

# Learning Economies, Innovation Systems and European Integration

Birgitte Gregersen and Björn Johnson  
Department of Business Studies  
Aalborg University

DRAFT

November 22, 1996

(To be published in *Regional Studies*)

## Abstract

This paper uses the 'learning economy' as an analytical framework to discuss how the process of European integration affects National Systems of Innovation. European integration is described as a process of institutional learning. It is argued that European integration will not do away with national systems of innovation in Europe and that only a very partial European System of Innovation in a narrow sense of the term is likely to emerge in the not too distant future.

Learning Economy   European Integration   National Systems of Innovation

## INTRODUCTION

The process of European integration affects the economic, political and social development in Europe in many different ways. The purpose of this paper is to pose the question of how it might affect innovation activities. More specifically, we will make three points. First, we suggest that the nation state still is a relevant level of analysis in the systems of innovation approach. Second, we propose that European integration may be described as a process of institutional learning, which will inevitably affect the national systems of innovation in Europe. Last, we argue that European integration will not do away with national systems of innovation in Europe and that only a very partial European system of innovation in a narrow sense of the term is likely to emerge in the not too distant future.

One of the main links between integration and innovation goes through institutions. Institutions in the sense of "common habits, routines, established practices, rules or laws that regulate the relations and interactions between individuals and groups" (EDQUIST and JOHNSON, 1997) shape the interactive learning processes in the economy. They affect the creation, storing, distribution, use and destruction of knowledge since they shape the cognition, the visions, and the patterns of communication and interaction of economic agents. Integration changes the institutional set up of the economies participating in the process and hence it affects the process of learning and innovation.

Furthermore, the character of the institutional link is profoundly affected by the fact that the integration process is going on between *learning economies* in which knowledge has become the most important resource and learning the most important process (LUNDVALL and JOHNSON, 1994). In this article we

use the learning economy as an analytical framework for a discussion of relationships between integration and innovation.

The paper has the following structure: We start by discussing the idea of a learning economy and establish some conceptual links between knowledge, learning and innovation. With interactive learning as key concept we then argue for the relevance of territorially based innovation systems and within this group for the relevance of national systems of innovation. This concept is then discussed somewhat more in detail and we propose that Europe may be described as a diversity of such systems. We proceed to define the integration process in terms of institutional learning and finally we discuss what this process might imply for the development of a possible European system of innovation.

## **THE LEARNING ECONOMY AS AN ANALYTICAL FRAMEWORK**

### *Learning and knowledge in the economy*

There is an important distinction between on the one hand learning as a deliberately organized process, i.e. some parts of the economy, for example, universities, research institutes, and R&D departments, are organized with the creation and utilization of new knowledge in mind, and on the other hand learning going on more or less as unintended by-products of normal economic activities such as procurement, production, and marketing. These two types of learning may be called direct learning and indirect learning, respectively. We make this distinction because heavy investments in direct learning as well as development of new ways to utilize indirect learning are characteristics of the learning economy. Furthermore, there are complementarities between the two types of learning.

Obviously, there are other distinctions than between direct and indirect learning. In the literature terms like learning by doing, learning by using, learning by searching, etc., have become quite common indicating that learning is a widespread and diversified phenomenon. It is often important to specify who is learning what, how, where and when. However, we would like to underline one common characteristic of almost all learning processes: They are interactive and depend on the ability to combine and recombine different pieces of knowledge into something new. Interactive learning is the most common type of learning and the dominant source of innovation.

In addition to being interactive we regard learning as partially cumulative. What one learns depends on what one already knows and therefore the production structure of the economy affects its learning processes. The production structure of an economy consists not only of a tangible structure of buildings, equipment, etc., but also of a connected intangible structure of knowledge accumulated through production experiences. Furthermore, different industries have different technological opportunities and bottle-necks, i.e. the learning possibilities are quite different in different lines of production.

We also want to draw attention to the role of forgetting in the economic process. The role of forgetting in the development of new knowledge has not been duly recognized in economic theory. The enormous power of routines and habits of thought in the economy constitutes a permanent risk for blocking potentially fertile learning processes. Sometimes 'creative destruction of knowledge' is necessary before new knowledge can get a foothold. Departments, organizations and firms have to be closed down, people have to move to new activities and so on. Thus, the learning economy is also a forgetting economy. It has to develop methods and institutions and channel resources to support 'creative

forgetting'. Forgetting is not only a nuisance and a cost but also an essential and integrated part of learning.

In order to specify the characteristics of the learning economy it is useful to make a distinction between the role of knowledge (as a kind of stock) and the role of learning (as a kind of flow) in the economy. Knowledge is not a stock in the same sense as water in a tank. It is not modified in a purely quantitative way by learning and forgetting. It is more like a complex, but sometimes quite loose structure. It consists of different degrees and kinds of knowledge, which do not add up in a simple manner. Tacit and codified knowledge may be largely complementary, but they are produced in different ways, have different degrees of stickiness and play different roles in learning processes. The categories of know-what, know-why, know-how and know-who (LUNDVALL and JOHNSON, 1994) play different roles in the economy and require different institutional arrangements. There may also be holes, incongruencies and inconsistencies in the knowledge structure and occasionally parts of it have to be reorganized, or forgotten, as a consequence of new facts delivered by learning activities. It may be described as a kaleidic structure where unexpected novelties - provided by learning processes - disintegrate, delete and rearrange existing patterns into new ones. Any deeper understanding of the learning economy requires that the relations between structure and change in the stock of knowledge, i.e. between technology and learning, is taken into account.

### *Learning and Innovation*

Learning is connected to innovation. We define innovations as the introduction into the economy of new knowledge or new combinations of old knowledge. Defined in this way, innovation is a process. It refers not only to the first introduction into the economy of a piece of knowledge but also to its subsequent diffusion. Furthermore, diffusion of new products or processes normally leads to changes in these, which again affects their diffusion. The introduction and the spread of new knowledge become one integrated process and it is difficult to localize innovations as unique events in time and space.

