Enlarging the Scale of Knowledge in Innovation Networks: Theoretical Perspectives and Policy Issues

Riccardo Cappellin, Michael Steiner

42nd Congress of the European Regional Science Association

Dortmund, August 27th – 31st, 2002

Abstract

Nowadays, it is widely accepted that knowledge and learning are the core of competitiveness, international division of labour and agglomeration and exclusion phenomena. Yet we are still in need of a better understanding of the processes which allow access by individual regions both to codified knowledge and RTD networks as well as tacit knowledge and know-how at the international/interregional level. This paper will discuss possible approaches to analyze the mechanisms which operate at the international/interregional level and lead to higher forms of integration of industrial and service firms, not only in a commercial or financial perspective but also in knowledge and innovation networks. It will point to a need to develop policy strategies in support of institutions that create and transfer knowledge on a European scale and outline open questions for the creation of the necessary institutional background for the creation and the support of knowledge and innovation networks at this level and for the conditions of its transferability to Objective 1 regions and the EU candidate countries.

1. Competitiveness factors in the transition to the knowledge society

According to recent developments in economic theory, economic advantages - both on an international and local level - have turned from “comparative” (being relatively cheaper) to “competitive” advantage relying on more qualitative elements. This shift resulted from a number of studies published in the 1980s and 1990s which emphasized the importance of “soft” factors - such as good quality of life and good services such as leisure, recreation and health, customized labour training and business networks - in explaining the economic competitiveness of localities. The studies included the work on Italian industrial districts by Piore and Sabel (1984) and Pyke, Beccattini and Sengenberger (1990), the competitiveness of nations by Porter (1990) and social capital by Putnam (1993).

In addition, more recently, knowledge has been recognized as a major source of competitive advantage in an increasing integrated world economy (Dosi 1996, Grant 1996, Foss 1999, Nonaka 2000). The most successful regions are perceived to be those whose firms display innovative capacity, being able to adapt to a rapidly changing marketplace and stay one step ahead of competitors. In fact, “knowledge represents the fundamental resource in the contemporary economy and the process of learning represents the most important process” (Lundvall and Johnson 1994).

In developed industrial economies, producing for open world markets, innovation and sustained productivity growth is less based on material infrastructure and capital than previously (European Commission 1995 and 1999). This kind of economic set-up and restructuring was predominant in the post-war period through to the 1970s. This basically meant the introduction of modern machinery and equipment in order to realize physical productivity gains . This kind of restructuring was relatively easy and resulted in relatively fast catch-up or advances for Europe and the less developed countries of the world vis-à-vis the US.

This process is now repeating itself at a European level with the EU economic lagging regions and the CEE countries preparing for accession to the EU. Yet these forms of catching up still leave a large and persistent “innovation gap”. This may be

explained by the fact that the process of catching up - after having reached a certain level through physical productivity gains – has to rely on other forms and processes, demanding more time and being based on additional strategies and instruments. In particular, the transition from a traditional model of industrialization, based on economies of scale and capital investment, to a modern model of industry characterized by flexibility and innovation represents a challenge both for the EU economic lagging regions and the accessing countries.

In the following we will outline important aspects of clusters and the network model as a basis for innovation processes (2), point to preconditions for the growth of the knowledge base through different forms of learning (3), discuss the role of institutions and social capital in knowledge creation (4) emphasize openness as a factor of innovation and development (5), give a short evaluation of the framework of European RTD and regional policies (6) and then present an agenda for future research and policy considerations (7).

2. Geographical agglomeration factors within clusters and the development of the local networks model

Innovation processes since the 1980s in Europe have essentially been marked by differing forms of innovative milieus and their supporting institutions. Here innovation and productivity gains are based on subtle forms of co-operation, where the creation of new knowledge implies an intense process of interaction. In particular, the role of clusters deserves special attention.

Clusters may be defined as "geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries and associated institutions… in a particular field that compete but also co-operate" (Porter 1990 and 2000). The economic growth of particular regions has been attributed to such clusters of firms that benefit from co-operative links and experience rapid rates of innovation (Porter 1998). It is widely believed that industrial clusters can help to improve the performance of regional economies by fostering innovation and strengthening the competitiveness of firms, thereby generating growth and employment.

Despite the frequent assertion that clusters raise competitiveness and innovativeness, little rigorous analysis has been presented to support this claim. The theory does not distinguish sufficiently between different kinds of forces that promote the spatial concentration of related activities. By conflating different phenomena it confuses the processes at work and may yield misguided policy prescriptions (overemphasis on local collaboration at the expense of promoting external connections).

Ambiguity and silence still prevail on the specific processes and factors that encourage innovation in industrial clusters and also on the various spatial scales on which clustering processes can operate. Most of the available literature on the relationships between technology, geographical distribution of innovative activities and international specialization has at its basis the concept of "locally bounded knowledge spill-overs". Indeed, both the theories inspired by the more orthodox approaches (Krugman's New Economic Geography 1990, 1991 and 1995) the more

heterodox approaches (Lundvall 1992) emphasize the concept of “local and bounded spill-overs” as one of the major mechanisms leading to agglomeration, persistent performances and specialization. Yet, it would be extremely valuable to analyze in much more detail how exactly these spill-overs occur in different areas and sectors.

