature assume the spillover of knowledge to be automatic, the existence of the knowledge filter impedes the spill over and commercialization of knowledge. By serving as a conduit of knowledge spillovers, entrepreneurship not only triggers industrial restructuring but also provides the missing link in models of economic growth.

2. Where Does Opportunity Come From?

Where do opportunities come from? Herbert and Link (1989) have identified three distinct intellectual traditions in the development of the entrepreneurship literature that addresses this question. These three traditions can be characterized as the German Tradition, based on von Thuenen and Schumpeter, the Chicago Tradition, based on Knight and Schultz, and the Austrian Tradition, based on von Mises, Kirzner and Shackle. The general view in these contributions is that entrepreneurial opportunities arise from a continuous stream of (exogenous) shocks due to changes in the physical environment (e.g. due to changes in relative factor prices) or in the knowledge base (e.g. due to innovation). However, this literature does not offer an endogenous view of how these shocks are actually generated, i.e. the formation of new opportunities is taken as exogenous.

The view taken by the contemporary literature on entrepreneurship is no different. There, it is a virtual consensus that entrepreneurship revolves around the recognition of opportunities and the pursuit of those opportunities (Venkataraman, 1997). But, in this literature, the existence of those opportunities is, in fact, taken as given. The focus has been on the cognitive process by which individuals reach the decision to start a new firm. This has resulted in a methodology focusing differences across individuals in analyzing the entrepreneurial decision (Stevenson and Jarillo, 1990). Krueger (2003, p. 105) has pointed out that, 'The heart of entrepreneurship is an orientation toward seeing opportunities,' which frames the research questions, 'What is the nature of entrepreneurial thinking and What cognitive phenomena are associated with seeing and acting on opportunities?'

Thus, the traditional approach to entrepreneurship essentially holds the opportunities constant and then asks how the cognitive process inherent in the entrepreneurial decision varies across different individual characteristics and

attributes (Shaver, 2003; McClelland, 1961). As Shane and Eckhardt (2003, p 187) summarize this literature in introducing the individual-opportunity nexus, 'We discussed the process of opportunity discovery and explained why some actors are more likely to discover a given opportunity than others.' Some of these differences involve the willingness to incur risk; others involve the preference for autonomy and self-direction, while still others involve differential access to scarce and expensive resources, such as financial capital, human capital, social capital and experiential capital.

Stevenson and Jarillo (1990) assume that entrepreneurship is an orientation towards opportunity recognition. Central to this research agenda are the questions, *'How do entrepreneurs perceive opportunities and how do these opportunities manifest themselves as being credible versus being an illusion?'* Krueger (2003) examines the nature of entrepreneurial thinking and the cognitive process associated with opportunity identification and the decision to undertake entrepreneurial action.

To say that the literature has treated opportunities for entrepreneurs as being exogenous does not mean that all opportunity for a broader range of economic actors has been considered to be exogenous. For example, the most predominant theory of the firm does not assume that opportunities are exogenous to the firm. Rather, innovative opportunities are the result of systematic effort by firms and the result of purposeful efforts to create knowledge and new ideas, and subsequently to appropriate the returns of those investments through commercialization of such investments (Chandler, 1990; Cohen and Levin 1989; and Griliches 1979). In what Griliches formalized as the model of the knowledge production function, incumbent firms engage in the pursuit of new economic knowledge as an input into the process of generating the output of innovative activity. Such efforts to create opportunities

involve investments in research and development (R&D) and the enhancement of human capital through training and education.

Thus, according to the model of the knowledge production function (Griliches, 1979) opportunities are endogenously created by purposeful and dedicated investments and efforts by firms. This is a stark contrast to the intellectual tradition in the entrepreneurship literature where opportunities are taken as being exogenous, but the decision to become an entrepreneur is endogenous.

3. Opportunity Exploitation

Who exploits, or takes advantage of opportunities? Different literatures have undertaken different approaches to provide different answers to this question. The entrepreneurship literature has not treated this as being exogenous, but rather as the central question in the literature.

The focal point of this research is on the cognitive process identifying the entrepreneurial opportunity along with the decision to start a new firm. Thus, a perceived opportunity and intent to pursue that opportunity are the necessary and sufficient conditions for entrepreneurial activity to take place. The perception of an opportunity is shaped by a sense of the anticipated rewards accruing from and costs of becoming an entrepreneur. Some of the research focuses on the role of personal attitudes and characteristics, such as self efficacy (the individual's sense of competence), collective efficacy, and social norms. Shane (2000) has identified how prior experience and the ability to apply specific skills influence the perception of future opportunities.

The concept of the entrepreneurial decision resulting from the cognitive processes of opportunity recognition and ensuing action is introduced by Shane and

Eckhardt (2003) and Shane and Venkataraman (2001). They suggest that an equilibrium view of entrepreneurship stems from the assumption of perfect information. In contrast, imperfect information generates divergences in perceived opportunities across different people. The sources of heterogeneity across individuals include different access to information, as well cognitive abilities, psychological differences, and access to financial and social capital.

This approach focusing on individual cognition in the entrepreneurial process has generated a number of important and valuable insights, such as the contribution made by social networks, education and training, and familial influence. The literature certainly leaves the impression that entrepreneurship is a personal matter largely determined by DNA, familial status and access to crucial resources. For example, Sarasvathy, Dew, Velamuri and Venkataraman (2003, p. 142) explain the role of entrepreneurial opportunity in the literature, 'An entrepreneurial opportunity consists of a set of ideas, beliefs and actions that enable the creation of future goods and services in the absence of current markets for them'. Sarasvathy, Dew, Velamuri and Venkataraman provide a typology of entrepreneurial opportunities as consisting of opportunity recognition, opportunity discovery and opportunity creation.

In contrast, a very different literature, associated with the model of the knowledge production function looked for opportunity exploitation for the unit of observation of the firm. This literature implicitly assumed that opportunity exploitation takes place within the same organizational unit creating those opportunities in the first place – the firm. By explicitly modeling and specifying the econometric estimation of the knowledge production function as linking firm innovative output to firm investments in new knowledge (Griliches, 1984), such as R&D and human capital, this literature assumed that the creation and exploitation of

new opportunities occurred within the same organizational unit. Just as the firm as viewed as providing the organizational unit for the creation of the opportunities, through purposeful investments in R&D, it is also viewed as appropriating the returns to those investments through innovative activity, such as patented inventions creating new intellectual property.

However, the empirical evidence from systematic empirical testing of the model of the knowledge production function contradicted the assumption of singularity between the organization creating the opportunities and the organization exploiting the opportunities. For example, Acs and Audretsch (1990) found that the most innovative U.S. firms are large corporations that account for most of the country's private R&D investments. However, large firms did not account for the greatest amount of innovative activity in all, or even most of the innovative industries. For example, in the pharmaceutical preparation and aircraft industries the large firms were much more innovative, while in computers and process control instruments small firms contributed the bulk of the innovations.

Acs and Audretsch (1988 and 1990) found a small-firm innovation rate in manufacturing of 0.309, compared to a large-firm innovation rate of 0.202. Their findings, along with others, suggested an organizational discordance between the creation and exploitation of opportunities.

A third literature concerning the exploitation of opportunity was provided by evolutionary economics (Nelson and Winter, 1982). Nelson and Winter suggested that opportunity exploitation was shaped by two distinct knowledge regimes underlying each industry context. What they term as the routinized technological regime reflects knowledge conditions where the large incumbent firms that have created the opportunities through purposeful R&D and other knowledge creating efforts also are

the firms that exploit the opportunities that they created. Thus, the routinized technological regime essentially corresponded to the assumption implicit in the model of the knowledge production function that the firm exploiting opportunities is the same firm that created those opportunities in the first place. In contrast, in the entrepreneurial technological regime the knowledge conditions bestow the capacity to exploit the opportunities in a different organizational context, a small enterprise (Winter, 1984). Thus, the empirical evidence from testing the model of the knowledge production function actually seemed to support the evolutionary view more than the assumption of organizational homogeneity for opportunity creation and exploitation.

There are, however, two important distinctions to emphasize. The first is the view that, in the entrepreneurial regime, the small firms exist and will commercialize the new knowledge or innovate. In the lens provided by the spillover theory of entrepreneurship, the new firm is endogenously created via entrepreneurship or the recognition of an opportunity and pursuit by an economic agent (or team of economic agents) to appropriate the value of their knowledge. These knowledge bearing economic agents use the organizational context of creating a new firm to attempt to appropriate their endowments of knowledge.