Put in a very simple way we regard innovations as 'learning results'. Learning leads to new knowledge and entrepreneurs of different kinds use this knowledge to form innovative ideas and projects and some of these find their way into the economy in the form of innovations. This means that there is a distinction between production of knowledge and utilization of knowledge. There is always a lot of knowledge around which is not put to use in the economy and the ability to utilize existing knowledge is a crucial aspect of the learning economy. Government policies have usually been aiming at the support of knowledge production (for example through R&D support) rather than knowledge utilization. Lately, however, there has been a growing emphasis on the distribution and utilization of knowledge, for example through support of various technology service systems.

### *The Modern Learning Economy*

In a sense all economies are knowledge-based. Even so called primitive economies have depended on complicated knowledge structures, partly stored through traditions, habits, folk-ways, and rites, which have made living in often harsh environments possible. Any knowledge-based economy has to develop ways of storing its knowledge but it does not always have to utilize it very intensively or turn it over

very fast. Parts of its knowledge may lay dormant for long periods and there may be restrictions on experimentation and acquiring of new knowledge.

In a learning economy, on the other hand, the rate of knowledge turnover is high; learning and forgetting are intense, the diffusion of knowledge is fast, and a substantial part of the total knowledge stock is changed every year. Furthermore, learning has become increasingly endogenous. Learning processes have been institutionalized and feed-back loops for knowledge accumulation have been built in so that the economy as a whole is learning by interacting in relation to both production and consumption. When economies learn how to learn the process tends to accelerate.

The post-Fordist era of the fifth Kondratieff long wave has brought new characteristics of the knowledge stock and the learning process into being. First, the modern learning economy is based on information, computer and communication technologies (ICT), which have dramatically reduced the costs of storing, handling, moving, and combining information and have made different kinds of networking possible.

Second, the process of innovation has changed in significant respects. For different reasons (for example increased competition, new technical possibilities, environmental regulation) product cycles have shortened and continual incremental innovation has become a condition of survival for many firms. At the same time, however, in many parts of the economy it has become more expensive to develop new products and new equipment. This, together with the diffusion of ICT, have led firms to develop organizational forms, which utilize the innovative resources better than before and which make it possible to adapt quickly to changes in both technological possibilities and demand. Communication within and between firms is encouraged, participation in the innovation process is broadened, management concentrates on new or improved products rather than on cost cutting, etc.

Third, the knowledge infrastructure (SMITH, 1996), which consists of universities, schools, training systems, research labs, telecommunication networks, libraries, databases, etc., has become much stronger. This has a major impact on innovation capabilities in the learning economy. For example, the combination of telecommunication and computer technologies with its profound effects on networking and interactive learning clearly depends on the knowledge infrastructure.

Fourth, there is a much stronger institutional support of learning and innovation. Financial institutions, institutions for redistribution of income, wealth and power, intellectual property rights, technological advice and service systems, tax rules and government subsidy systems, etc., have been developed to support innovation. Of course, not all institutional changes support innovation.<sup>1</sup> Some aspects of this institutional development may be described as evolution of a 'learning culture' in which people regard long formal education, repeated re-education and retraining, and even life-long education, as necessary and normal aspects of economic life.

Finally, in the modern learning economy the role of government policy has changed. It becomes a crucial role of governments to support learning and, sometimes, forgetting. This means that the state has a role to play in connections with for example the means to learn (schools, training systems, etc.), the incentives to learn (intellectual property rights, taxes and subsidies, supporting learning networks, etc.), access to relevant knowledge (libraries, databases, technological service systems, telecommunication systems, etc.), decreasing the costs of forgetting (retraining, labour market mobility, social security, etc.), and more generally keeping options open by protecting technological

and institutional diversity and promote an openness to learning from abroad in different fields of knowledge (Dalum, Johnson and Lundvall, 1992).

When integration is regarded as a process of institutional change it becomes necessary to understand how it affects the structures of knowledge and the capacities for interactive learning of the European economies. Europe is a diversity of concrete learning economies, each with its own unique institutional set-up and knowledge diversity, and the integration process has an impact upon learning and innovation in each single country. We will use the concept of national systems of innovation to analyze these impacts.

## **SYSTEMS OF INNOVATION**

The main idea of the concept of innovation systems is that the overall innovation performance of an economy depends not only on how specific organizations like firms and research institutes perform, but also on how they interact with each other and with the government sector in knowledge production and distribution. Innovating firms operate within a common institutional set-up and they jointly depend on, contribute to and utilize a common knowledge infrastructure. It can be thought of as a system which creates and distributes knowledge, utilizes this knowledge by introducing it into the economy in the form of innovations, diffuses it and transforms it into something valuable, for example, international competitiveness and economic growth.

### *Technologically and territorially based systems of innovation*

Within the innovation systems approach to innovation analysis different types of systems have been defined. There is a main distinction between systems which take a specific sector or a specific technology as its point of departure<sup>2</sup> and systems, which build on some kind of geographical proximity - either local, regional, national, continental or even global systems of innovation. Supporters of the former argue that systems of innovation are more technological than geographical and, often, that, as far as they are territorially based at all, they are local or regional rather than national. The argument is that national systems may have been important earlier but because of increasing internationalization of most economic processes they are losing out to local and regional systems unaffected by national borders.