Attention has focused on innovation as an interactive process involving the sharing and exchanging of different forms of knowledge between actors (Lawson and Lorenz 1999). The key argument here is that the collaborative nature of innovation processes has reinforced tendencies toward geographical clustering , because of the advantages of locating in close proximity to other firms in specialist and related industries (Storper 1995 and 1997). Despite the claimed ubiquity of access to information engendered by the rapid growth of telecommunications, access to tacit knowledge based on networks and face-to-face contacts, which offer greater reliability and less risk, tends to be spatially concentrated.

Clusters and networks, as a special form of spatially based economic strength, relying on specific milieus, are based on various qualified links of co-operation. Co-operation can come in the form of bi- and multi-lateral relationships and can be oriented to vertical linkages between suppliers and clients or horizontal linkages with other firms in the same and complementary fields (in industrial and service sectors). Firms co-operate with public, semi-public and private research and development institutions, which are envisioned to create synergies and thereby qualitative economic advantages. Within these clusters, the sense of belonging represents the basis of an “associative approach” or “associative governance” that leads to the creation of club, fora, consortia and different institutional schemes of partnership (Cooke 1998, Cooke and Morgan 1998).

Among the perceived advantage of agglomeration are (Marshall 1890, Chinitz 1961, Porter 1995):

- access to the maximum flow of information and ideas and provision of shared or non-traded inputs specific to an industry;
- greater opportunities for collaboration;
- greater availability of specialist subcontractors/suppliers,

- greater availability and efficiency of particular local services such as venture capital, specialized property, education institutions, airports, ICT or other public goods and infrastructures;
- development of a local pool of specialized labour related to the existence of specialist training institutions;
- less risk for firms and workers to locate in clusters than elsewhere, because their options are greater; and
- greater customer choice.

The network model can be regarded as a critical component of economic development and of knowledge generation, as knowledge is channeled by formal and informal institutions within networks (Kogut et al., 1993; Keeble and Wilkinson, 1999, Amin and Cohendet, 1999; Gordon, 1991). Networks can refer to both social relationships among individuals and interactions among organizations. The nature of co-operative linkages and networks between firms has received increasing attention in the past decade. The social network model based on the work of Granowetter (1985) and other economic sociologists (Piore and Sabel 1984) place a premium on close collaboration and trust between firms and related institutions (Zucker 1986), so that market failure can be overcome, risk spread, and innovation and learning facilitated through collaboration. In fact, trust is strengthened by local common identity and tradition and spatial proximity. Moreover, economists and political scientists have begun to use extensively the concept of networks: as a result, there are good reasons for more dialogue and collaboration among authors from different disciplinary backgrounds.

The term “network” refers theoretically to goods and services whose production costs (utility) decreases (increases) with an increasing number of participants and increasing systemic connection between single participants (Katz and Shapiro 1994, Economides 1996).

From an economic point of view, the output of the economy depends not only on factors of production, such as capital, labor and technology, but also on the very different forms of organization or cooperation within networks of the material and

immaterial flows between firms, institutions and others actors involved in economic system.

Yet there is still the need to establish a link between the literature on industrial and geographical clusters (Aydalot and Keeble 1988, Audretsch and Feldman 1996, Florida 1995, Gordon and McCann 2000, Maillat 1995, Maillat and Kebir 1999, Malecki 2000, Maskell and Malmberg 1999, OECD 1995, Saxenian 1996 Steiner 1998, Von Hippel 1998, Morgan 1997) and a parallel, but so far largely divorced strand of literature (O'Dell and Grayson 1998, Nooteboon 1999), which has focused mainly on the organizational structures of firms and introduced concepts such as "loosely coupled" organizations to denote specific mixtures of internal research capabilities, on the one hand, and on the other, reliance on research agreements, as a means to explore new promising new research directions and/or to provide complementary competencies.

It is well known that networks are highly differentiated across sectors, regions and countries. Thus far, the literature has analyzed these networks mainly on the basis of case studies and the term "network" has been used somewhat loosely. It is important though to recognize that the specific structures of networks are of crucial importance. There is no such thing as a network, but networks with specific structures (cf. for example, the concept of "small worlds", used to indicate types of networks that are tightly interconnected "inside", but have also non-redundant external relationships).

Networks have become a key focus of research on regional economic development. Many network studies have focused on the hypothesis that strong networking activities will aid local economic performance through increased information and knowledge sharing between individuals, enterprises and organizations. Thus, it is important to arrive at a theoretically-driven taxonomy of clusters and some basic principles underlying their structure and performance as a theoretical tool and basis for policy.

3. Interactive learning and the process of knowledge creation

Growth of the knowledge base depends on intended and unintended processing of experiences, i.e. “learning”, while the interpretation, transfer and use of experiences is influenced by interaction between individuals and between organisations (Cohen and Levinthal, 1989, Anderson 1995).

The generation of new knowledge has to be seen as a cognitive process, where own or foreign, intended or unintended new experiences are recognised and compared to already existing cognitive patterns within the human brain (McCain 1992, Laughlin 1996, Rizzello 2000).

Approaches solely referring to quantitative indicators to identify learning capacities and knowledge in society reach their limits, when tacit and highly specialised knowledge serve as a decisive factor to use and adapt new ideas and experiences (see for quantitative approaches OECD, 1999; Cantner, Pyka 1998). Secondly, besides formal institutions, trust and routines often are decisive prerequisites for successful emergence and sustainability of innovation and learning networks. This refers to the basic concept of social capital (Putnam 1993, Woolcock 1998, Grootaert 1998, Krishna 2000).

Innovation should be considered from a cognitive perspective, suggesting three separate dimensions: knowledge, competencies and product/process innovation (Arrow 1962, Metcalfe and James 2000, McKenzie 1979, Mansell and Wehn 1998, Morgan 1997, Prahalad and Hamel 1990).

