Innovation, Industry Evolution and Employment: Introduction

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1. The Employment and Growth Challenges

Economic growth and employment creation are the twin horns of not just the European dilemma but of what looms as the major challenge confronting the West.[1] Unemployment in the European Union is twice as high as that in Japan and the U.S. together. Over 11 percent of the work force in the European Union was unemployed in 1996, ranging from 3.3 percent in Luxembourg and 4.4 percent in Austria and to 15.3 percent in Finland and over 20 percent in Spain.[2] Germany, Europe's biggest labor market, experienced 9 percent unemployment, a number that has kept growing fast. Individual countries have responded to the twin horns of the growth-employment dilemma with a broad spectrum of policy approaches. Led by France and Germany, continental European countries have generally pursued policies of maintaining the status quo, while the United Kingdom and the Netherlands have been bolder at reducing the role of the state.

The continued rising unemployment coupled with moderate growth in Europe has triggered a plea by policy makers for rethinking the policy approach that ushered in European prosperity during the post-war era. The resulting policy debate has been cast in terms of an inevitable tradeoff between greater employment but at the sacrifice of lower wages on the one hand, versus the maintenance of wages and living standards but at the cost of less employment on the other. According to this debate, the Anglo-American solution has been the former, while the continental Europeans have chosen the latter.

The purpose of this book is to suggest that this policy debate has been miscast. There is an alternative. This alternative involves structural change, and in particular shifting economic activity out of traditional moderate-technology industries and into new emerging knowledge-based industries. In other words, it involves innovation, industry evolution and their consequences for employment development.

2. Globalization and the Telecommunications Revolution

The cold war combined with internal political instability rendered potential investments in Eastern Europe and much of the developing world as risky and impractical. During the post-war era most trade and foreign direct investment was generally confined to Western Europe and North America, and later a few of the Asian countries, principally Japan and the Asian Tigers. The comparative advantage was generally attained through large-scale production, which facilitated low-cost production through exploiting scale economies. Large-scale mass production was essential to gaining the comparative advantage. The relatively small domestic markets in most European countries seemed to pose a serious threat to European competitiveness during the Post-War era. However, three strategies were quickly developed to compensate for a small domestic market. The *first* strategy has been that of the creation of a larger and more coherent domestic European market. The *second* strategy was to internationalize by developing markets outside of the domestic market. The *third* was to rely on skilled labor and high levels of human capital to

[1] For example, *The Economist* (11 May, 1996, p. 86) points out, "Ask any European what is today's biggest policy problem, and without hesitation he will say: unemployment. Ask an American economist the same question, and you will hear something about flagging productivity growth."

[2] OECD (1997), standardized rates.

produce goods that, although they might cost more, were of superior quality. Large transnational corporations such as Philips Electronics thrived on this dual strategy basing the comparative advantage on large-scale production made possible by superior management and organization combined with high-skilled labor. The comparative advantage of Europe lay in large-scale production of moderate-technology products in traditional industries, such as machine tools, automobile parts and metalworking.

This comparative advantage has been lost in the high-cost countries of Western Europe and North America in the last decade for two reasons. The *first* has to do with globalization or the advent of competition from not just the emerging economies in Southeast Asia but also from the transforming economies of Central and Eastern Europe. The production costs, and in particular labor costs, are considerably lower in these countries.[3] At the same time, the potential labor force of about 500 million persons in China and 350 million persons in India will put a continuous pressure on any upward lift of the wage rate. While the uncertainties of the cold war and the internal political instabilities in Eastern Europe rendered transnational activities prohibitively risky during the first four post-war decades, this is no longer the case.

The *second* factor triggering the loss of the traditional comparative advantage in the advanced developed countries of Western Europe and North America has been the communications revolution. The new communications technologies have triggered a virtual spatial revolution in terms of the geography of production.[4] The marginal cost of transferring information across geographic space has been reduced to virtually nothing. Information can be transferred around the globe via e-mail, fax machines, and cyberspace, making it not only feasible but even desirable to shift economic activity out of the high-cost locations in Europe to lower-cost locations in Central Europe and Asia.

Confronted with lower cost competition in foreign locations, producers in the high-cost countries have responded by pursuing four distinct options: (1) maintain wages and suffer a loss in global market shares, (2) reduce wages and other production costs sufficiently in the home country to compete with low-cost foreign producers, (3) substitute capital and technology for labor in the home country to increase productivity, and (4) shift production out of the high-cost location and into the low-cost location.