As argued above, the specialization pattern<sup>3</sup> of an economy has a strong impact on its innovation performance. This means that when differences are observed between for example countries in innovation performance this may be because of differences in production structures. It is possible to argue that these are not national differences; the innovation performance is determined by what is produced rather than by where it is produced. The technologies of the specific industry affect its innovation possibilities. This would especially be the case for industries like Chemical products and Semiconductors, which are closely connected to science and where some kind of dominant design has already been established. They are probably not very influenced by national factors but function in about the same way all over the world.<sup>4</sup>

Even if these arguments are correct they do not contradict the existence and relevance of territorial systems of innovation. It is quite possible that innovation patterns are formed simultaneously by both

sectoral and territorial, for example national, factors. A specific sector may in certain respects behave in the same way in different countries and yet show national idiosyncrasies in other respects. In fact, this is what BRESCHI and MALERBA (1997) find in a recent empirical analysis of sectoral innovation systems and Nelson reporting from an international comparative study on the development of several high-tech industries concludes that “it is apparent that each of them developed along somewhat, sometimes significantly, different paths in different countries” (NELSON, 1996, p. 27). It follows that the concepts of territorially and technologically based innovation systems should be regarded as complements rather than substitutes.

### *National systems of innovation?*

The theoretical case for territorially based systems of innovation builds on interactive learning. The performance of all such systems depends on the relations between proximity and diversity. Different kinds of knowledge diversity are the basis of interactive learning, which depend on communication between people and groups of people with different knowledge endowments. Some parts of this may take the form of simple economic transactions, i.e. buying and selling goods and services, but as a rule innovation also requires qualitative communication in terms of other categories than prices and quantities. Behind the process of innovation we often find durable and selective relationships of quite another kind than arms-length, anonymous market transactions. In networks and other kinds of ‘organized’ market relations people develop codes of communication, styles of behaviour, trust, methods of co-operation, etc., to facilitate and support interactive learning. All this is facilitated by proximity between the parties.

In this context proximity does not only refer to geographical distances. Distances may sometimes be more meaningfully measured in time rather than in kilometers. In addition to this, other kinds of proximity may be at least as important. LUNDVALL (1992) makes a distinction between economic space, organizational space and cultural space.<sup>5</sup> If one or more of these distances become too long interactive learning will be hampered. Or expressed slightly differently, proximity is a precondition for diversity to support innovation. A larger territorial space may contain more diversity, but this will not lead to innovation if there is not enough proximity to support communication.

Even if there is a theoretical case for territorially based innovation system the question as which territories are relevant is not yet settled. The concept of regional systems seems to be less provocative than national systems. This may be because a region is a rather ambiguous concept. There are regions within countries and regions crossing national borders. There are regions with and without political governments. Regions may be defined *ex ante* or *ex post*. A region may be a small part of a little country or it may encompass a whole continent, etc. Some regions are, of course, excellent territories for innovation systems. Other, in fact most regions, are much less productive as environments for innovation processes.

Admittedly, nations are also very different and some of them are much stronger candidates for innovation system analysis than others. Often, however, national borders raise barriers for communication, and nation-states do constitute relevant environments for interactive learning and innovation.<sup>6</sup> There are several reasons for that (GREGERSEN and JOHNSON, 1995):

*First*, innovations are affected by institutions and institutional change. Without institutional adaptations and institutional innovations the process of technical change would be more and more restricted. Many of these institutional changes, which are necessary for the process of technical innovation, require regulation by the state. Intellectual property rights, standards, capital and labour market regulations, contract laws, etc., need to be developed or changed.

*Second*, innovation leads to structural change, which means different rates of growth for different parts of the economy and hence redistribution of incomes, wealth and powers between different groups of people. This generates conflicts, which may restrict continual growth. Institutions for reducing the conflicts generated by the combined process of growth and structural change are important parts of the environment for innovation and growth formed by the nation state.

*Third*, as mentioned above, learning and innovation depend on an infrastructure, which requires regulation as well as investments by the government. Due to technical and organizational changes, classical fields of infrastructure, like transport and energy, may be of decreasing importance as state monopolies, but in areas as education, supply of information, technical standards, basic research, and so on, i.e. in the knowledge infrastructure, the importance of state activities is increasing.

*Fourth*, innovation driven economic growth is a process of continual transformation. The economy expands into new materials, new sources of energy, new processes and new products, and it contracts from old ones. This requires a mobile labour force. People have to be ready to move from one occupational position to another maybe several times within a generation. This is not possible without the support of a system of education and training, which provides both general purpose and learning skills and diversified specialization possibilities as the national educational systems supervised by the state has done for years. There are some tendencies towards international integration of education, but this is mainly on the post graduate level and as a supplement to national systems.

Intense labour mobility between different social and occupational positions requires not only theoretical abilities and instrumental skills but also a kind of cultural homogenization. This is an important aspect of the system of education and training. The nation is often an expression of a common culture which is supported by the political power of the state. This is the *fifth* aspect of the nation state as an environment for learning and innovation. The performance of an innovation system depends on effective communication and interaction between people with different skills and knowledge and thus on the nation state as an environment for such communication and interaction.<sup>7</sup>

As a concluding remark for this section we want to underline that systems of innovation are open systems and that different systems may overlap each other. A specific firm for example may be part of more than one system. It may be a part of a sectoral, a local and a national system at the same time. Systems of innovation are not necessarily sectoral *or* territorial; regional *or* national. All these systems exist and the context of analysis determines the relevant concept. For example, sometimes a regional system of innovation needs to be understood as a particularly national phenomenon. Route 66 may partly be a specific American phenomenon and the radio-communication cluster in Northern Jutland may be a particularly Danish phenomenon depending on national institutions and policies in the fields of property rights, tax incentives, financing, education, R&D, and so on. It is obviously true that all nation states are not equally relevant as innovation systems. Some countries may be too culturally and linguistically divided and a lack of congruence between power structures and cultural structures may prevent them from forming territorial bases for interactive learning. Furthermore, shared cultures do

not always fit with national boundaries. In other cases, however, the concept of a national system of innovation may be quite relevant.