The creation of new knowledge implies an intense process of interaction (Knack and Keefer 1997, Nonaka and Takeuchi 1995, Nonaka and Konno 1998, Nonaka et al. 2000, Ritzen et al. 2000, Spender 2001, Steven 1998), which is characterized by the transformation of tacit into codified knowledge and a movement back to practice where new kinds of tacit knowledge are developed. The transfer of tacit knowledge requires face to face contacts and physical proximity, while explicit knowledge may be transferred through ICT at long distances. Tacit knowledge often is more important than widely and routinely available codified knowledge. The interactive processes of

“learning-by-producing” and “learning-by-searching” between firms and various economic and social actors represent the major mechanisms for combining existing knowledge and introducing new knowledge into the economy.

Knowledge may circulate within networks of suppliers and clients in an interactive trans-disciplinary practice in the context of applications, since different type of knowledge are required to enable firms to solve problems framed in this context of applications (Gibbon et al.1994). At the same time, the changing nature of knowledge production and emergence of inter- and trans-disciplinary research centres within universities which engage with external research partners and increasingly rely on external funding sources challenges the basis of disciplinary based knowledge.

The actual “knowledge society” is characterized by the rapid enlargement of production processes both from geographical and institutional perspectives. The crucial change is that the production of scientific and technological knowledge is increasingly self-contained. In fact, the learning process has an interactive character, since it encompasses groups of individuals, both within individual firms and the overall economy (via social networks) and requires the development of links, networks and co-operation between different actors as well as outside the existing institutional channels.

Clearly, the production of scientific knowledge is no longer the exclusive domain of special institutions such as universities and public research agencies, from which knowledge can diffuse as a spill-over or spin-off to the benefit of other sectors. The number of places and actors that are actively involved in the generation of knowledge is rapidly multiplying. As a result, a local production and innovation system is made up of a plurality of actors, such as large and small firms working in a production sector where network relationships exist or could be economically foreseen, institutes of research and superior training, private RTD laboratories, agencies of technological transfer, consultancies, venture capitalists, chambers of commerce, associations of enterprises, organizations of professional training and specific governmental agencies as well as informal social groups, networks and associations (Patel and Pavitt 1994, Freeman 1995, Cooke 1998).

A central fact about the modern process of innovation is that it is based on the division of labour. Division of labour produces efficiency gains from specialization and professionalization, but it also requires a framework to connect together the

component contributions of different agents. As far as knowledge and skills are concerned, this aspect of connectivity, or technology transfer, cannot be effectively coordinated by conventional markets. Therefore the creation of institutions enhancing the connectivity of technology should be a central concern of policy.

The global and knowledge-based new economy is characterized by the interdependence of economic, political, social and cultural factors. The knowledge economy rests on the value of human potential, which tightly linked to economic performance.

In this framework, detailed studies of how knowledge is transferred across firms and learning takes place through the labour market could be of high interest, in order to deepen the knowledge on how the labour market influences co-operation and learning and how well knowledge is passed on by means of labour mobility between firms. Thus, it is important to focus the analysis on models of the relationship between learning and innovation processes and the relationship between these latter and changes in labour markets in Europe.

In conclusions, the changes in the organization of firms and forms of international/interregional integration are linked to new dimensions of the process of innovation (Kline and Rosenberg 1986, Lundvall 1992):

- the gradual and cumulative character of the innovation process, developing in a gradual way and proceeding along trajectories or development paths, which is based on the continuous learning process by entrepreneurs, technicians and workers engaged in production;
- the integration of different and numerous technological and organizational knowledge inputs, derived from other sectors and regions, which allow know-how to be renewed and new problems to be solved. External knowledge should be combined with the knowledge and technologies internally available, since the frontier of technology increasingly is at the crossroads of two or more disciplines and traditional cultures; and
- the interactive character of the learning process, which involves groups of individuals, both within individual firms as well as outside (social networks) and which requires the development of linkages, networks and co-operation between different actors, again outside the channels of existing institutional structures.

Moreover, recent studies have established a broad conceptualization of innovation that not only incorporates, but also extends beyond product and service development, to include business activities and organizational change and renewal (Atherton and Hannon 2000). Innovation here is broadly defined as extending beyond research and development activities to include more incremental developments such as the adaptation of product and services to meet the changing needs of customers and markets.

Thus, a deeper understanding of the mechanisms of learning, knowledge accumulation and innovation is especially useful in order explore the process of restructuring and diversification in regions, where new tacit and codified knowledge has allowed that entirely different innovative productions 'branches' or emerge from the 'old economy' industries or that these latter have evolved toward medium-technology services/manufacturing productions, where no evidence of 'knowledge economy' advances are discernible.

So it is important to understand how such sectors developed, what were or are the mechanisms responsible, to what extent do market versus policy forces explain such development, how systemic are institutional interactions between business, financial investment, human capital and knowledge institutions, and to what degree are firms engaged in both global and local value chains.

4. The role of institutions and social capital in knowledge creation

Economic growth should be understood as an evolutionary process and the endogenous approach seems rather satisfactory for understanding the forces behind the "immediate sources of growth" and the processes that are within the "black box". For interpreting and explaining economic growth the nature and dynamics of the organization of production, the role and change of institutions, and technology and technological advancement should be specified. They generate extemal and internal economies of scale, reduce production and transaction costs and favor economies of scope.