Pursuing the first option will generally lead to the demise of the firm. The second option is generally not viable in Western Europe where wage rigidities prevent such drastic reductions. The most common response has been the third and fourth options, both of which reduce employment in the home country.[5] Substituting capital and technology for labor, along with shifting production to lower-cost locations, has resulted in waves of corporate downsizing throughout Western Europe and North America. At the same time, it has generally preserved the viability of many of the large corporations. As record levels of both European and American stock indexes indicate, the profitability of the large companies has generally not suffered.[6]

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[3] For example, the daily earnings of labor have been estimated to be $78.34 in the European Union, but only $6.14 in Poland, $6.45 in the Czech Republic, $1.53 in China, $2.46 in India and $1.25 in Sri Lanka (Jensen, 1993).

[4] According to *The Economist* ("The Death of Distance," 30 September, 1995), "The death of distance as a determinant of the cost of communications will probably be the single most important economic force shaping society in the first half of the next century."

[5] For example, about 70 percent of Sweden's manufacturing employees work for large multinational corporations, such as Volvo, which through outward foreign direct investment have been constantly shifting production out of the high-cost domestic location and into lower-cost countries. Between 1970 and 1993 Sweden lost 500,000 private sector jobs, and unemployment reached 13 percent of the workforce in 1995. Sweden is not an exceptional case; every third car that is manufactured by a German company is actually produced outside of Germany. Similarly, Lufthansa recently shifted the location of a number of office functions, such as telephone operators, out of high-cost Germany and into India.

[6] "Big is Back," *The Economist*, 22 June, 1995 and "The Year Downsizing Grew Up," *The Economist*, 21 December 1996.

Corporate downsizing triggered by the shifting comparative advantage as a result of globalization has not been restricted to just a few countries. Rather, the response to globalization has led large corporations to downsize throughout the OECD countries. For example, between 1979 and 1995 more than 43 million jobs were lost in the United States as a result of corporate downsizing.[7] Similarly, the 500 largest U.S. manufacturing corporations cut 4.7 million jobs between 1980 and 1993, or one quarter of their work force (Audretsch, 1995). Perhaps most disconcertingly, the rate of corporate downsizing has apparently increased over time in the United States, even as the unemployment rate has fallen. During most of the 1980s, about one in 25 workers lost a job. In the 1990s this has risen to one in 20 workers.

This wave of corporate downsizing has triggered cries of betrayal and lack of social conscience on the part of the large corporations.[8] Such accusations are misconceived. It is a mistake to blame the large corporations for this wave of downsizing that has triggered massive job losses and rising unemployment in so many countries. These corporations are simply trying to survive in an economy of global competitors who have access to lower cost inputs.

3. The Shifting Comparative Advantage

There is a fifth response to the twin forces of globalization and the telecommunications revolution in order to revitalize the capitalist engine (Nelson, 1990). This alternative does not require sacrificing wages to create new jobs, nor does it require fewer jobs to maintain wage levels and the social safety net. This alternative involves shifting economic activity out of the traditional industries where the high-cost countries of Europe and North America have lost the comparative advantage and into those industries where the comparative advantage is compatible with both high wages and high levels of employment – knowledge based economic activity. In the Silicon Valley region of the United States, 15 percent more jobs were created between 1992 and 1996, and at the same time the level of wages rose to a level that is 50 percent greater than the national average. By shifting to knowledge-based economic activity the seemingly inevitable tradeoff between wages and employment can be avoided.

The emergence of geographic regions where both wages and employment are expanding, such as Silicon Valley in California, Research Triangle in North Carolina, and Cambridge in the United Kingdom, may seem surprising and even paradoxical in a world increasingly dominated by global telecommunications. The conventional wisdom would have suggested that the telecommunications revolution combined with globalization would make location irrelevant. The resolution to this paradox lies in a crucial distinction between knowledge and information. Information consists of facts, such as the price of gold in Tokyo, or the weather in New York, which can be costlessly transmitted around the globe. By contrast, knowledge, and especially tacit knowledge consists of ideas that are subjective, uncertain and difficult to explicitly write down (Nooteboom, 1994). Many of these ideas arise as a result of face-to-face contact and interchange.[9] Many of the most creative ideas have been the result of chance meetings at a social event in a supportive environment (Nelson, 1995).

Economic activity based on new ideas and tacit knowledge cannot be easily copied by competitors located far from the original source nor easily transferred to lower-cost countries by multinational corporations. While the processes and organizational methods required to produce automobiles can be transferred from Stuttgart to Hungary, it is not so easy to transfer innovative work in biotechnology around the globe.

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[7] "The Downsizing of American," *New York Times*, 3 March, 1996, p. 1. These 43 million jobs include 24.8 million blue collar jobs and 18.7 million white collar jobs.