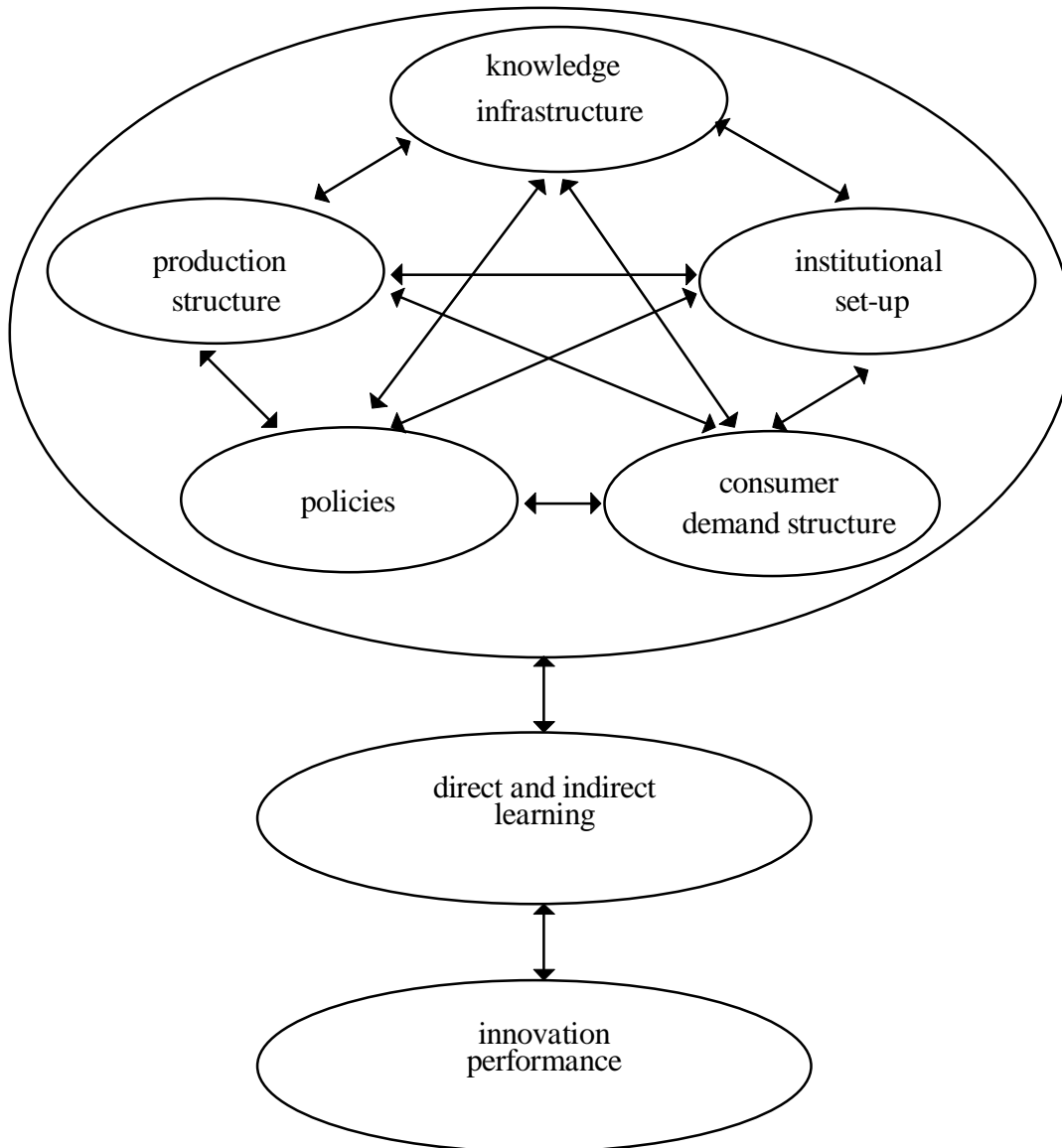
### *System element and system boundaries*

There seems to be at least two ways, a narrow and a broad one, to look upon innovation systems. In the more narrow perspective innovations are generated in and distributed from a specific sector of the economy (the school system, the universities, research and development organizations, technological service systems, etc.) and are supported by specific institutions (intellectual property rights, disclosure norms, etc.). According to the broader view, innovations are not only emanating from a specific knowledge producing sector, from which they are subsequently spread to the rest of the economy. They are also connected to, and may follow as by-products of, ordinary economic activities like procurement, production, and marketing in almost all parts of the economy.

In the perspective of innovations as resulting from interactive learning the broader view on innovation systems is the more relevant one. Using the broad perspective and extending from LUNDVALL (1992) we regard a national system of innovation as a system of actors (firms, organizations, government agencies) who interact with each other in ways which influence the innovation performance of a national economy. It is influenced by specific parts of the institutional set-up, the knowledge infrastructure, the specialization pattern, the public and private demand structure (or consumer tastes in the broad sense), and the government policy. This means that to describe and compare systems of innovation in the broad sense you have to open the boxes and specify those relations in Figure 1 below which have importance for the innovation performance<sup>8</sup>:

The *knowledge infrastructure* and the *production structure* have been mentioned above. They are distinctively different from country to country and they are fairly stable over time. *Institutions* play a central role in innovation systems. That seems now to be a common understanding amongst all scholars in the field. As argued above, institutions form the interactive learning processes in the economy, and fulfill several important roles in relation to innovation activities (EDQUIST and JOHNSON, 1997). Furthermore, the now well documented existence of technological trajectories (DOSI, 1982), innovation avenues, technological guideposts (SAHAL, 1985), etc., is an indication of the institutional impact on innovation. As FREEMAN (1992, p. 197) points out, technological trajectories are not, as sometimes believed, 'natural' but the results of human decisions and institutions. "Trajectories are self-fulfilling prophecies based on the 'actors' decisions and expectations of the future. Like any institutions they are sustained not by 'naturalness' but by the interests that develop in their continuance and the belief that they will continue".