It is therefore important to stress the role of institutions. Development processes do not take place in a vacuum but rather have profound institutional and cultural roots (North 1981, 1986 and 1990). "The central issue of economic history and of economic development is to account for the evolution of political and economic institutions that create an economic environment that induces increasing productivity," (North, 1991, p. 98).

Economic development, then, is stimulated in those territories with highly evolved, complex and flexible institutional systems. That is why training and research institutions, entrepreneurial associations, unions and local governments can more efficiently use available resources and improve competitiveness when firms are integrated into territories characterized by thick relational networks. Barriers, which hinder self-sustained growth processes, frequently appear due to deficiencies in- and poor performance of the institutional network.

New institutional theory argues that the strategic significance of institutions in development processes lies in the economies that its functioning provides. Their behavior can lead to the reduction of transaction and production costs, increased trust among economic and social actors, improved entrepreneurial capacity, increased learning and relational mechanisms, reinforced networks and cooperation among the actors.

As far as knowledge and skills are concerned, connectivity or technology transfer cannot be effectively coordinated by conventional markets. Clusters and networks

are learning organizations and among the non-market devices by which firms seek to coordinate their activities with other firms and other knowledge-generating institutions. Thus, clusters are subtle and differentiated institutions for co-operation and interactive learning and connectivity of technology producing institutions should be a central concern of policy.

The basic interdisciplinary results for individual learning processes stress the importance of institutional arrangements for the generation of knowledge and learning networks, which are not all available in the markets (Maskell and Malmberg 1999, Navaretti et al. 1998, Lawson and Lorenz 1999):

- to reduce the uncertainty about the experiential knowledge of others (of other companies, research institutes etc.),
- to increase incentives for medium-(long)-term investments into diffusion channels – e.g. common codes, products, fora – between the different participants in a network,
- to develop and adapt research, production, distribution, and after-sales strategies to increase the absorptive capacity of new information by the other participants,
- to raise the specifity of development, processing and diffusing knowledge within the network to strengthen incentives for the participants to concentrate their investments in the network and protect new knowledge against competing networks.

Learning can be considered as a social process of ongoing development embedded in a socio-cultural (regional) context. In particular, organizational learning is the conscious attempt of the part of the organization to retain and improve competitiveness, productivity and innovativeness in uncertain technological and market circumstances (Argyris and Schon 1978, Dixon 1995, Dodgson 1993, Duncan 1979, Fiol and Lyles 1985, Hedberg 1981, Nevis et al 1995, Pedler et al 1991, Shrivastava 1983, Stankiewicz 2001). Organizational learning takes place when the organization develops systemic processes to acquire, use and communicate organizational knowledge, as learning is conceived as something, that should deliberately be pursued by the organization and its members. Thus, organizational

learning may be recognized by the existence of learning systems that are independent of the individuals.

One of the key (and elusive) concepts underlying the analysis of learning networks is that of “integrative capabilities”. That is to say, one of the key features of interactive learning is that different fragments of knowledge, competencies, etc. have not only to be accessed but also integrated in specific configurations. Again, the available literature has focused mainly on the processes through which knowledge is accessed and acquired, much less on how it is actually integrated. Yet, there is considerable suggestive evidence that the ways different agents frame available fragments of knowledge and information constitutes a major source of differentials in competitiveness and leads to strongly differentiated performances. At the same time, the transfer of “integrated knowledge” appears to be much more difficult than the transfer of specific pieces of knowledge and information, even within the same firms and organizations.

Integration or “compatibility”, however, is intensely linked with the availability of common diffusion channels – i.e. standards of communication, codes of expressing experiences etc. –, which emerge by common and repeated routines and intended investments.

In a similar way, the analysis should focus on how the integration of different previously disconnected networks can be achieved. To make an example, empirical results about scientific research tend to show numerous top-level research centres are present in Europe in most scientific disciplines, but they tend to remain more strongly specialized and less integrated in different phases of the research process than their American counterparts. Moreover, in the US, institutions sometimes exist that provide precisely this type of integration among differentiated research groups (e.g. the NIH as far as biomedical research is concerned).

Whereas, in principle, explicit and codified knowledge may be traded on markets, tacit knowledge is untradable and requires non-market allocation (for instance, within the firm, in the context of inter-firm networks or forms of co-operation between private agents and public institutions).

Clusters and networks can then be regarded as economic clubs acting to internalize the problems of effective knowledge transmission. To this degree, they are a substitute both for formal markets and organizational integration.

In the literature, one often finds the concept of “locally bounded knowledge spill-overs” (Feldman 2000). According to some contributions, knowledge “is in the air” (at least locally) and everybody benefits (at least in principle) by the existence of such a “stock of knowledge”, as it is embodied for example in universities and research centres, other firms, etc.. Others argue that knowledge is transferred mainly through face-to-face contacts, formal and informal conversations, etc. While both mechanisms are certainly important, these representations are too extreme and may fail to capture some fundamental processes and channels through which knowledge is exchanged and created. It might be argued, for example, that spill-overs are much less automatic than described in the literature and they are organized and mediated by a variety of other institutional devices, including the labour market, markets for technologies, labour mobility, etc.

Clusters and networks as a specific expression of innovation processes can be regarded as a form of Coase institution (Coase 1992) that tries to integrate the positive external effects of innovation, technological knowledge and development activities (Coleman 1988, Keeble et al. 1999, Lagendijk and Cornford 2000). Critical in this context, the concepts of trust and social capital are increasingly being applied in attempts to understand the underlying institutional features of clusters and network. Social capital is the more inclusive concept which, according to one popular definition (Putnam 1995): “refers to features of social organization, such as trust, norms and networks, that can improve the efficiency of society by facilitating co-ordinated actions”. Social capital can be seen as a conceptualization of the glue that facilitates transactions, cooperation and learning in an uncertain world.