The second distinction is that the knowledge will be commercialized, either by large or small firms. In the lens provided by the Knowledge Spillover Theory of Entrepreneurship, which is explained in the following section, the knowledge filter will impede and pre-empt at least some of the spillover and commercialization of knowledge. Only certain spillover mechanisms, such as entrepreneurship, can to some extent permeate the knowledge filter. But this is not a forgone conclusion, but rather will vary across specific contexts, and depends on a broad range of factors, spanning

individual characteristics, institutions, culture, laws, and is characterized by what Audretsch et al. (2006) denote as *Entrepreneurship Capital*.

4. The Knowledge Spillover Theory of Entrepreneurship

The discrepancy in organizational context between the organization creating opportunities and those exploiting the opportunities that seemingly contradicted Griliches' model of the firm knowledge production function was resolved by Audretsch (1995), who introduced *The Knowledge Spillover Theory of Entrepreneurship*, 'The findings challenge an assumption implicit to the knowledge production function – that firms exist exogenously and then endogenously seek out and apply knowledge inputs to generate innovative output... It is the knowledge in the possession of economic agents that is exogenous, and in an effort to appropriate the returns from that knowledge, the spillover of knowledge from its producing entity involves endogenously creating a new firm' (pp. 179-180).

What is the source of this entrepreneurial opportunity that endogenously generated the startup of new firms? The answer seemed to be through the spillover of knowledge that created the opportunities for the startup of a new firm, 'How are these small and frequently new firms able to generate innovative output when undertaken a generally negligible amount of investment into knowledge-generating inputs, such as R&D? One answer is apparently through exploiting knowledge created by expenditures on research in universities and on R&D in large corporations' (p. 179).

The empirical evidence supporting the Knowledge Spillover Theory of Entrepreneurship was provided from analyzing variations in startup rates across different industries reflecting different underlying knowledge contexts. In particular, those industries with a greater investment in new knowledge also exhibited higher startup rates than those with less investment in new knowledge. This evidence suggests one conduit for transmission of knowledge spillovers.

Thus, compelling evidence was provided suggesting that entrepreneurship is an endogenous response to opportunities created but not exploited by the incumbent firms. This involved an organizational dimension involving the mechanism transmitting knowledge spillovers – the startup of new firms. In addition, Jaffe (1989), Audretsch and Feldman (1996) and Audretsch and Stephan (1996) provided evidence concerning the spatial dimension of knowledge spillovers. In particular their findings suggested that knowledge spillovers are geographically bounded and localized within spatial proximity to the knowledge source. None of these studies, however, identified the actual mechanisms which actually transmit the knowledge spillover; rather, the spillovers were implicitly assumed to automatically exist (or fall like Manna from heaven), but only within a geographically bounded spatial area.

As Section Two of this chapter emphasized, while in the recent literature much has been made about the key role played by the recognition of opportunities in the cognitive process underlying the decision to become an entrepreneur, relatively little has been written about the actual source of such entrepreneurial opportunities. The Knowledge Spillover Theory of Entrepreneurship identifies one source of entrepreneurial opportunities – new knowledge and ideas. In particular, the Knowledge Spillover Theory of Entrepreneurship posits that it is new knowledge and ideas created in one context but left uncommercialized or not vigorously pursued by

the source actually creating those ideas, such as a research laboratory in a large corporation or research undertaken by a university, that serves as the source of knowledge generating entrepreneurial opportunities. Thus, in this view, one mechanism for recognizing new opportunities and actually implementing them by starting a new firm involves the spillover of knowledge. The organization creating the opportunities is not the same organization that exploits the opportunities. If the exploitation of those opportunities by the entrepreneur does not involve full payment to the firm for producing those opportunities, such as a license or royalty, then the entrepreneurial act of starting a new firm serves as a mechanism for knowledge spillovers.

Why should entrepreneurship play an important role in the spillover of new knowledge and ideas? And why should new knowledge play an important role in creating entrepreneurial opportunities? In the Romer (1986) model of endogenous growth new technological knowledge is assumed to automatically spill over. Investment in new technological knowledge is automatically accessed by third-party firms and economic agents, resulting in the automatic spill over of knowledge. The assumption that knowledge automatically spills over is, of course, consistent with the important insight by Arrow (1962) that knowledge differs from the traditional factors of production – physical capital and (unskilled) labor – in that it is non-excludable and non-exhaustive. When the firm or economic agent uses the knowledge, it is neither exhausted nor can it be, in the absence of legal protection, precluded from use by third-party firms or other economic agents. Thus, in the spirit of the Romer model, drawing on the earlier insights about knowledge from Arrow, a large and vigorous literature has emerged obsessed with the links between intellectual property protection

and the incentives for firms to invest in the creation of new knowledge through R&D and investments in human capital.

However, the preoccupation with the non-excludability and non-exhaustibility of knowledge first identified by Arrow and later carried forward and assumed in the Romer model, neglects another key insight in the original Arrow (1962) article. Arrow also identified another dimension by which knowledge differs from the traditional factors of production. This other dimension involves the greater degree of uncertainty, higher extent of asymmetries, and greater cost of transacting new ideas. The expected value of any new idea is highly uncertain, and as Arrow pointed out, has a much greater variance than would be associated with the deployment of traditional factors of production. After all, there is relative certainty about what a standard piece of capital equipment can do, or what an (unskilled) worker can contribute to a mass-production assembly line. In contrast, Arrow emphasized that when it comes to innovation, there is uncertainty about whether the new product can be produced, how it can be produced, and whether sufficient demand for that visualized new product might actually materialize.

In addition, new ideas are typically associated with considerable asymmetries. In order to evaluate a proposed new idea concerning a new biotechnology product, the decision maker might not only need to have a PhD in biotechnology, but also a specialization in the exact scientific area. Such divergences in education, background and experience can result in a divergence in the expected value of a new project or the variance in outcomes anticipated from pursuing that new idea, both of which can lead to divergences in the recognition and evaluation of opportunities across economic agents and decision-making hierarchies. Such divergences in the valuation of new

ideas will become greater if the new idea is not consistent with the core competence and technological trajectory of the incumbent firm.

Thus, because of the conditions inherent in knowledge – high uncertainty, asymmetries and transaction costs – decision making hierarchies can reach the decision not to pursue and try to commercialize new ideas that individual economic agents, or groups or teams of economic agents think are potentially valuable and should be pursued. The basic conditions characterizing new knowledge, combined with a broad spectrum of institutions, rules and regulations impose what Acs et al. (2004) term *the knowledge filter*. The knowledge filter is the gap between new knowledge and what Arrow (1962) referred to as economic knowledge or commercialized knowledge. The greater is the knowledge filter, the more pronounced is this gap between new knowledge and new economic, or commercialized, knowledge.

The knowledge filter is a consequence of the basic conditions inherent in new knowledge. Similarly, it is the knowledge filter that creates the opportunity for entrepreneurship in the Knowledge Spillover Theory of Entrepreneurship. According to this theory, opportunities for entrepreneurship are the duality of the knowledge filter. The higher is the knowledge filter, the greater are the divergences in the valuation of new ideas across economic agents and the decision-making hierarchies of incumbent firms. Entrepreneurial opportunities are generated not just by investments in new knowledge and ideas, but in the propensity for only a distinct subset of those opportunities to be fully pursued by incumbent firms.

Thus, the Knowledge Spillover Theory of Entrepreneurship shifts the fundamental decision making unit of observation in the model of the knowledge production function away from exogenously assumed firms to individuals, such as

scientists, engineers or other knowledge workers – agents with endowments of new economic knowledge. As Audretsch (1995) pointed out, when the lens is shifted away from the firm to the individual as the relevant unit of observation, the appropriability issue remains, but the question becomes "*How can economic agents with a given endowment of new knowledge best appropriate the returns from that knowledge?"* If the scientist or engineer can pursue the new idea within the organizational structure of the firm developing the knowledge and appropriate roughly the expected value of that knowledge, she has no reason to leave the firm. On the other hand, if she places a greater value on his ideas than do the decision-making bureaucracy of the incumbent firm, he may choose to start a new firm to appropriate the value of his knowledge.