Figure 1: Main Factors affecting Learning and Innovation in a National System of Innovation



Institutional set-ups are stable over time and distinctly different between countries. This does not imply that innovations in one country are not affected by international institutions, for example the European or American patent system. Neither does it mean that institutions might not be local or regional. For example, important aspects of the technological service system in a country are often regional. It means, however, that nations matter for the evolution and maintenance of many institutions that affect interactive learning and innovation. It is not unlikely, for example, that trust, willingness to co-operate and ability to build networks are affected by the nation state as a cultural and political entity.

In an interactive learning perspective it is relevant to single out public and private *consumer demand* as a specific element of national systems of innovation. As PASINETTI (1981) argues, consumer learning is fundamental for changes in the production structure and for future growth opportunities. The specific characteristics of quantitative and qualitative demand for clothes, housing, leisure products, welfare service, etc., is a basic ingredient in what we in everyday language call national cultures and tradition. In this way, public and private consumer tastes and behaviour are strongly related to the institutional set-up. However, an analytical separation is made here to stress the importance of both the quantitative and qualitative aspects of consumer demand and consumer learning as an important fundament for innovation processes.

Since most countries have *policies* directly aiming at stimulating innovation, it is relevant to include this in the description of a national system of innovation. However, other types of policies, for example education policies, income distribution policies, social security policies, employment policies, and policies in relation to the communication infrastructure, which are not directly targeted at innovation activities, may affect these even more.

Infrastructures, production structures, institutional set-ups, consumer demand structures, and government policies are not independent explanatory factors for innovation performance. They are interdependent and they evolve in interaction with each other. For example, the development of a new industrial sector is strongly affected by how fast and effectively an institutional supporting system is built up. Special financing institutions may be needed, standards may have to be created, R&D institutions and technological service systems may have to be developed, etc. The gradual strengthening of the new sector, in turn, leads to a firmer institutional support system and so on. The different subsystems could be thought of as co-evolving. The match or miss-match between for example institutions and specialization patterns is then an important aspect of the evolution of the system as a whole. In the same way there are important feed-back mechanisms between the performance of a national system of innovation and its innovation determining factors. For example, a strong innovation performance in a specific sector may stimulate consumer learning and also lead to strengthening of the institutional and infrastructural support, which lead to even better innovation performance, etc.

Our discussion of the constituting groups of elements in national systems of innovation has shown that the boundaries of the system are not completely defined in terms of national borders. A national system of innovation is an open system in many ways: some of its firms are multinational, its technologies are mostly imported from abroad, it depends on international institutions, its innovation policies are influenced by international organizations, etc. It is also important to acknowledge that national systems of innovation may be more or less coherent. They contain many subsystems knitted together into rather loose structures. They are more evolved than designed and the cohesion of the systems changes over time and differs significantly between countries.

Still, however, the institutional set-ups, the production structures, the knowledge infrastructures, the patterns of consumer demand, and the government policies of national systems of innovation have sufficiently clear national stamps on them and are sufficiently stable over time to motivate this level of analysis within the innovation systems approach to innovation studies. From this point of view, Europe may be looked upon as a diversity of national systems of innovation. A diversity which changes in the long run through convergence and divergence between the systems and through the relative

strengthening or weakening of coexisting regional innovation systems but which, nevertheless, has some stability and staying power over time.

The figure above should not be interpreted as if innovation performance depends on almost everything. Only some aspects of, for example, the institutional set-up are really important for innovation performance and the trick is to identify these aspects. Likewise, only some of the connections between, for example, the production structure and the institutional set-up really matters. But this picture of the broad version of a national system of innovation provides a perspective - a way of looking at and understanding the determinants of the innovation performance of a national economy. The concept of a national system of innovation in the broad sense of Figure 1 opens up for the very likely possibility that other types of policy than innovation policy, for example education policy and social security policy, may affect innovation performance even more. It emphasizes the possibility that norms of co-operation, habits of trust, collective and non-monetary incentives, etc., may influence innovations more than patent rights and tax incentives for R&D. It provides new perspectives and enlightens new places where to look for the sources of innovation.

## **INTEGRATION AS A PROCESS OF INSTITUTIONAL LEARNING**

If economic integration is seen as attempts to combine separate national economies into larger economic regions, most countries in the world economy of today are members of some sort of integration arrangements. It goes for the OECD countries, Latin America, South East Asia, most countries in Africa, and the countries of the former Soviet block. The degree and the experience of the international economic integration vary of course, but each arrangement nevertheless has the following three features (ROBSON 1987, p.2):

1. it encompasses measures to suppress or eliminate economic discriminating barriers among the members
2. it encompasses measures to maintain economic discrimination against the rest of the world
3. it limits the unilateral use of certain instruments of economic policy.

In that sense, the process of integration reflects changes in the *institutional set-up* of the participating countries. Inspired by Tinbergen (1965) we may include both 'negative institutional changes' and 'positive institutional changes', where the former refer to the removal of discriminating national institutions, while the latter are concerned with the modification of existing institutions and the creation of new ones either on the national or the supra-national level. We may thus define integration as a process towards a coherent or mutually consistent institutional set-up for production, trade, and innovation within a specified geographical area.

New institutions have to be learned, and obsolete institutions need often to be replaced as a precondition for further integration. Integration is a complicated socio-economic process, which cannot be designed, planned and implemented in accordance with a one-dimensional rationality. Like most socio-economic processes, integration may be as unpredictable as an expedition without maps, where the participants have to learn and adjust the course and the speed as the expedition goes along. It is a learning process including several dimensions: the Commission and other EU 'institutions', national governments, firms and other organizations are all learning how to use new institutions and how to

cope without disappearing ones. Their reactions in these learning situations feed back into the process of institutional change and results in new learning effects and so on.