The creation of such institutions may be endangered/put into question by high transaction costs (Williamson 2000). Yet because of the specific character of technological knowledge, its asymmetric and tacit character these transactions have to be mediated by non-market methods, primarily through networks and other forms of arrangement between organizations and individuals, procedures which build trust and work to limit the damaging consequences of asymmetric information. So we need the support of clusters by policy, reducing transaction costs.

The processes of new knowledge formation, that is, learning processes, are social and interactive and dependent on the institutional set-up of the economy. Rules (procedures, organizational forms, norms, routines) constitute the foundation of

organizational behavior in a way it is paradoxical that the focus on economic change goes hand in hand with a growing interest in institutions.

The generation and transmission of new forms of tacit knowledge is facilitated and may even be conditioned by a certain level of social capital. Thus, this latter represents an asset, which may become increasingly important in the emerging context of the learning economy.

Leaning processes in organizations is a booming field in organizational theory and have been intensively studied. Theories of organizational learning emphasize the cognitive processes among organizational agents, the role of rules and the interactive processes of learning in loosely coupled organizations. Learning can also be seen as one type of adaptation (absorption capabilities, accumulation capabilities) of an organization to its environment. However, this has only marginally been integrated in studies of the knowledge-based and learning economy.

Finally , local and regional authorities may also be a source of financial and technical support for company development and innovation. They may provide specialized infrastructures, information systems or training programmes for particular industries. They may encourage constructive interactions between firms and discourage opportunistic behavior by supporting institutions that promote their collective interest.

In particular, “institutions building” or “institutional thickness” is important in the CEE transition countries. In fact, CEE countries are facing two main closely inter connected problems: a) building up capitalism/ market economy; b) building up democracy/democratic political system. This results in undertaking huge structural changes in industry and performing re-organisation of a country administration. The restructuring processes in the industry need a lot of effort and is generating a lot of social tensions. Re-organization of country administration was performed in CEE countries allowing for future acceptance of Structural Funds.

Networks as a form of cooperation between group of individuals, firms, scientific institutions, political bodies, etc. are of a great importance especially for CEE countries as they: build up trust and cooperation between partners, promote democracy and active participation in solving local and national problems, e.g. unemployment; contribute to development of innovativeness and cooperation with RTD institutions; promote cooperation on interregional and international level.

5. Openness as a factor of innovation and development

The literature on clusters and local networks often neglects the role of external relations. On the other hand, the actual "knowledge society" is characterized by the rapid enlargement of the production processes both in a geographical and institutional perspective.

Economic literature has identified both positive and negative effects of multinational enterprises (MNE) on recipient economies. On the one hand, MNEs may positively affect local productivity by training workers and managers who may move or spin off from foreign owned firms and become available to domestic enterprises (Fosfuri et al. 2001), by demonstrating the feasibility of new technology, providing technical assistance, transferring patented knowledge, and generating opportunities for imitation of technological, organizational and managerial practices (Mansfield and Romeo 1980, Dunning 1993, 2000), by creating demand for local inputs, increasing the specialization and efficiency of upstream and downstream activities and generating positive externalities for local industries (Hirschman 1958, Rodiguez-Clare 1996) and exerting competitive pressures to improve the static and dynamic efficiency of domestic firms (Caves 1974, Cantwell 1989). The hypothesis that multinational firms can act as export catalysts has also received some support (Aitken and Harrison 1999, Rodriguez-Clare 1997).

The impact of foreign investments on productivity growth and the development potential of a local economy have been interpreted according to two contrasting hypotheses (Blomstrom and Kokko 1998). On the one hand, some have put forward the idea that the larger the productivity gap between host country firms and foreign-owned firms, the larger the potential for technology transfer to the former. Thus, the "catching up hypothesis" (Findlay 1978) identifies a positive relation between the size of the technology gaps and growth opportunities induced by foreign investments. This means promoting the entry of MNEs that are active at the technological frontier, particularly where domestic manufacturers are relatively weaker, provided that appropriate antitrust and other competition policies are adopted to reduce the risks of monopolization in these markets.

On the other hand, scholar have argued that the lower the technological gap between domestic and foreign firms and the higher the relative absorptive capacity of the former, the higher are the expected benefits in terms of technology transfer to domestic firms. Thus, the “technology accumulation” hypothesis (Cantwell 1989), stresses the role of domestic absorptive capacity and the development of internal catching up capabilities in addition to the coherence of foreign and domestic technology as determinants of virtuous effects of inward investment. This is consistent with the view that relatively low technological differentials between domestic and foreign firms would grant higher ability of local economies to capture technological opportunities and respond to the stimuli created by MNEs.

Foreign technologies are useful to local firms, when the latter possess the skills needed to apply or learn foreign technologies. On the contrary, large gaps may signal that foreign technologies are too different from local ones and that local firms have nothing to learn or are so weak that they are not able to learn. In fact, Cohen et Levinthal (1989) reveal that R&D investments are not only directed towards the production of new information, but are also devoted to the function of assimilation of external knowledge.

The absorptive capacity of a firm corresponds to the quantity of external knowledge it is able to utilise and is related to the technological distance (or organisational proximity) between two economic actors. Thus, in order to beneficiate from interregional/international transfers of knowledge, it is necessary for the firm to own internal capabilities necessary to assimilate or reproduce this imported knowledge. Clearly, the absorption capacity is related to the concepts of social capital and institutional thickness, which have been illustrated above.