[8] As the German newspaper, *Die Zeit* (2 February, 1996, p. 1).pointed out in a front page article, "When Profits Lead to Ruin – More Profits and More Unemployment: Where is the Social Responsibility of the Firms?"

[9] For further explanations of the distinction between information and knowledge see Audretsch and Feldman (1996) and Audretsch and Stephan (1996).

The global demand for products in emerging knowledge-based industries is high and rapidly growing; yet the number of workers who can contribute to producing and commercializing new knowledge is limited to just a few areas in the world, largely in North America and Western Europe. Economic activity based on skills that can be found throughout large parts of the world is doomed to generate lower wage rates as a result of global competition. By contrast, economic activity based on new knowledge will generate higher wages and greater employment opportunities reflecting the exploding demand for new and improved products and services.

There are many indicators reflecting the shift in the comparative advantage of the high-wage countries towards an increased importance of knowledge-based economic activity. For example, Kortum and Lerner (1997, p. 1) point to "the unprecedented recent jump in patenting in the United States," as evidenced by the rise in applications for U.S. patents by American inventors since 1985, which exceeds the increase in other decades in this century. Throughout this century, patent applications fluctuated within a band of between 40,000-80,000 per year. By contrast, in 1995 there were over 120,000 patent applications. Similarly, Berman, Bound and Machin (1997) have shown that the demand for less skilled workers has decreased dramatically throughout the OECD, while at the same time the demand for skilled workers has exploded.

Why has it proven so difficult to shift economic activity out of the traditional industries where the products are now fairly standardized and where production can be easily transferred to lower-cost locations?[10]. The present collection of studies attempts to present an answer starting from a macroeconomic-labor-industrial organization synthesis.

4. The Macroeconomic-Labor-Industrial Organization Synthesis

In order to shed light on the links between innovation, industry evolution and employment generation, the Tinbergen Institute of Erasmus University Rotterdam, the School of Policy Studies at Georgia State University, and EIM Small- and Medium Sized Business Research and Consultancy in Zoetermeer, the Netherlands hosted a two day conference on the subject in Rotterdam and Zoetermeer, 29-30 August, 1997. The chapters included in this volume reflect a carefully edited and revised selection of the papers of this conference. What the papers have in common is that they link some measure of economic performance to technology and innovation, and they do it using a dynamic framework based on a longitudinal database that tracks micro-observations over time. By and large, the emphasis is on how various measures of performance, such as wages, growth, productivity, and survival, for different units of observations such as industries, firms, regions and individuals, are shaped in an evolutionary context by technology and innovation. Within this general framework, the focus of chapters two through five is on productivity and wages while that of chapters six through nine is on innovation. The last five chapters generally deal with industry evolution.

This book begins with "Wages, Firm Size and Wage Inequality: How Much do Exports Matter?" by Bee Yan Aw and Geeta Batra. This *Second Chapter* examines the links between wages and different types of labor, with a particular focus on the role of exports, all within the context of an Asian Tiger, Taiwan. The authors use the longitudinal Census Data Base to track the performance of over 80,000 Taiwanese firms spanning ten manufacturing industries. The empirical evidence suggests that the gap between production and non-production workers varies substantially between exporting firms and non-exporting firms. In particular, exporting firms pay their production and non-production workers higher wages than do non-exporting firms, even after controlling for firm-specific characteristics identified in the literature as being highly

[10] What *Der Spiegel* ("Wer ist der Nächste?: Angst um den Arbeitsplatz," number 5, 1994, pp. 82-83) concludes for Germany is equally valid for much of Europe, "Global structural change has had an impact that only a short time ago would have been unimaginable. Many of the products, such as automobiles, machinery, chemicals, and steel are no longer competitive in global markets. And in the industries of the future, like biotechnology and electronics, the German companies are barely participating."

correlated with wages. The cross-industry mean wage premium associated with exporting over non-exporting firms is about 30 percent for non-production workers and 14 percent for production workers. In general, exporters in all ten industries are also associated with higher wage inequality between the non-production and the production workers relative to their counterparts in the domestic market. Thus, the evidence from Taiwan clearly suggests that the propensity for some firms to export while others do not account for a considerable amount of the wage gap between production and non-production workers.