Integration activities in the form of the Maastricht Treaty and its connected directives, the Structural Funds, ESPRIT, and numerous other formal EU-programmes aiming at a diminishing of various barriers for transnational mobility of capital, labour and knowledge by removal of barriers on the national level or by establishing new common institutions on the EU level are, perhaps, what most people associate with European integration. We shall refer to such changes in the formal institutional set-up as formal integration.<sup>9</sup>

Complementary to formal integration there is informal integration, which occurs in connection to changes in the informal institutional set-up, i.e. activities towards a higher degree of coherence or towards a higher degree of compatibility between national values, routines, norms, etc. A higher degree of compatibility in norms and routines may be a precondition for instance for those EU-financed research projects that require collaboration between research teams from three or more EU countries. Such informal elements of integration may be at least as important for the innovation process as the more formal elements.

There is a distinction between integration as a result of a designed political process, i.e. implementation of political plans, programmes, compromises, etc., and integration as evolved or 'self-grown' results of formal or informal activities of firms, consumers, governments and other economic actors. There are two central aspects embedded in this distinction. The first is, that the integration process depends on the participating actors and their power resources and rivalry. Reshuffling of power resources is part and parcel of the process. It includes i) the rivalry among involved political actors and their different ideologies, ii) the rivalry among firms and their various economic interests, and iii) the rivalry and power alliances between political and economic actors. The second aspect is, that the traditional distinction from political sciences between policy and outcome is relevant here too. An integration initiative (for instance a new EU directive) may have unintended consequences, it may conflict with other integration initiatives, firms may not be aware of it or they may simply disobey. Furthermore, self-grown processes of integration often run ahead of the formal institutional arrangements and vice versa. Some of these integrative activities lead to intangible results as for instance diffusion of innovation across borders, changed patterns of specialization, growing inter- or intra industry trade, direct investments, etc. However, many of the most important long term results of the integration process, especially how integration affects interactive learning and innovation, are not possible to observe directly and often they do not have a monetary counterpart.

### *The Diversity of Systems of Innovation*

Technical, organizational, and institutional diversity are parts of the knowledge base of the economy and affect interactive learning. Diminishing diversity implies a reduction of the number of options, that are immediately open. It also means decreased possibilities for communication and interaction between different kinds of skills, knowledge, competencies, visions, and so on. Innovation is a process in which a diversity of knowledge feeds interactive learning, that creates and distributes new knowledge subject to different kinds of selection.<sup>10</sup> For this reason, diversity in the stock of knowledge supports both incremental and radical innovation through interactive learning. However, there is also a cost side to consider. Diversity in products and production processes means the loss of possible economies of scale.

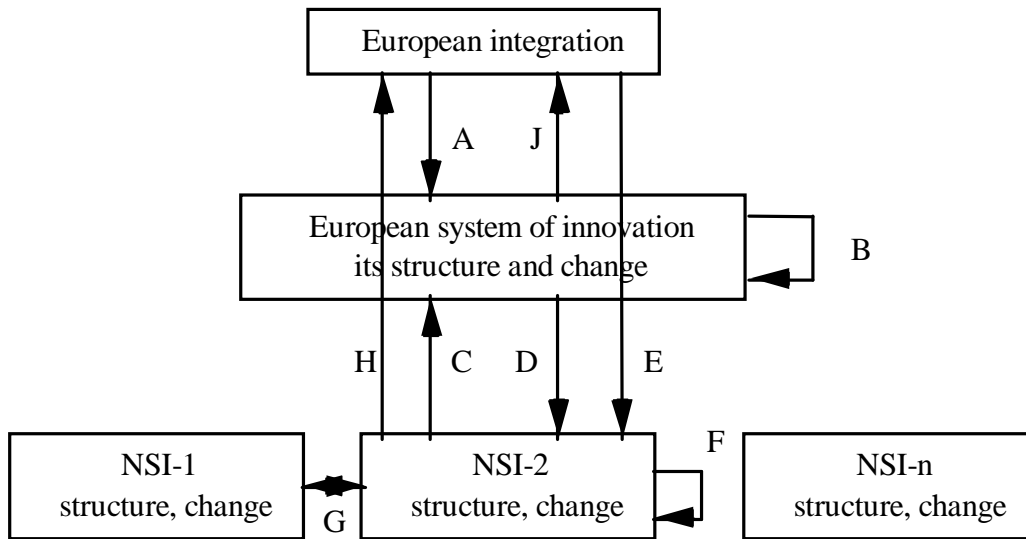
In addition to this, there are transaction costs to take into account. It requires more information to describe a more diversified system and this leads to costs for both producers and consumers. It takes more time and effort to make qualified decisions. It is an important question how the integration process affects the costs and benefits of diversity; does it develop institutions that create and recreate diversity and does it develop institutions that can manage this diversity, i.e. utilize its learning benefits and control its costs? In this sense, integration may be a process of institutional learning.

Within the innovation systems research programme the existence and importance of a wide diversity across Europe of national systems of innovation is increasingly recognized. Specialization patterns, infrastructures, institutional set-ups, consumer demand structure, and innovation related policies are all very different between countries and possible processes of convergence or divergence are slow.