However, the literature on the relationship between FDI and technological transfers and spill-over has mainly focused on the case of the less developed countries. Thus, it should be adapted to the European case and the relationships between the most developed regions and the less favoured and peripheral regions of an enlarged EU.

In a globalized world of freely moving capital and increasingly freely moving people, it is only social capital, that remains tied to specific locations. Thus, the “learning economy” is characterized by the hypermobility of the information and knowledge and the local character of the social capital. That, apparent paradox may be solved

by promoting an effort of institutional co-operation at the international/interregional scale and harmonization of the relevant norms and institutions.

On the other hand, local and regional clusters are increasingly internationalized or exposed to international threats or opportunities. Particularly important in this framework is to identify whether small and medium size firms are able to be present in global markets. In fact, a recent important characteristic of cluster-like forms of co-operation in many European countries is an internationalisation process of the various actors of the production system, namely of small and medium size enterprises (Storey 1994, Szarka 1990). Local networks are increasingly integrated in larger networks where flows of intermediate products, specialized services, capital, information, know-how and knowledge circulate.

In a network model of organization, also SMEs may aim to perform a global role, by being tightly integrated with other SMEs and large firms in foreign countries. In fact, internationalization requires the capability by the firms to work in different environment and a greater decentralization of functions and the creation of flexible alliances with foreign firms.

Instead of interpreting the globalisation process as an external constraint and risk to their survival , the increasing internationalisation of local production system, has to be described as the extension at an international framework of the same model of specialization and cooperation with other firms, which since long time exists within a regional framework. Thus, a major characteristics of the internationalization process of SMEs is the fact that firms gradually extend the geographical scope, from a sub-national to an international level, of those relationships of thrust and collaboration, which were originally common only within local clusters. The internationalization process is similar to a gradual process of "organizational learning" (Cappellin 1998), where the forms adopted by the individual firms vary continuously, trying to adapt pragmatically to the different environment of the various countries on the base of experience.

The increasing importance of technology and the process of internationalization of national and local economies are transforming the relationships between the firms, which have become more complex, risky and require to be redesigned in a long term perspective. This has compelled firms to device new organization forms and contractual arrangements which may be capable to manage these new and more

complex relationships.Thus, it is mostly relevant for smaller companies to develop strategic alliances or other forms of institutional arrangements to participate in social and technological innovations in other regions of the world (Khanna et al. 1998, Dixon, 2000). On the other hand, peripheral regions are still often rather isolated and less connected or open to economic, social technological relations with other regions and countries.

The contribution of regional economics on interregional/international spill-overs focus on the role of distance and soft and hard infrastructures. In particular, it is possible to distinguish two concepts of distance (Bellet et al 1993, Gilly and Torre 1998, Rallet and Torre 1998):

a) “geographical”;

b) “organizational/ institutional”.

In fact, geographical distance, which is related to transport and communication technologies , is less important as an obstacle to international co-operation, when organizational or technological distance is limited, as it occurs between the firms which operate in the same technological sector or between countries, which have traditions, norms and institutions in common. Moreover, the enhancement of the process of networking requires some “enabling structures” both material (transport, ICT) and immaterial (intermediate institutions, service centres, agencies, technological transfer centres).

Also the double-dichotomous set of distinctions between global/local and explicit/tacit forms of knowledge that should be brought into question. It is often assumed that, while explicit and codified knowledge may be traded on markets, tacit knowledge is untradable and it requires non-market allocation. However, appropriate organizations allowing the transfer of tacit knowledge, such as those of the relations within the large multinational firms or in the context of inter-firm networks or the forms of co-operation between private agents and public institutions, are not in principle bounded to a specific locality.

The learning process both within firms and between firms is occurring within an organizational and institutional framework. The untraded interdependencies between the firms become less informal, as they were originally in industrial clusters, and the

modern economic relationships require ad hoc institutions and organizations, which perform the role of specialized intermediaries.

Clearly individual relationships may span only at the local level. However, the relationships between organizations and institutions, which have a collective character and are more formal, may occur also at large distance.

Moreover, the perceived advantage of agglomeration in term of access to the maximum flow of information, local pool of specialized labour, availability of specialist subcontractors/suppliers and specialized business services are challenged by the development of modern information and communication technologies, the increasing mobility of labour, the changes in industrial organization, such as outsourcing, logistics and JIT, which allows to manage tight relations also at long distances.

When spatial distances are important, access to knowledge and learning networks depends on the existence of specific skills, of social relationships and of organizations and "soft" infrastructures, which may allow to have access to tacit knowledge and to be involved into processing of new experiences.

Geographical proximity certainly enhances the organizational and institutional proximity between the various local actors. However, physical distance may represent a sufficient but not necessary condition for the creation of knowledge and innovation networks between firms and organization.

In fact, the accumulation of tacit knowledge, the building of new skills and the knowledge spill-over are enhanced by geographical proximity, but they especially require a common culture, organizational framework, social capital and institutions. Thus, knowledge transfers are not territorially bounded when culture, organizational framework, social capital and institutions are common or harmonized. As indicated by Perroux's definition of the "polarized space", space may be considered as the result of various economic relations. Otherwise, as indicated by the theories of local development, the territory is a social construct.

In particular, appropriate policies may remove the obstacles to technological integration and may overcome the organizational and institutional distance and the tendencies to geographical concentration, thus enhancing the spread of development and innovation in the peripheral regions.