In the Knowledge Spillover Theory of Entrepreneurship the knowledge production function is actually reversed. The knowledge is exogenous and embodied in a worker. The firm is created endogenously in the worker's effort to appropriate the value of his knowledge through innovative activity. Typically an employee from an established large corporation, often a scientist or engineer working in a research laboratory, will have an idea for an invention and ultimately for an innovation. Accompanying this potential innovation is an expected net return from the new product. The inventor would expect to be compensated for his/her potential innovation accordingly. If the company has a different, presumably lower, valuation of the potential innovation, it may decide either not to pursue its development, or that it merits a lower level of compensation than that expected by the employee.

In either case, the employee will weigh the alternative of starting his/her own firm. If the gap in the expected return accruing from the potential innovation between the inventor and the corporate decision maker is sufficiently large, and if the cost of starting a new firm is sufficiently low, the employee may decide to leave the large

corporation and establish a new enterprise. Since the knowledge was generated in the established corporation, the new start-up is considered to be a spin-off from the existing firm. Such start-ups typically do not have direct access to a large R&D laboratory. Rather, the entrepreneurial opportunity emanates from the knowledge and experience accrued from the R&D laboratories with their previous employers. Thus the knowledge spillover view of entrepreneurship is actually a theory of endogenous entrepreneurship, where entrepreneurship is an endogenous response to opportunities created by investments in new knowledge that are not commercialized because of the knowledge filter.

As investments in new knowledge increase, entrepreneurial opportunities will also increase. Contexts where new knowledge plays an important role are associated with a greater degree of uncertainty and asymmetries across economic agents evaluating the potential value of new ideas. Thus, a context involving more new knowledge will also impose a greater divergence in the evaluation of that knowledge across economic agents, resulting in a greater variance in the outcome expected from commercializing those ideas. It is this gap in the valuation of new ideas across economic agents, or between economic agents and decision-making hierarchies of incumbent enterprises, that creates the entrepreneurial opportunity

As already discussed, a vigorous literature has identified that knowledge spillovers are greater in the presence of knowledge investments. Just as Jaffe, (1989) and Audretsch and Feldman (1996) show, those regions with high knowledge investments experience a high level of knowledge spillovers, and those regions with a low amount of knowledge investments experience a low level of knowledge spillovers, since there is less knowledge to be spilled over.

The Knowledge Spillover Theory of Entrepreneurship analogously suggests that, *ceteris paribus*, entrepreneurial activity will tend to be greater in contexts where investments in new knowledge are relatively high, since the new firm will be started from knowledge that has spilled over from the source actually producing that new knowledge. A paucity of new ideas in an impoverished knowledge context will generate only limited entrepreneurial opportunities. In contrast, in a high knowledge context, new ideas will generate entrepreneurial opportunities by exploiting (potential) spillovers of that knowledge. Thus, the knowledge spillover view of entrepreneurship provides a clear link, or prediction that entrepreneurial activity will result from investments in new knowledge and that entrepreneurial activity will be spatially localized within close geographic proximity to the knowledge source. Systematic empirical evidence consistent with the Knowledge Spillover Theory of Entrepreneurship has been provided by Audretsch, Keilbach and Lehmann (2006) and Acs, Audretsch, Braunerhjelm and Carlsson (2004). Both studies find that entrepreneurship rates tend to be greater in the context of greater investments in new knowledge.

5. Growth

The Knowledge Spillover Theory of Entrepreneurship, which focuses on how new knowledge can influence the cognitive decision making process inherent in the entrepreneurial decision links entrepreneurship and economic growth, is consistent with theories of industry evolution (Jovanovic, 1982; Ericson and Pakes, 1995; Audretsch, 1995; Hopenhayn, 1992; Lambson, 1991 and Klepper, 1996). While traditional theories suggest that small firms will retard economic growth, by imposing

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

A distinguishing feature of these evolutionary theories is the focus on change as a central phenomenon. Innovative activity, one of the central manifestations of change, is at the heart of much of this work. Entry, growth, survival, and the way firms and entire industries change over time are linked to innovation. The dynamic performance of regions and even entire economies, that is the *Standort*, is linked to the efficacy of transforming investments in new knowledge into innovative activity.

Why are new firms started? The traditional, equilibrium-based view is that new firms in an industry, whether they are startups or firms diversifying from other industries, enter when incumbent firms in the industry earn supranormal profits. By expanding industry supply, entry depresses price and restores profits to their long-run equilibrium level. Thus, in equilibrium-based theories entry serves as a mechanism to discipline incumbent firms. In contrast, the new theories of industry evolution develop and evaluate alternative characterizations of entrepreneurship based on innovation and

costs of firm growth. These new evolutionary theories correspond to the disequilibrating theory of entrepreneurship proposed by Shane and Eckhardt (2003).

For example, Audretsch (1995) analyzes the factors that influence the rate of new firm startups. He finds that such startups are more likely in industries in which small firms account for a greater percentage of the industry's innovations. This suggests that firms are started to capitalize on distinctive knowledge about innovation that originates from sources outside of an industry's leaders. 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, that is its relative efficiency, but rather discovers this through the process of learning from its actual post-entry performance. In particular, Jovanovic (1982) assumes that entrepreneurs are unsure about their ability to manage a new-firm startup and therefore their prospects for success. Although entrepreneurs may launch a new firm based on a vague sense of expected post-entry performance, they only discover their true ability – in terms of managerial competence and of having based the firm on an idea that is viable on the market – once their business is established. Those entrepreneurs who discover that their ability exceeds their expectations expand the scale of their business, whereas those discovering that their post-entry performance is less than commensurate with their expectations will contact the scale of output and possibly exit from the industry. Thus, Jovanovic's model is a theory of *noisy selection*, where efficient firms grow and survive and inefficient firms decline and fail. The links between entrepreneurship on the one hand and growth and survival

on the other have been found across a number of social science disciplines, including economics, sociology and regional studies.

A series of survey articles by Sutton (1997), Caves (1998) and Geroski (1995) summarize the findings from a plethora of empirical studies examining the relationship between firm size and growth within the North American context. The early studies were undertaken using data from the U.S. These 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. A *stylized result* (Geroski, 1995) emerging from this literature is that, when a broad spectrum of firm sizes is included in samples of U.S. enterprises, smaller firms exhibit systematically higher growth rates than their larger counterparts. The growth advantage of small and new firms vis-à-vis large enterprises has been shown to be even greater in high technology industries (Audretsch, 1995).

These so-called stylized results between firm size and age on the one hand, and growth and survival on the other hand were subsequently confirmed for a number of European countries A wave of studies have confirmed these findings for different European countries, including Portugal (Mata, Portugal and Guimaraes, 1995; and Mata, 1994), Germany (Wagner, 1994), Norway (Tveteras and Edide; 2000 and Klette and Mathiassen; 1996) and Italy (Audretsch, Santarelli and Vivarelli, 1999).

Using a large comprehensive panel data set from the ZEW-foundation Panel (West), ‘Gibrat’s Law’ is rejected for the group of young firms belonging to technology intensive branches as well as those operating in non-technology intensive branches (Almus and Nerlinger, 2000), indicating that the smaller enterprises grow faster than their larger counterparts.

Heshmati (2001) has examined the relationship between firm size, age and growth for a large sample of small firms in Sweden between 1993 and 1998. The results indicate that, in Sweden, firm size and age are negatively related to employment growth, which is consistent with the findings for the U.S. However, in terms of sales growth, a positive relationship emerges, suggesting that, at least over this period, larger firms generated more growth in terms of sales than in terms of employment.

Wagner (1994) tracked the performance of small (and large) firms prior to exit. He used a longitudinal data base identifying the pre-exit performance of cohorts of firms exiting in 1990, 1991 and 1992. One striking result he found was that more than half of the exiting firms (between 53 percent and 61 percent) were founded prior to 1979, making them over 11 years old. He also found that young firms, which were classified as being younger than five years old, accounted for about a third of all exits. At the same time he found that the likelihood of survival increases with firm size.

Almus and Nerlinger (2000) also use a large panel data base to examine how the post-entry performance of new firms varies across sectors. In particular, they find that the growth rates of new firms tends to be greater in very high-tech industries than in high-tech industries and other manufacturing industries. This mirrors the results found in the North American context.