As is indicated in Figure 2, the diversity of national systems of innovation in Europe is affected through various channels:

A European System of Innovation (ESI) develops through institutional learning taking place on different levels. Arrow A symbolizes actions taken within the over all European framework, e.g. the Maastricht Treaty, EMU, the Structural Funds or common labour market policies, which shape and affect an emerging ESI. Such integration arrangements also constrain monetary and economic policy on the national level (arrow E). Arrow B illustrates that a ESI develops through actions taken within the ESI itself. The common European patent regulation and the various European R&D programmes with their associated committees, representative bodies, lobbies, administrative control systems, etc., are examples of such actions reinforcing the evolution of a ESI. Another example is the development of Framework Programmes reflecting a process of institutional learning within the political and the administrative European organizations themselves. However, the construction of the Framework Programmes is not a simple top-down process. The diversity of national science and technology structures and political priorities also affect the formulation of the Programmes. This reflects the ability of national governments, other interest groups and political parties, various Committees and individual members in the European Parliament to influence the issues on the agenda. Arrow C illustrates such actions emanating from the various national systems of innovations (NSIs).

Figure 2: A Diversity of European Systems of Innovation



The NSIs change through actions by 'Europe' (D and E), through their own actions (F) and through actions from other NSIs (G). Referring to evaluation reports carried out for the European Commission CARACOSTAS and SOETE (1997) conclude that the Community policy often affects institutional learning in less favoured countries more than in the advanced ones. Greece is mentioned as an example on how initiatives at the EU level concerning R&D collaboration lead to establishment of a set of R&D institutions on the national level to match the European R&D collaboration programmes as a precondition for participating in these programmes (arrow D). Arrow G, for instance, illustrates the case when cross country collaboration in R&D (which may be initiated through a 'D-activity') results in technology transfers, networking, diffusion of firm level organizational innovations, upgrading of human resources or other institutional arrangements increasing the innovation capability by a utilization of the diversity of NSIs.

The result of these interdependent processes is the development of a European system of innovation and a new and changing diversity of national systems of innovation in Europe. Both phenomena are, in turn, affecting the process of European integration (H and J).

### TOWARDS A EUROPEAN SYSTEM OF INNOVATION?

The empirical evidence of what is happening to national systems of innovation is still rather weak. We do not really know if they are losing out to systems on the European and/or regional levels or not. The empirical situation is improving, however. For example, the European Commission is financing a number of studies on systems of innovation, including national systems, within the Fourth Framework Programme and the OECD has launched a project to describe and compare the distribution power of a number of national systems of innovation. A conceptual framework has been developed and tested through eight country studies (Austria, Denmark, Finland, Italy, Netherlands, Norway, Sweden and UK). Especially for the Nordic countries there are at the moment several projects analyzing, amongst

other things, organizational and institutional dimensions of these systems. The Danish ‘Disco project’<sup>11</sup> may be the most ambitious effort so far to map a national system of innovation in a broader sense. It includes analysis of organizational forms at the firm level, relations between firms, the overall production structure, institutional infrastructure, and policy perspectives. This means, that it includes important parts of all the elements of Figure 1, except consumer demand.

The data sources for analysis of innovation systems have also been much improved, even if the development of adequate measures of innovation and innovation sources is still in its infancy. R&D activities is now fairly well described and patent statistics are well developed and much used. There has also been a development from the first ‘Frascati Manual’ for the measurement of scientific and technical activities to the ‘Oslo Manual’ which will now be revised and a whole family of related manuals. In addition to this the recognition of the central role played by firms in the innovation process has led to the gathering of longitudinal firm level information. The Community Innovation Surveys (CIS) carried out in most European countries in 1992-94 and the European Report on Science and Technology Indicators have produced much information and so has the PACE study. A number of national and special surveys have also been carried through. A consensus on how to describe a national innovation system and what to include in the description has yet to be established, however, and much empirical work has to be carried out before there is an empirical base for a mapping of the state and development of innovation systems in Europe.

The empirical evidence of an ‘autonomous’ European system of innovation in a broad sense is still rudimentary. For the time being, it is more reasonable to talk about an emerging European system of innovation in the narrow sense of the term, that is a system which only includes a specific knowledge producing sector of the economy. Exploring formal integration related to S&T support, innovation and technology transfer and training and education, Caracostas & Soete (1997) have made an interesting contribution to a description of an emerging European system of innovation. They conclude that “the process of post-national institution building in Europe has been characterized by ‘muddling through’, by finding ad hoc arrangements in a slow and incremental institutional change process, sometimes spurred by the political attainment of radical new formal Treaties, but where compatibility with national rules and routines are a constant problem.”

There is now a lot of persistent Community activities in the area of S&T. S&T programmes have increased substantially since the 1980s and in some Member Countries such programmes have become the most important sources of investment in the emerging science and technology system. This is constantly building up expectations, practices, routines, etc., connected with important elements of innovation systems both at the community level and in Member Countries. There is still a wide diversity across the Member Countries in the amount of resources devoted to research, the structure of those resources, the importance of industry/university relationships, the institutional organizational set-up of government support (central, federal, regional), and the S&T policies. However, there is also evidence of a convergence in the objectives of such policies and their implementation mechanisms (European Commission, 1994). A process of institutional learning is well under way.

Compatibility between institutions at the national and the European level is a key issue in the whole integration process. The development of a European patent system is a clear illustration on this. From its origins, the registration of a patent took place within a national legal system reflecting national specific regulations on intellectual property rights. Spurred by the ongoing European economic

integration and the creation of the “Single Market” the European Patent Office (EPO) was established under the Munich Convention of 1973 in order to facilitate industrial protection based on a unified system of registration which ensures the protection of inventions simultaneously in several European countries.<sup>12</sup> When an inventor wish to protect an invention in several European countries it is sufficient to file a single application to the EPO, which then is empowered to deliver a centralized agreement covering all the ‘designated’ countries in the request, while the protection of the patent itself still depends upon the specific national regulations of each designated country. However, within the Community efforts (based on the EU Patent Convention from 1989) have been taken towards a common EU patent system in the strict sense. The intention is to build a unified legal and administrative system, where a ‘EU-patent’ is assigned the same legal status inside the whole EU area.