The two concepts of distance imply a different structure of networks, in particular production, technological and financial networks. In fact, a lower geographical distance allows the development of tighter relations of production integration, such as in just-in-time (JIT) systems or outsourcing of different parts of the production process. On the contrary, a lower institutional/organizational distance allows tighter forms of financial and technological integration, as often occurs in multinational firms operating in high-technology sectors.

If geographical distance can be decreased as investments lower transport and communication costs, this allows tighter production integration between different regions. On the other hand, when geographical distance is high, tight intrasectoral specialization and just in time subcontracting and co-makership become less feasible.

However, a low organizational/institutional distance facilitates investments by foreign firms in joint ventures together with local firms as well as the acquisition of or financial participation in local firms. This process encourages the creation of technological spin-offs and the specialization of local firms in innovative production, which may be integrated with those done by other firms of the same group at international level. These forms of international technological, production and marketing collaboration do not require a strong geographical proximity as the information flows and financial flows could be managed at large distance when a strong organizational and institutional proximity exist.

This is the case demonstrated by various dynamic areas in Europe, such as Ireland as well as the Italian regions of the Centre-North, which have been very successful in attracting non-European investments. At the international level this case may be represented by some Far East countries, which are distant from European and US markets, but are tightly embedded in the networks of international alliances between firms and clearly characterized by a strong openness to international linkages.

In conclusion, the perspective of the “knowledge society” raises dangers of exclusions, which reduce benefits of common European markets and research strategies and lead to further divergences and segmentations between economically strong and CEE and Objective 1-regions as well as between different groups within the affected European regions.

The European Single Market after enlargement will provide the freedom to supply goods and services. It has to be accompanied by the free and undistorted movement of factors of production, such as labor, capital and enterprise to be located anywhere (the right of establishment). Innovation and technological development should be incorporated into an analysis of macro-and microeconomic effects of an integration process at different stages. In fact, the question arises to what extent the technology can be incorporated as an independent factor of production to the theoretical analysis of integration processes and creation of the learning regions integrated into an “European Single Market of Knowledge”.

Further integration and cohesion within an enlarged European Union offers the opportunity to link together different national (regional) innovation systems into one unique multi-disciplinary and multi-sectoral network of innovation, where different strengths are multiplied and weaknesses are compensated.

6. The framework of European RTD and regional policies

At the Lisbon European Council in March 2000, Europe's Heads of State and Governments set an ambitious objective: over the next ten years, Europe should become the most competitive and dynamic knowledge society in the world, capable of sustainable economic development, accompanied by a quantitative and qualitative improvement in the level of employment, and greater social cohesion. In its Communication "Towards a European Research Area" of January 2000 ("Towards a European Research Area", COM(2000)6, 18 January 2000),the Commission outlined the objectives and scope of a new strategy, aiming at a fully developed, functioning and interconnected research space.

However, as indicated by Second Report on Economic and Social Cohesion adopted by the Commission in January 2001, significant differences remain at the national and regional levels in terms of technological development and innovation, as well as in terms of human resources. Data and analyses indicate that the technology gap between the less favoured regions and those in the EU Member States where research and innovation related expenditure is highest (Germany, France, Sweden and Finland) has widened rather than narrowed (with the notable exception of Ireland). This technology gap is reflected at the level of the regions. In fact, one of the most important gaps between Objective 1 regions and those located in the rest of the EU Member States, remains business expenditure for RTD and innovation. These differences are also illustrated by the latest available statistics on Science, Technology and Innovation produced by the Commission.[1]

Thus, as indicated by the Communication from the Commission: "The Regional Dimension of The European Research Area" (Brussels, 03.10.2001, COM(2001) 549 final): "These overall disparities may impede the process of transition of the Union to a knowledge-based economy. Serious efforts have to be targeted on enhancing

[1] See "Towards a European Research Area, Science, Technology, Innovation, Key Figures 2000, EUR 19396, ISBN 92-828-9755-9, EUROSTAT, DG Research, and Key Figures 2001 Special edition "Indicators for benchmarking of national research policies", (2001). See also "Statistics on Science and Technology in Europe, Data 1985-1999.Eurostat. ISBN 92-894-0176-1" (2000). For the candidate countries, the European Commission has published an analysis of innovation policies (Innovation Policy in Six Candidate Countries: The Challenges Cyprus, Czech Republic, Estonia, Hungary, Poland and Slovenia. http://www.cordis.lu/innovation-smes/scr/studies3.htm).

knowledge diffusion, upgrading human resources and promoting organizational changes that will drive science, technology and innovation efforts further."

Facilitating economic lagging regions to take part effectively in collaborative research projects at national or European level, develop their human science and technology resources, take more advantage of the opportunities offered by venture capital provision and thus integrate faster at the European research community, remain primary targets of Community policy. Also in a previous key European document on the guidelines of the European regional policies (such as the "ESDP - European Spatial Development Perspective: Towards Balanced and Sustainable Development of the Territory of the European Union", Potsdam, May 1999), it is indicated that: "Policy must ensure that all regions, even islands and peripheral regions, have adequate access to infrastructure, in order to promote social and economic and, therefore, spatial cohesion in the Community."

Thus, knowledge and innovation networks have since long time recognized as a key factor, which may promote European integration. The ESDP document indicates that: "Knowledge, education and training are becoming an ever more important foundation stone for economic participation and success. Regions with limited or unsatisfactory access to information and knowledge, because of a lack of further education, research and training facilities, are likely to have problems in maintaining population and, in particular, getting people with higher education and more advanced skills attached to the region. This could reinforce population movements to areas that are already well endowed with infrastructure, increasing pressures on these areas while reducing the prospects for better living standards in economically weaker regions".