Using firm-level data from Italy, Audretsch, Santarelli, and Vivarelli (1999) find that growth rates are negatively related to firm size. In addition, they find that the likelihood of survival is greater in the startup year than in the second year, but subsequently increases over time. Similarly, Tveteras and Eide (2000) provide evidence for Norwegian manufacturing using the estimation technique of a semi-proportional Cox Model that the likelihood of survival is lower for smaller and

younger establishments. Bruederl and Preisendoerfer (1998) examine a data base consisting of 1,700 new-firm startups in Germany and find that the subsequent performance, measured in terms of likelihood of survival and growth, is greater for those entrepreneurs that (1) participate in a network with other entrepreneurs, (2) receive active help from their spouse, and (3) receive emotional support from their spouse. In addition, they find that entrepreneurial success is positively influenced by the ethnic background which of the entrepreneur, educational background, type of work experience, and whether the entrepreneur already had entrepreneurial experience. Their most striking finding is that entrepreneurial success is the highest within the context of a network with other entrepreneurs.

Thus, while there is somewhat more ambiguity in the studies linking growth and survival to firm size and growth, the results for Europe generally mirror the so-called 'Stylized Results' found within the North American context:

1. Growth rates are higher for smaller enterprises;
2. Growth rates are higher for younger enterprises;
3. Growth rates are even higher for small and young enterprises in knowledge-intensive industries;
4. The likelihood of survival is lower for smaller enterprises;
5. The likelihood of survival is lower for younger enterprises; and
6. The likelihood of survival is even lower for small and young enterprises in knowledge-intensive industries.

What emerges from the new evolutionary theories and corroborative empirical evidence on the role of entrepreneurial firms is that firms are in motion, with a lot of new firms entering the industry and a lot of firms exiting out of the industry. The evolutionary view of entrepreneurship is that new firms typically start at a very small scale of output. They are motivated by the desire to appropriate the expected value of new economic knowledge. But, depending upon the extent of scale economies in the industry, the firm may not be able to remain viable indefinitely at its startup size. Rather, if scale economies are anything other than negligible, the new firm is likely to have to grow to survival. The temporary survival of new firms is presumably supported through the deployment of a strategy of compensating factor differentials that enables the firm to discover whether or not it has a viable product.

The role of learning in the selection process has been the subject of considerable debate. On the one hand is what has been referred to as the *Larackian* assumption that learning refers to adaptations made by the new enterprise. In this sense, those new firms that are the most flexible and adaptable will be the most successful in adjusting to whatever the demands of the market are. As Nelson and Winter (1982, p. 11) point out, 'Many kinds of organizations commit resources to learning; organizations seek to copy the forms of their most successful competitors.' On the other hand is the interpretation that the role of learning is restricted to discovering if the firm is producing a good or offering a service that is compatible with market viability. Under this interpretation the new enterprise is not necessarily able to adapt or adjust to market conditions, but receives information based on its market performance with respect to its *fitness* in terms of meeting demand most efficiently vis-à-vis rivals. The theory of organizational ecology proposed by Michael T. Hannan and John Freeman (1989) most pointedly adheres to the notion that, 'We

assume that individual organizations are characterized by relative inertia in structure.' That is, firms learn not in the sense that they adjust their actions as reflected by their fundamental identity and purpose, but in the sense of their perception. When viewed from this evolutionary perspective, the startup of a new firm injects diversity into the market. The process of entrepreneurship, or starting a new firm, is therefore a mechanism generating diversity and the spillover of knowledge. As a result of the startup, knowledge is transformed into new approaches that otherwise would have remained unexplored.

As a result of the diversity of new approaches, entrepreneurship is a vital force fostering industrial restructuring. In his 1911 classic treatise, *Theorie der wirtschaftlichen Entwicklungen* (Theory of Economic Development), Schumpeter proposed a theory of *creative destruction*, where new firms with the entrepreneurial spirit displace less innovative incumbents, ultimately leading to a higher degree of economic growth. Even in his 1942 classic, *Capitalism and Democracy*, Schumpeter (p. 13) still argued that entrenched large corporations tend to resist change, forcing entrepreneurs to start new firms in order to pursue innovative activity: 'The function of entrepreneurs is to reform or revolutionize the pattern of production by exploiting an invention, or more generally, an untried technological possibility for producing a new commodity or producing an old one in a new way…. To undertake such new things is difficult and constitutes a distinct economic function, first because they lie outside of the routine tasks which everybody understands, and secondly, because the environment resists in many ways.' By pursuing opportunities that otherwise would not have been pursued by the incumbent organizations, entrepreneurship plants the seeds for entire new industries and is, thus, a driving force of industrial restructuring.

The systematic and empirical evidence described above 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 minimum efficient scale (MES) level of output and the size of the firm. However, the likelihood of any particular new firm surviving tends to decrease as this gap increases. Such new suboptimal scale firms are apparently engaged in the selection process. Only those firms offering a viable product that can be produced efficiently will grow and ultimately approach or attain the MES level of output. The remainder will stagnate, and depending upon the severity of the other selection mechanism – the extent of scale economies – may ultimately be forced to exit out of the industry.. Rather, by serving as agents of change, entrepreneurial firms provide an essential source of new ideas and experimentation that otherwise would remain untapped in the economy. The impact of entrepreneurship is therefore manifested by growth – at the levels of the firm, the region and even at the national level.

But is this motion horizontal, in that the bulk of firms exiting are comprised of firms that had entered relatively recently, or vertical, in that a significant share of the exiting firms had been established incumbents that were displaced by younger firms? In trying to shed some light on this question, Audretsch (1995) proposes two different models of the evolutionary process. Some contexts can be best characterized by the model of the conical revolving door, where new businesses are started, but there is also a high propensity to subsequently exit from the market. Other contexts 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 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 startups that are not so successful ultimately exit within a few years subsequent to entry. By serving as agents of change, new firms provide an essential conduit of knowledge spillovers exploiting new opportunities through experimentation that otherwise would remain untapped in the economy.

The likelihood that the new idea spawning the entrepreneurial startup is not compatible with market viability and sustainability is high. Thus, the evolutionary interpretation linking knowledge to entrepreneurship and ultimately economic growth suggests that the entrepreneurial act is to learn from the market about the viability and compatibility of a new idea that was rejected, or undervalued by incumbent organizations. The new startup serves as a conduit for knowledge spillovers from the source producing that knowledge to commercialization in a new firm.

One of the important findings of Glaeser et al. (1992) and Feldman and Audretsch (1999) is that economic growth is promoted by knowledge spillovers. However, their findings, as well as the corroborative results from a plethora of studies, focused on a spatial unit of observation, such as cities, regions and states. For example, Glaeser et al. (1992) found compelling empirical evidence suggesting that a greater degree of knowledge spillover leads to higher growth rates of cities. If the existence of higher knowledge spillovers bestow higher growth rates for cities, this relationship should also hold for the unit of observation of the (knowledge) firm. The performance of entrepreneurial firms accessing knowledge spillovers should exhibit a superior performance. Thus, the *Entrepreneurial Performance Hypothesis* states that ‘The

performance of knowledge-based startups should be superior when they are able to access knowledge spillovers through geographic proximity to knowledge sources, such as universities, when compared to their counterparts without a close geographic proximity to a knowledge source.'

The *Entrepreneurial Performance Hypothesis* has been subjected to empirical scrutiny. Evidence supporting the *Entrepreneurial Performance Hypothesis* at the firm level has been provided by Gilbert (2004), Audretsch, Keilbach and Lehmann (2006), and Gilbert, McDougall and Audretsch (2005).

However, the *Entrepreneurial Performance Hypothesis* and supporting empirical evidence cannot be interpreted as attributing the entire impact of entrepreneurship on growth to be restricted to the growth of entrepreneurial firms themselves. Such an extreme assumption of no external impacts is implicit in the analyses of new and small enterprises found in the pathbreaking Birch (1979) study, as well as the more recent Davis et al. (1996a and 1996b) update. While there is severe methodological disagreement between the Davis et al. and Birch approaches to measuring the impact of small firms on economic performance, both implicitly agree in an absence of external impact. Thus, in a type of statistical apartheid or segregation, in the Birch and Davis et al. studies, the impact of small and new firms is measured only within that set of firms.