For some national systems of innovation the effect of the ongoing European integration process is reflected in a strengthening of the institutional building on the national level. This is the case for instance when new EU environmental regulations and administrative procedures are implemented in Member Countries, where such institutions do not already exist or where the national environmental standards have to be improved to match the new EU regulation. The development, mentioned above, of a whole new set of R&D collaborating institutions in Greece as a response to the European R&D collaboration programmes is an illustration of how European integration may reinforce national institutional learning. The lesser developed national systems of innovation are here in a unique position to improve their innovation performance through institutional learning. For other national systems of innovation the institutional effects of integration may be less visible or it may move decision-making competence from the national to the European level and weaken the institutional learning at the national level. For instance, in Denmark environmentalists have pointed out that national environmental standards and consumer protection are devalued as a consequence of decisions taken at the EU level and that this weakens the institutional support for innovation related to environmental protection.

The need for compatibility between institutions at the national and the European level as a precondition for further integration is embedded in the whole European integration set-up in the sense that all the formal European institutions are based on a combination of federalism and intergovernmental co-operation between nation states. Even in the case of federalism, where sovereignty is located at the European level, the established European institutions have not replaced the national ones, although they may be changed towards a higher degree of mutual coherence. The European Parliament, the Commission, the Council of Ministers, etc., are occupied by national seats reflecting national interests. The role of the nation states is furthermore acclaimed by the subsidiarity principle which distinguishes those areas where the Community has exclusive competence and those where competencies are shared between the EU and its Member States.

During the last years, compatibility between institutional building at the European and the regional level has attracted increasing interest in the theoretical debate and in policy practices. An increasing number of European programmes (e.g. the Science Park scheme, The European Business network and Business Innovation Centres (BICs), the Regional Innovation and Technology Transfer Strategies and Infrastructures (RITTS), the Regional Technology Plan schemes) are dealing with regionally based innovation activities in order to make Europe more competitive and cohesive. Despite the consequent increase in compatible institutional learning on the regional and European level, it is far to early to

suggest the demise of the national systems of innovation. The activities on the regional level are still rather sporadic and the European system of innovation does, so far, only exist in a rather narrow sense.

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## NOTES

<sup>1</sup> The tendency towards commodification of knowledge observable in both the private and the public sector has stimulating as well as inhibiting effects on the production and distribution of knowledge.

<sup>2</sup> See for example Carlsson and Stankiewicz, in Carlsson ed., (1995)

<sup>3</sup> We use this term in a broad sense synonymous to production structure, i.e. it makes reference to specialization in total production and not only in trade.

<sup>4</sup> However, even in these cases there are some national stamps on the sectors. Semiconductor production in Japan and Europe tends to be organized within electrical equipment manufacturing companies and in specialized semiconductor firms in America for example (Nelson, 1996).

<sup>5</sup> Economic space refers to how closely production activities are located in terms of how much they deliver to each other. Organizational space refers to horizontal and vertical integration. Cultural space

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is more difficult to define since it has to include several dimensions of real and imagined interpersonal relationships. A long cultural distance is like a dragon - difficult to describe *ex ante*, but you know it when you see it.

<sup>6</sup> The importance of the nation-state as an institutional context for economic growth has been acknowledged by several scholars, for example Kuznets: "It is not accidental that in measuring and analyzing economic growth, we talk of economic growth of *nations* and we use *national* economic accounts. In doing so, we imply that the sovereign state is an important factor in modern economic growth; that, given the transnational worldwide character of the supply of useful knowledge and science, the major permissive factor of modern economic growth, the state unit, in adjusting economic and social institutions to facilitate and maximize application, plays a crucial supplementary role." (Kuznets, 1971, p. 346-47).

<sup>7</sup> This does not mean, that nation states should be portrayed as fixed and stable learning environments. "Just like technology - nation states are continually envisioned, designed, launched, remodeled, renamed, dissembled and scrapped" (Elam, 1995).

<sup>8</sup> The performance of a national system of innovation can be divided into immediate performance and ultimate performance (Gregersen; Johnson and Kristensen, 1994). Immediate performance refers to direct outcomes of the innovation system in terms of product- and process innovations and their diffusion. Ultimate performance refers to the contribution of innovation to over-all social welfare. Accordingly, as examples of ultimate performance indicators we may think of levels and growth of income, employment, balance of payments and so on.

<sup>9</sup> It is often useful to distinguish between institutions which are 'formal' (laws, e.g. patent laws, government regulations of bank conduct, formal instructions for officials of a technological service system, regulations and instructions for installation of electrical equipment, etc.) and institutions which are 'informal' (common law, customs, traditions, work norms, norms of co-operation, conventions, practices, etc.) (Edquist and Johnson, 1997).

<sup>10</sup> It is well known that Schumpeter saw innovations as new combinations of previously known things. See also WEITZMAN (1996): "Suppose that ideas build upon each other in such a way that new ideas are essentially successful reconfigurations of existing ideas that have not previously been combined with each other." Diversity also plays a role in the rare cases of more genuine creativity. In his book, "The act of Creation", Arthur Koestler gives an example of this when he describes how Gutenberg got the idea of how to construct a printing press by participating in the wine harvest and observing the power of the wine press. The identification of surprising new combinations from vastly different fields of activity is often a factor behind 'acts of creation'.

<sup>11</sup> Disco (Danish Innovation System in COmparative perspective) is financed by The Ministry of Industry and is carried out at the University of Aalborg by the IKE group.

<sup>12</sup> The EPO system came into force in 1978 and throughout the 1980s a rapid growth in patent applications took place. Presently, more than 55 000 patent applications are submitted in Europe each year (European Commission, 1994).