The source of wage differentials is also the subject of the *Third Chapter* on "Trade Technology and Wage Differentials in the Canadian Manufacturing Sector," by John R. Baldwin and Mohammed Rafiquzzaman. Like in most other countries, the authors point out that the wage gap between skilled and unskilled workers has increased in Canada during the last decade. In particular, Baldwin and Rafiquzzaman use a comprehensive longitudinal database from the Canadian Census of Manufactures to examine the impact of technology use on the structure of worker wages. Like in the previous chapter by Aw and Batra, Baldwin and Rafiquzzaman focus on the gap in wages between production and non-production workers. The authors find that the effects of technology have not been felt equally in all segments of the labor market – the wages of non-production workers have risen relative to the wages of production workers. While the evidence suggests that some of the increased wage gap is attributable to changing trade patterns, a key finding in this chapter is that the use of new technology has also contributed to the growing wage gap. Most strikingly, the premium paid to non-production labor was the greatest during the 1980s, when capital intensity and labor-enhancing technology use was the highest.

In *Chapter Four* Martin Carree and Roy Thurik examine "Industrial Structure and Economic Growth." While a number of studies have identified a systematic shift in economic activity in the OECD countries away from large firms towards small enterprises, virtually no study has been able to identify any light on the welfare implications of this shift. That is, is this shift welfare enhancing and therefore to be fostered by government policy, or does it lead to reduced economic welfare and should therefore be impeded by government policy? Carree and Thurik use a longitudinal database consisting of 13 manufacturing industries in 12 European countries to identify the impact of this shift on economic growth. The evidence clearly suggests that countries which have experienced greater rates of growth also experienced the greatest shift in economic activity towards small enterprises. The authors point out in their conclusions that the evidence in the chapter provides support for specific policies introduced during the 1980s and 1990s in European countries stimulating small enterprises.

Chapter Five, by Marcel Lever and Henry Nieuwenhuijsen, focuses on a slightly different measure of economic performance – productivity. In particular, in their "The Impact of Competition on Productivity in Dutch Manufacturing" the authors examine the relationship between the degree of competition and productivity growth in Dutch manufacturing. They estimate a Cobb-Douglas production function, incorporating several distinct measures of competition using a longitudinal database consisting of nearly 2,000 Dutch manufacturing firms between 1978 and 1993. The authors find considerable evidence suggesting that economic performance, in this case productivity growth, responds positively to the degree of competitive pressure.

A considerably different measure of firm performance, investment, is the focus of *Chapter Six*. Bronwyn Hall, Jacques Mairesse, Lee Branstetter and Bruno Crepon examine "The Time Series Relationship between Investment and Cash Flow in the Scientific Sector: A Panel Data Study Comparing French, Japanese and United States Firms." In this chapter the authors examine the impact of financial institutions and corporate governance on the performance of industrial firms. Using a panel data version of the vector autoregressive (VAR) methodology, they test for the causal relationship between sales and cash flow on the one hand, and investment and R&D on the other. This test is undertaken using three large longitudinal databases of firms in the scientific

(high technology) sectors in the United States, France, and Japan. The evidence suggests that both investment and R&D are more sensitive to cash flow in the United States than in France and Japan. Their findings imply that the different institutional structure in France and Japan enables firms to avoid liquidity constraints experienced by their counterparts in the United States. Thus, there is substantial reason to believe that the institutional structure, in terms of financial institutions and corporate governance, shapes the dynamic performance of firms.

Chapter Seven, by Michael Fritch and Rolf Lukas, is concerned with economic performance at a different unit of observation than the firm – the region. Focusing on the performance of regions is important because ultimately economic policy makers are responsible for the economic welfare of what is called in Germany, the *Standort*, or location, rather than for particular firms. In "Innovation, Cooperation and the Region," Fritsch and Lukas ask the question why the extent of cooperation and linkages among firms varies from region to region. They develop a new source of data to identify the extent and nature of regional cooperative linkages in Germany. This new database enables them to identify the characteristics of businesses engaging in cooperative relationships. They find that the regional distribution of cooperative partners suggests that, in particular, public research institutions and non-vertically related firms within a given region tend to constitute key elements of the regional innovation system. The authors also find that there are pronounced differences with regard to the propensity to cooperate as well as with regard to the locational structure of cooperation partners which may have an impact on two key measures of regional performance – innovation and growth.

Economic performance for the unit of observation of regions is also the focus of *Chapter Eight*, "Industry Clusters: Biotechnology and Polymers in Ohio and Sweden," by Bo Carlsson and Pontus Braunerhjelm. Using data from the United States and Sweden, Carlsson and Braunerjhelm address a series of questions about the nature of the innovative performance in regions: (1) What are the origins, extent and composition of the technological system surrounding innovative activities in each region? (2) Who are the main actors both in the industrial/commercial area and in the science, research, and institutional infrastructure? (3) What is the nature of industrial clustering within each region? (4) What are the characteristics of regional networks? (5) What has been the role of public policy in shaping these clusters? And (6) what are the policy implications for both private firms and public policy? An important finding in this chapter is that the universities apparently play an important role in generating new knowledge for commercial development within the region.