In contrast, the impact of entrepreneurship on economic growth is not constrained to be limited to manifest itself solely in those entrepreneurial firms, but rather has an external impact of far greater significance. The link between entrepreneurship and economic growth should also exist at the more aggregated level of economic activity. A location, or *Standort*, endowed with a higher degree of what is Audretsch, Keilbach and Lehmann (2006) term as *Entrepreneurship Capital*, will

facilitate knowledge spillovers and the commercialization of knowledge, thereby generating greater economic growth. The *Growth Hypothesis* states, 'Given a level of knowledge investment and severity of the knowledge filter, higher levels of economic growth should result from greater entrepreneurial activity, since entrepreneurship serves as a mechanism facilitating the spillover and commercialization of knowledge.'

In introducing the model of the production function, Robert Solow (1956) argued that economic growth is determined explicitly by the stocks of capital and labor. Technical change entered the production function exogenously as a shift factor. More recently Romer (1986), Lucas (1993) and others extended the neoclassical model of growth by suggesting that not only is knowledge an important factor generating growth, but because it spills over for use by third-party firms it is actually the most potent factor.

The Knowledge Spillover Theory of Entrepreneurship explained in the previous section suggests that this assessment of the role of knowledge overlooks some of the most fundamental mechanisms driving the process of economic growth. The spillover process that Romer and the endogenous growth theory assume to be automatic is not at all automatic. Rather it is a process that is actively driven by economic agents. According to Audretsch et al. (2006), *Entrepreneurship Capital* serves as a mechanism facilitating the spillover of knowledge.

While Romer and Lucas added the factor of knowledge capital to the traditional factors of physical capital and labor, Audretsch et al. (2006) do not dispute the importance of the traditional factors, but suggest an additional factor as well – the degree of entrepreneurship capital specific to a *Standort*, or location. By entrepreneurship capital Audretsch et al. (2006) mean the capacity for the *Standort*,

that is the geographically relevant spatial units of observation, to generate the startup of new enterprises.

While the neoclassical tradition identified investment in *physical capital* as the driving factor of economic performance (Solow, 1956), the endogenous growth theory (Romer 1986, 1990; Lucas 1988) put the emphasis on the process of the accumulation of knowledge, and hence the creation of *knowledge capital*. The concept of *social capital* (Putnam, 1993 and Coleman, 1988a and 1988b) could be considered as a further extension because it added a social component to those factors shaping economic growth and prosperity. According to Putnam (2000, p. 19),

> '*Whereas physical capital refers to physical objects and human capital refers to the properties of individuals, social capital refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them. In that sense social capital is closely related to what some have called 'civic virtue.' The difference is that 'social capital' calls attention to the fact that civic virtue is most powerful when embedded in a sense network of reciprocal social relations. A society of many virtues but isolated individuals is not necessarily rich in social capital.'*

Putnam also challenged the standard neoclassical growth model by arguing that social capital was also important in generating economic growth, 'By analogy with notions of physical capital and human capital – tools and training that enhance individual productivity – social capital refers to features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefits.'

A large and robust literature has emerged trying to link social capital to entrepreneurship (Aldrich and Martinez, 2003 and Thorton and Flynn, 2003). However, while it was clear that Putnam was providing a link between social capital and economic welfare, this link did not directly involve entrepreneurship. The components of social capital Putnam emphasized the most included associational membership and public trust. While these may be essential for social and economic well being, it was not obvious that they involved entrepreneurship, per se.

Social capital and entrepreneurship capital are distinctive concepts that should not be confused. According to Putnam (2000, p. 19), 'Social capital refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them. In that sense social capital is closely related to what some have called "civic virtue." … Social capital calls attention to the fact that civic virtue is most powerful when embedded in a sense network of reciprocal social relations…. Social capital refers to features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefits.'

Audretsch et al. (2006) argue that what has been called social capital in the entrepreneurship literature may actually be a more specific sub-component, which we introduce as *entrepreneurship capital*. Entrepreneurship has typically been defined as an action, process, or activity. Entrepreneurship involves the startup and growth of new enterprises. Entrepreneurship capital involves a milieu of agents and institutions that is conducive to the creation of new firms. This involves a number of aspects such as social acceptance of entrepreneurial behavior but of course also individuals who are willing to deal with the risk of creating new firms[2] and the activity of bankers and venture capital agents that are willing to share risks and benefits involved. Hence entrepreneurship capital reflects a number of different legal, institutional and social

factors and forces. Taken together, these factors and forces constitute the entrepreneurship capital of an economy, which creates a capacity for entrepreneurial activity (Hofstede et. al., 2002).

It should be emphasized that entrepreneurship capital should not be confused with social capital. The major distinction is that, in our view, not all social capital may be conducive to economic performance, let alone entrepreneurial activity. Some types of social capital may be more focused on preserving the status quo and not necessarily directed at creating challenges to the status quo. In contrast, entrepreneurship capital could be considered to constitute one particular sub-set of social capital. While social capital may have various impacts on entrepreneurship, depending on the specific orientation, entrepreneurship capital, by its very definition, will have a positive impact on entrepreneurial activity.

Audretsch et al. (2006) include a measure of entrepreneurship capital, along with the traditional factors of production of labor, physical capital and knowledge capital, in a production function model to estimate economic growth. Their evidence suggests that entrepreneurship capital exerts indeed a positive impact on economic growth. This finding holds for different measured of entrepreneurship capital, ranging from the more general to the more risk oriented.

While the findings by Audretsch et al. (2006) certainly do not contradict the conclusions of earlier studies linking growth to factors such as labor, capital, and knowledge, their evidence points to an additional factor, entrepreneurship capital, that also plays an important role in generating economic growth.

The results from including measures of entrepreneurship capital in the context of estimating economic growth in a production function model are consistent with other studies also finding a positive relationship between various measures of

entrepreneurship and economic growth. For example, Acs et al. (2004) find a positive relationship between entrepreneurship and growth at the country level. Wennekers and Thurik (1999) provided empirical evidence from a 1984-1994 cross-sectional study of the 23 countries that are part of the Organization for Economic Co-operation and Development (OECD), that increased entrepreneurship, as measured by business ownership rates, was associated with higher rates of employment growth at the country level. Similarly, Audretsch et al. (2002) and Carree and Thurik (1999) find that OECD countries exhibiting higher increases in entrepreneurship also have experienced greater rates of growth and lower levels of unemployment.

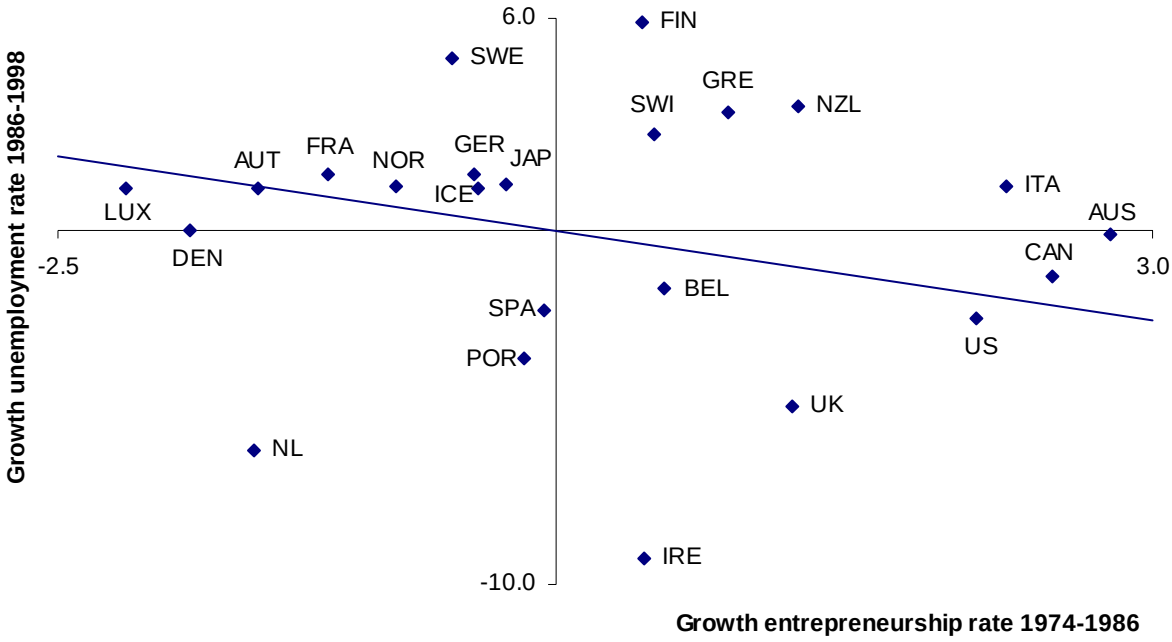
In a study for the OECD, Audretsch and Thurik (2002) undertook two separate empirical analyses to identify the impact of changes of entrepreneurship on growth. Each one uses a different measure of entrepreneurship, sample of countries and specification. This provides some sense of robustness across different measures of entrepreneurship, data sets, time periods and specifications. The first analysis uses a data base measures entrepreneurship in terms of the relative share of economic activity accounted for by small firms. It links changes in entrepreneurship to growth rates for a panel of 18 OECD countries spanning five years to test the hypothesis that higher rates of entrepreneurship lead to greater subsequent growth rates. The second analysis uses a measure of self-employment as an index of entrepreneurship and links changes in entrepreneurship to unemployment at the country level between 1974 and 1998. The different samples including OECD countries over different time periods reach consistent results – increases in entrepreneurial activity tends to result in higher subsequent growth rates and a reduction of unemployment