While David Audretsch and Paula Stephan are similarly concerned with the linkages between knowledge sources and commercialization, in *Chapter Nine* they shift the unit of observation away from firms and regions to the individual. In addressing the questions, "How and Why Does Knowledge Spill Over in Biotechnology?" they focus on the incentives confronting scientists to appropriate the expected value of their knowledge considered within the context of their path-dependent career trajectories. In particular, they focus on the ability of scientists to appropriate the value of their knowledge embedded in their human capital along with the incentive structure influencing if and how scientists choose to commercialize their knowledge. They use a longitudinal data base tracking the career paths of scientists over time and use a hazard model to estimate the duration over a scientist's career to starting a new biotechnology firm. They conclude that the spillover of knowledge from the source creating it, such as a university, a research institute, or an industrial corporation, to a new-firm startup facilitates the appropriation of knowledge for the individual scientist(s) but not necessarily for the organization creating that knowledge.

In *Chapter Ten*, "Technological Intensity, Demand Conditions and the Longevity of Firms," by José Mata and Pedro Portugal, performance is again at the unit of observation of the firm and is measured in terms of the ability of firms to survive. In particular, the authors focus on the impact of demand and technological conditions on the likelihood of survival of Portuguese

firms. They use a large longitudinal database of Portuguese firms and find that both demand and technological conditions influence firm performance.

Firm survival, as well as growth, are also the performance measures in *Chapter Eleven*, "Do Services Differ from Manufacturing? The Post-Entry Performance of Firms in Dutch Services" by David Audretsch, Luuk Klomp and Roy Thurik. While a large literature has emerged focusing on the post-entry performance of firms, in terms of the links between growth, survival, size and age, virtually all of these studies are based on manufacturing. In this chapter, the authors fill this gap in knowledge about the role of non-manufacturing in the dynamics of industrial organization. They suggest there are theoretical reasons why the relationships between firm age and size on the one hand, and survival and growth on the other may, in fact, not be the same in services as they are for manufacturing. They use a longitudinal data base for Dutch firms in the retail and hotel and catering sectors to identify around 13,000 new-firm startups and 47,000 incumbents in the services and track them over subsequent years. The results suggest that the most fundamental relationships between firms size, firm age, survival and growth are strikingly different for services than for manufacturing. In terms of the dynamics of industrial organization, services may, in fact, not simply mirror the manufacturing sector.

Audretsch (1995) suggested and found empirical evidence from a large longitudinal database of U.S. firms that "Who Exits and Why?" is determined by the existence of two distinct models of industry evolution. The first is the *model of creative destruction,* where new entrants displace the large incumbents and the second model is that of *the revolving door*, where most new entrants exit from the industry within a short period. In *Chapter Twelve*, "Who Exits from German Manufacturing and Why? Evidence from the Hannover Firm Panel Study," Joachim Wagner pursues the same question using a large-scale longitudinal database of Germany firms. In fact, on the basis of the evidence presented in this chapter, Wagner rejects both of Audretsch's models and instead proposes a third variant – the *Darwinian model*, or the survival of the fittest. Wagner argues that this new variant is more consistent with the evidence from Germany, because firms, independent of age, that do not grow in terms of size or productivity or earn higher profits are confronted with a greater risk of failure than their fitter counterparts.

In "Does Start-Up Size Influence the Likelihood of Survival?" in *Chapter Thirteen*, David Audretsch, Enrico Santarelli and Marco Vivarelli also measure performance in terms of survival. In particular, they use a large longitudinal database in Italy to track new-firm startups and their subsequent post-entry performance over time. After comparing the results with those from the United States, they conclude that there is evidence supporting two very distinct views about the economic role of small firms. While the evidence between firm size and performance, measured as the likelihood of survival, supports the evolutionary view of small firms in the United States, the evidence from Italy is more consistent with the static network view of small firms.

The final and *Fourteenth Chapter* of the volume, "Barriers to Growth of Firms in Developing Countries: Evidence from Burundi," by Micheline Goedhuys and Leo Sleuwaegen, also measures firm performance in terms of growth and survival. However, as the title suggests, the context is very different and is in terms of a developing country, Burundi. It shows that a learning process shapes the growth of firms in the developing world as it does in the developed world. However, this process is hampered by institutional and environmental conditions specific to the developing world.

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