The Global Entrepreneurship Monitor (GEM) Study (Reynolds et al., 2000) also established an empirical link between the degree of entrepreneurial activity and

economic growth, as measured by employment, at the country level. Thus, there are not only theoretical arguments but also empirical evidence suggesting that the growth of countries is positively associated with an entrepreneurial advantage.

Figure 1 shows that those countries exhibiting a greater increase in entrepreneurship rates between 1974 and 1986 also tended to exhibit greater decreases in unemployment rates between 1986 and 1998. This would suggest a negative relationship between entrepreneurial activity and subsequent unemployment. Unemployment is used here because of its importance as a policy goal. A similar relationship between entrepreneurship and growth rates for a broader spectrum of countries, including both OECD and non-OECD countries, is shown by the Global Entrepreneurship Monitor (GEM) Study (Reynolds et al., 2000).

Figure 1: Changes in entrepreneurship and unemployment rates in OECD countries



Source: Audretsch et al., 2002

Several studies have attempted to link entrepreneurship to regional growth. The unit of observation for these studies is at the spatial level, either a city, region, or state. The most common and most exclusive measure of performance is growth, typically measured in terms of employment growth. These studies have tried to link various measures of entrepreneurial activity, most typically startup rates, to economic growth. Other measures sometimes used include the relative share of SMEs, and self-employment rates.

For example, Holtz-Eakin and Kao (2003) examine the impact of entrepreneurship on growth. Their spatial unit of observation is for states. Their measure of growth is productivity change over time. A vector autoregression analysis

shows that variations in the birth rate and the death rate for firms are related to positive changes in productivity. They conclude that entrepreneurship has a positive impact on productivity growth, at least for the case of the United States.

Audretsch and Fritsch (1996) analyzed a database identifying new business startups and exits from the social insurance statistics in Germany to examine whether a greater degree of turbulence leads to greater economic growth, as suggested by Schumpeter in his 1911 treatise. These social insurance statistics are collected for individuals. Each record in the database identifies the establishment at which an individual is employed. The startup of a new firm is recorded when a new establishment identification appears in the database, which generally indicates the birth of a new enterprise. While there is some evidence for the United States linking a greater degree of turbulence at the regional level to higher rates of growth for regions (Reynolds, 1999), Audretsch and Fritsch (1996) find that the opposite was true for Germany during the 1980s. In both the manufacturing and the service sectors, a high rate of turbulence in a region tends to lead to a lower and not a higher rate of growth. They attribute this negative relationship to the fact that the underlying components – the startup and death rates – are both negatively related to subsequent economic growth. Those areas with higher startup rates tend to experience lower growth rates in subsequent years. Most strikingly, the same is also true for the death rates. The German regions experiencing higher death rates also tend to experience lower growth rates in subsequent years. Similar evidence for Germany is found by Fritsch (1997).

Audretsch and Fritsch (1996) conjectured that one possible explanation for the disparity in results between the United States and Germany may lie in the role that innovative activity, and therefore the ability of new firms to ultimately displace the incumbent enterprises, plays in new-firm startups. It may be that innovative activity

did not play the same role for the German *Mittelstand* as it does for SMEs in the United States. To the degree that this was true, it may be hold that regional growth emanates from SMEs only when they serve as agents of change through innovative activity.

The empirical evidence suggested that the German model for growth provided a sharp contrast to that for the United States. While Reynolds (1999) had found that the degree of entrepreneurship was positively related to growth in the United States, a series of studies by Audretsch and Fritsch (1996) and Fritsch (1997) could not identify such a relationship for Germany. However, the results by Audretsch and Fritsch were based on data from the 1980s.

Divergent findings from the 1980s about the relationship between the degree of entrepreneurial activity and economic growth in the United States and Germany posed something of a puzzle. On the one hand, these different results suggested that the relationship between entrepreneurship and growth was fraught with ambiguities. No confirmation could be found for a general pattern across developed countries. On the other hand, it provided evidence for the existence of distinct and different national systems. The empirical evidence clearly suggested that there was more than one way to achieve growth, at least across different countries. Convergence in growth rates seemed to be attainable by maintaining differences in underlying institutions and structures.

However, in a more recent study, Audretsch and Fritsch (2002) find that different results emerge for the 1990s. Those regions with a higher startup rate exhibit higher growth rates. This would suggest that, in fact, Germany is changing over time, where the engine of growth is shifting towards entrepreneurship as a source of growth. The results of their 2002 paper suggest an interpretation that differs from their

earlier findings. Based on the compelling empirical evidence that the source of growth in Germany has shifted away from the established incumbent firms during the 1980s to entrepreneurial firms in the 1990s, it would appear that a process of convergence is taking place between Germany and the United States, where entrepreneurship provides the engine of growth in both countries. Despite remaining institutional differences, the relationship between entrepreneurship and growth is apparently converging in both countries.

The positive relationship between entrepreneurship and growth at the regional level is not limited to Germany in the 1990. For example, Foelster (2000) examines not just the employment impact within new and small firms but on the overall link between increases in self-employment and total employment in Sweden between 1976 and 1995. By using a Layard-Nickell framework, he provides a link between micro behavior and macroeconomic performance, and shows that increases in self-employment shares have had a positive impact on regional employment rates in Sweden.

Callejon and Segarra (1999) use a data set of Spanish manufacturing industries between 1980-1992 to link new-firm birth rates and death rates, which taken together constitute a measure of turbulence, to total factor productivity growth in industries and regions. They adopt a model based on a vintage capital framework in which new entrants embody the edge technologies available and exiting businesses represent marginal obsolete plants. Using a Hall type of production function, which controls for imperfect competition and the extent of scale economies, they find that both new-firm startup rates and exit rates contribute positively to the growth of total factor productivity in regions as well as industries.

Conclusions

The prevalent and traditional theories of entrepreneurship have typically held the context constant and then examined how characteristics specific to the individual impact the cognitive process inherent in the model of entrepreneurial choice. This often leads to the view that is remarkably analogous to that concerning technical change in the Solow model – given a distribution of personality characteristics, proclivities, preferences and tastes, entrepreneurship is exogenous. One of the great conventional wisdoms in entrepreneurship is '*Entrepreneurs are born not made.*' Either you have it or you don't. This leaves virtually no room for policy or for altering what nature has created.

This paper has presented an alternative view. The Knowledge Spillover Theory of Entrepreneurship holds the individual attributes constant and rather focuses on variations in the context. In particular, we consider how the knowledge context will impact the cognitive process underlying the entrepreneurial choice model. The result is a theory of endogenous entrepreneurship, where (knowledge) workers respond to opportunities generated by new knowledge by starting a new firm. In this view entrepreneurship is a rationale choice made by economic agents to appropriate the expected value of their endowment of knowledge. Thus, the creation of a new firm is the endogenous response to investments in knowledge that have not been entirely or exhaustively appropriated by the incumbent firm.

In the endogenous theory of entrepreneurship, the spillover of knowledge and the creation of a new, knowledge-based firm are virtually synonymous. Of course, there are many other important mechanisms facilitating the spill over of knowledge that have nothing to do with entrepreneurship, such as the mobility of scientists and

workers, and informal networks, linkages and interactions. Similarly, there are certainly new firms started that have nothing to do with the spillover of knowledge. Still, the spillover theory of entrepreneurship suggests that there will be additional entrepreneurial activity as a rationale and cognitive response to the creation of new knowledge. Those contexts with greater investment in knowledge should also experience a higher degree of entrepreneurship, *ceteris paribus*. Perhaps it is true that entrepreneurs are made. But more of them will discover what they are made of in a high-knowledge context than in an impoverished knowledge context. Thus, we are inclined to restate the conventional wisdom and instead propose that entrepreneurs are not necessarily made, bur are rather a response – and in particular a response to high knowledge contexts that are especially fertile in spawning entrepreneurial opportunities.

By endogenously facilitating the spill over of knowledge created in a different organization and perhaps for a different application, entrepreneurship may provide what could be considered to be the missing link to economic growth. Confronted with a formidable knowledge filter, public policy instruments emerging from the new growth theory, such as investments in human capital, R&D, and university research may not adequately result in satisfactory economic growth. One interpretation of the European Paradox, where such investments in new knowledge have certainly been vigorous and sustained, is that the presence of such an imposing knowledge filter chokes off the commercialization of those new investments, resulting in diminished innovative activity and ultimately stagnant growth.

By serving as a conduit for knowledge spillovers, entrepreneurship is the missing link between investments in new knowledge and economic growth. Thus, the spillover theory of knowledge entrepreneurship provides not just an explanation of

why entrepreneurship has become more prevalent as the factor of knowledge has emerged as a crucial source for comparative advantage, but also why entrepreneurship plays a vital role in fostering industrial restructuring and generating economic growth. Entrepreneurship is an important mechanism permeating the knowledge filter to facilitate the spill over of knowledge, create new industries and move out of old ones, and ultimately generate economic growth.

References

Acs, Z. and Audretsch, D. 1988. "Innovation in Large and Small Firms: An Empirical Analysis". *American Economic Review, 78,* 678-690.

Acs, Z. and Audretsch, D. 1990. *Innovation and Small Firms.* Cambridge: MIT Press.

Acs, Z., Audretsch D., Braunerhjelm P. and Carlsson, B. 2004. *The Missing Link: The Knowledge Filter and Entrepreneurship in Endogenous Growth*. (Discussion Paper). Center for Economic Policy Research, Stockholm.

Aldrich, H. and Martinez, M. 2003. "Entrepreneurship, Networks and Geographies". In *Handbook of Entrepreneurship Research* New York: Springer Publishers, 359-400.

Almus, M. and Nerlinger, E. 2000. "Testing Gibrat's Law for Young Firms – Empirical Results for West Germany". *Small Business Economics, 15,* 1-12.

Arrow, K. 1962. "Economic Welfare and the Allocation of Resources for Invention". In *The Rate and Direction of Inventive Activity.* Princeton: Princeton University Press, 609-626.

Audretsch, D. 1991. "New Firm Survival and the Technological Regime". *Review of Economics and Statistics, 73,* 441-450.

Audretsch, D. 1995. *Innovation and Industry Evolution.* Cambridge: MIT Press.

Audretsch, D. 2005. *The Entrepreneurial Society.* New York: Oxford University Press.

Audretsch et al. 2002. "Impeded Industrial Restructuring: The Growth Penalty". *Kyklos, 55,* 81-98.

Audretsch, D. and Feldman, M. 1996. "R&D Spillovers and the Geography of Innovation and Production". *American Economic Review, 86,* 630-640.

Audretsch, D. and Fritsch, M. 1996. "Creative Destruction: Turbulence and Economic Growth". In *Behavioral Norms, Technological Progress, and Economic Dynamics: Studies of Schumpeterian Economics.* University of Michigan Press. 137-150.

Audretsch, D. B. und Fritsch, M. 2002. "Growth Regimes over Time and Space", *Regional Studies*, 36, 113-124.

Audretsch, D., Keilbach, M. and Lehmann, E. 2006. *Entrepreneurship and Economic Growth.* London: Oxford University Press.

Audretsch, D., Santarelli, E. and Vivarelli, M. 1999. "Start-up Size and Industrial Dynamics: Some Evidence from Italian Manufacturing". *International Journal of Industrial Organization, 17,* 965-983.

Audretsch, D. and Stephan, P. 1996. "Company-Scientist Locational Links: The Case of Biotechnology". *American Economic Review, 86*, 641-652.

Audretsch, D. and Thurik, R. 2002. *Linking Entrepreneurship to Growth* (STI Working Paper) 2081/2 OECD.

Birch, D. 1979. *The Job Creation Process, 1979.* Unpublished Report, MIT Program on Neighborhood and Regional Change.

Birch, D. 1981. "Who Creates Jobs?". *The Public Interest, 65*, 3-14.

Bruederl, J. and Preisendoerfer, P. 1998. "Network Support and the Success of Newly Founded Businesses". *Small Business Economics, 10*, 213-225.

Callejon, M. and Segarra, A. 1999. "Business Dynamics and Efficiency in Industries and Regions: The Case of Spain". *Small Business Economics, 13,* 253-271.

Carree, M. and Thurik, R. 1999. "Industrial Structure and Economic Growth". In *Innovation, Industry Evolution, and Employment*. Cambridge: Cambridge University Press, 86-110.

Caves, R. 1998. "Industrial Organization and New Findings on the Turnover and Mobility of Firms". *Journal of Economic Literature, 36,* 1947-1982.

Chandler, A. 1977. *The Visible Hand: The Managerial Revolution in American Business*. Cambridge: Belknap Press.

Chandler, A. 1990. *Scale and Scope: The Dynamics of Industrial Capitalism.* Cambridge: Harvard University Press.

Coleman J. 1988a. "Social Capital in the Creation of Human Capital". *American Journal of Sociology, 94,* 95-121.

Coleman J. 1988b. "The Creation and Destruction of Social Capital: Implications for the Law". *Notre Dame Journal of Law, Ethics and Public Policy, 3,* 375-404.

Cohen, W. and Levin, R. 1989. "Empirical Studies of Innovation and Market Structure" In *Handbook of Industrial Organization (Vol. 2).* "Amsterdam: North Holland, 1059-1107.

Dunne, T., Roberts M. and Samuelson, L. 1989. "The Growth and Failure of U.S. Manufacturing Plants". *Quarterly Journal of Economics, 104,* 671-698.

Davis, S., Haltiwanger, J. and Schuh, S. 1996a. *Job Creation and Destruction.* Cambridge: MIT Press.

Davis, S., Haltiwanger, J. and Schuh, S. 1996b. "Small Business and Job Creation: Dissecting the Myth and Reassessing the Facts". *Small Business Economics, 8,* 297-315.

Ericson, R. and Pakes, A. 1995. "Markov-Perfect Industry Dynamics: A Framework for Empirical Work". *Review of Economic Studies, 62,* 53-82.

Feldman, M., and Audretsch, D. 1999. "Science-Based Diversity, Specialization, Localized Competition and Innovation". *European Economic Review,* 43, 409-429.

Foelster, S. 2000. "Do Entrepreneurs Create Jobs?". *Small Business Economics, 14,* 137-148.

Fritsch, M. 1997. "New Firms and Regional Employment Change". *Small Business Economics, 9,* 437-448.

Galbraith, J. 1956. *American Capitalism: The Concept of Coutervailing Power*. Boston: Houghton Mifflin.

Galbraith, J. 1962. *Economic Development in Perspective*. Cambridge: Harvard University Press.

Gartner, W. and Carter, N. 2003. "Entrepreneurial Behavior and Firm Organizing Processes". In *Handbook of Entrepreneurship Research*. New York: Springer Publishers, 195-222.

Geroski, P. 1995. "What Do We Know About Entry". *International Journal of Industrial Organization, 13,* 421- 440.

Gilbert, B., McDougall, P. and Audretsch, D. 2005. “Clusters, Knowledge and New Venture Performance: An Empirical Investigation”. (Unpublished Manuscript).

Gilbert, B. 2004. *Clusters and New Venture Performance* (PhD Dissertation). “Bloomington: Indiana University.

Glaeser, E., Kallal, H., Scheinkman, J. and Shleifer, A. 1992. “Growth of Cities”. *Journal of Political Economy, 100,* 1126-1152.

Griliches, Z. 1979. “Issues in Assessing the Contribution of Research and Development to Productivity Growth”. *Bell Journal of Economics, 10,* 92-116.

Griliches, Z. 1984. *R&D, Patents and Productivity*. Chicago: University of Chicago Press.

Hall, B. 1987. “The Relationship between Firm Size and Firm Growth in the U.S. Manufacturing Sector”. *Journal of Industrial Economics, 35,* 583-605.

Hannan, M. and Freeman, J. 1989. *Organizational Ecology*. Cambridge: Harvard University Press.

Hebert, R. and Link, A. 1989. “In Search of the Meaning of Entrepreneurship”. *Small Business Economics, 1,* 39-49.

Heshmati, A. 2001. “On the Growth of Micro and Small Firms: Evidence from Sweden”. *Small Business Economics, 17*, 213-228.

Hofstede, G. et al. 2002. “Culture’s Role in Entrepreneurship: Self-employment Out of Dissatisfaction”. In *Innovation, Entrepreneurship and Culture: The Interaction between Technology, Progress and Economic Growth*. Brookfield (VT): Edward Elgar.

Holtz-Eakin, D. and Kao, C. 2003. *Entrepreneurship and Economic Growth: The Proof is in the Productivity.* Syracuse University: Center for Policy Research.

Hopenhayn, H. 1992. "Entry, Exit and Firm Dynamics in Long Run Equilibrium". *Econometrica, 60,* 1127-1150.

Jaffe, A. 1989. "The Real Effects of Academic Research". *American Economic Review, 79,* 957-970

Jovanovic, B. 1982. "Selection and the Evolution of Industry. *Economica, 50,* 649-70.

Klepper, S. 1996. "Entry, Exit, Growth, and Innovation over the Product Life Cycle". *American Economic Review, 86,* 562-583.

Klette, T. and Mathiassen, A. 1996. "Job Creation, Job Destruction and Plant Turnover in Norwegian Manufacturing". *Annales d"Economie et de Statistique, 41/42,* 97-125.

Krueger, N. 2003. "The Cognitive Psychology of Entrepreneurship". In *Handbook of Entrepreneurship Research.* New York: Springer Publishers, 105-140.

Lambson, V. 1991. "Industry Evolution with Sunk Costs and Uncertain Market Conditions". *International Journal of Industrial Organization, 9,* 171-196.

Lucas, R. 1988. "On the Mechanics of Economic Development". *Journal of Monetary Economics, 22,* 3-42.

Lucas, R. 1993. "Making a Miracle". *Econometrica, 61,* 251-272.

Mansfield, E. 1962. “Entry, Gibrat’s Law, Innovation, and the Growth of Firms”. *American Economic Review, 52*, 1023-1051.

Mata, J. 1994. “Firm Growth during Infancy. *Small Business Economics, 6,* 27-40.

Mata, J., Portugal P. and Guimaraes, P. 1995. “The Survival of New Plants: Start-up Conditions and Post-entry Evolution”. *International Journal of Industrial Organization, 13,* 459-481.

McClelland, D. 1961. *The Achieving Society.* Princeton: Van Nostrand.

Nelson, R. 1981. “Research on Productivity Growth and Differences: Dead Ends and New Departures”. *Journal of Economic Literature, 19,* 1029-1064.

Nelson, R. and Winter S. 1982. *An Evolutionary Theory of Economic Change.* Cambridge: Belkap Press.

Putnam, R. 1993. *Making Democracy Work.* Princeton: Princeton University Press.

Putnam, R. 2000. *Bowling Alone: The Collapse and Revival of American Community.* New York: Simon and Schuster.

Reynolds, P. 1999. “Creative Destruction: Source or Symptom of Economic Growth?”. In *Entrepreneurship, Small and Medium-sized Enterprises and the Macroeconomy*. Cambridge: Cambridge University Press, 97-136.

Reynolds, P. et al. 2000. *Global Entrepreneurship Monitor: 2000 Executive Report*. Wellesley: Babson College.

Romer, P. 1986. “Increasing Returns and Long-Run Growth”. *Journal of Political Economy, 94*, 1002-1037.

Romer, P. 1990. “Endogenous Technological Change”. *Journal of Political Economy, 98,* 71-102.

Sarasvathy, S., Dew, N., Velamuri, R. and Venkataraman, S. 2003. “Three Views of Entrepreneurial Opportunity”. In *The International Handbook of Entrepreneurship*. Dordrecht: Kluwer Academic Publishers.

Scherer, F. 1970. *Industrial Market Structure and Economic Performance.* Chicago: Rand McNally.

Schumpeter, J. 1911. *Theorie der wirtschaftlichen Entwicklung. Eine Untersuchung über Unternehmergewinn, Kapital, Kredit, Zins und den Konjunkturzyklus*. Berlin: Duncker und Humblot.

Schumpeter, J. 1942. *Capitalism, Socialism, and Democracy*. New York: Harper and Brothers.

Shane, S. 2000. “Prior Knowledge and the Discovery of Entrepreneurial Opportunities”. *Organization Science, 11,* 448-471.

Shane, S. and Eckhardt, J. 2003. “The Individual-Opportunity Nexus”. In *Handbook of Entrepreneurship Research.* New York: Springer Publishers, 161-194.

Shane, S. and Venkataraman, S. 2001. “Entrepreneurship as a Field of Research: A Response to Zahra and Dess, Singh, and Erickson”. *Academy of Management Review, 26,* 13-17.

Shaver, K. 2003. “The Social Psychology of Entrepreneurial Behaviour”. In *Handbook of Entrepreneurship Research.* New York: Springer Publishers, 331-358.

Solow, R. 1956. “A Contribution to The Theory of Economic Growth”. *Quarterly Journal of Economics, 70,* 65-94.

Stevenson, H. and Jarillo, J. 1990. “A Paradigm of Entrepreneurship: Entrepreneurial Management”. *Strategic Management Journal, 11,* 17-27.

Sutton, J. 1997. “Gibrat’s Legacy”. *Journal of Economic Literature, 35*, 40-59.

Thorton, P. and Flynne, K. 2003. “Entrepreneurship, Networks and Geographies”. In *The International Handbook of Entrepreneurship*. Dordrecht: Kluwer Academic Publishers.

Tveteras, R. and Eide, G. 2000. “Survival of New Plants in Different Industry Environments in Norwegian Manufacturing: A Semi-Proportional Cox Model Approach”. *Small Business Economics, 14,* 65-82.

Venkataraman, S. 1997. “The Distinctive Domain of Entrepreneurship Research”. In *Advances in Entrepreneurship, Firm Emergence and Growth (Vol. 3).* “Greenwich: JAI Press, 119-138.

Wagner, J. 1994. “Small Firm Entry in Manufacturing Industries: Lower Saxony, 1979-1989”. *Small Business Economics, 6,* 211-224.

Wagner, J. 1995. “Exports, Firm Size, and Firm Dynamics”. *Small Business Economics, 7,* 29-40.

Wagner, J. 2001. “A Note on the Firm Size-Export Relationship”. *Small Business Economics, 17,* 229-237.

Wennekers, S. and Thurik, R. 1999. Linking entrepreneurship and economic growth. *Small Business Economics,* 13(1), p. 27

Williamson, O. 1968. "Economies as an Antitrust Defence: The Welfare Tradeoffs". *American Economic Review, 58,* 18-36.

Winter, S. 1984. "Schumpeterian Competition in Alternative Technological Regimes". *Journal of Economic Behavior and Organization, 5,* 287-320.

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[1] Solow, of course, did acknowledge that technical change contributed to economic growth, but in terms of his formal model, it was considered to be an unexplained residual, which 'falls like manna from heaven.' As Nelson (1981, p. 1030) points out, 'Robert Solow's 1956 theoretical article was largely addressed to the pessimism about full employment growth built into the Harrod-Domar model…. In that model he admitted the possibility of technological advance.' Solow's pathbreaking research inspired a subsequent generation of economists to rely upon the model of the production function as a basis for explaining the determinants of economic growth. This approach generally consisted of relating various measures representing these two fundamental factors of production, physical capital and unskilled labor, in trying to explain variations in growth rates. It must be emphasized that the unexplained residual, which typically accounted for a large share of the (unexplained) variance in growth rates, was attributed to technological change.

[2] As Gartner and Carter (2003) state, 'Entrepreneurial behavior involves the activities of individuals who are associated with creating new organizations rather than the activities of individuals who are involved with maintaining or changing the operations of on-going established organizations.'