It also indicates that: "Access to knowledge has the same importance for the competitive situation of the EU as access to infrastructure. Regionally interdependent labour markets and production and service locations require dynamic innovation systems; effective technology transfer; and institutions for training their workforces. Despite the progress of the past decade, which created the climate for new technologies and also provided improved training opportunities and specialist knowledge, access to knowledge and the capacity for innovation are still spatially unbalanced. The awareness of the population of the opportunities offered must also be strengthened. Governments (at all levels) must ensure that there are better links

between education and research and the requirements of regional economic structures. They must also ensure that the general level of education is raised".

Reflecting this approach, initially, Structural Funds activities in less favoured regions were concentrated on physical infrastructure. This was essential to build capacity in terms of laboratories and equipment. Today, despite the fact that critical infrastructures are still important for enabling the transition to a knowledge-based society and economy (for example the availability of modern telecommunications and data networks), the growing importance of intangible investments in education, training, research and innovation priorities is widely acknowledged. In particular, the programming exercise for Structural Funds activity 2000-2006 revealed the strong weight given to RTD and the Information Society as a central axis in development plans for Objective 1 regions.

With enlargement, the adoption of the principle of European cohesion will be extended from the Objective 1 regions of the present 15 Member states to regions in the candidate countries in Central and Eastern Europe. Thus, also the majority of the concepts developed in the context of the "European Research Area" will be applied to the candidate countries. Consequently, research is one of the areas that contributes substantially to the accession strategy.

As well as regional policies, Community RTD policies have supported knowledge and innovation networks at an international level. To date, the prevalent policy stance in the Commission has been to support applied transnational research projects in order to progressively achieve a stronger integration of research teams from weaker countries with those of the stronger. These policies have had some success in this respect, but their record is much less clear as the integration of the different stages of the research process and different disciplinary bases are concerned. Despite the success of EU policies, the European research systems remain strongly nationally based. In order to achieve a better integration, for instance, it has been suggested that a European Science foundation, partly modeled after the American National Science Foundation, might be useful in this context.

As indicated by the Communication from the Commission: "The Regional Dimension of The European Research Area" it is necessary to promote synergies between less developed and advanced regions through the introduction of coordination and networking activities. It is not only necessary to establish a local research and

innovation strategy mobilizing all available resources and actors within the individual regions, but also to embark on interregional co-operation schemes, forming networks of various types. In this perspective, it is important to extend innovative experiments by some particularly successful regions, which have engaged in cross-border RTD co-operation. These initiatives will have a real Community added value, by virtue of their contribution to economic and social cohesion.

The creation of the necessary conditions for the integration of research capabilities existing in less favoured regions in the European research fabric requires stimulating the setting up of real networks of scientific and technological competence, thus facilitating knowledge transfer and creating transnational organizations that associate regions together. However, the integration of less developed regions in the European Research Area cannot be restricted to the enhancement of international collaboration between RTD institutions. It should consider a wider perspective where RTD institutions are only one of the components of the various regional economic and social systems and innovation is related to interactive learning processes, which involve many firms, specialized services, institutions of vocational and higher level education, professional associations, etc. Increasing the knowledge base of an economy does not mean only to invest into research and development by one single researcher, company or institute, but also to improve and intensify linkages both of codified and tacit knowledge between single actors of different kinds.

Thus the study of the national integration of local clusters and their process of increasing international openness will shed some light on a still open issue: how learning processes and knowledge and innovation networks may be extended to the less developed regions of the EU and CEE countries.

7. Agenda for future research and policy considerations.

A number of open questions (already hinted at in the previous chapters) and agenda for future research and policy issues arise from these considerations.

a) New issues in the analysis of learning and innovation processes

We still have to study in detail how innovation in firms and institutions are affected or even determined by learning processes occurring not only at the individual level, but also at the corporate level and even within the local social system and institutions.

We also have to analyze why the constraint of geographical proximity has been gradually relaxed and how learning processes are occurring on the base of the interaction between individuals/organizations/institutions at a wider geographical scale.

In fact, the challenge of globalization and international competition justifies an effort aiming to remove the problems and obstacles hindering a tighter economic and technological integration between the countries/regions of Europe. In a theoretical perspective, the problem to be tackled by the research is that of finding ways to enlarge the geographical span of those interactive learning processes or knowledge spill-overs, which according to the literature are common when industrial and service activities are geographically concentrated in specific clusters or linked in local networks.

Thus we still have to investigate the key theoretical question of how important spatial proximity is for the sustainability of learning and innovation networks, and how the need for spatial proximity can be made compatible with the need for connectivity, in order to intensify European integration and cohesion and to bridge the gap between highly and low skilled in European economies.

The interactivity of the innovation process refers to the internal collaboration between different departments of a company as well as to external co-operation with other firms (especially with customers and suppliers), knowledge providers, finance, training and public administration.

These arguments, together with the broad understanding of innovation, imply an extension of the range of industries that can be viewed as innovative from typical high-tech industries, often located in central areas, to include also traditional, non-R&D-intensive industries often located in peripheral regions.

b) Confrontation of the experience in the most developed regions with that in the less developed regions

We still have to verify the hypothesis that a firm located in a peripheral area not only need technological help or transfer, but will also face the necessity to develop its own absorptive capacity, in order to be able to absorb knowledge coming from outside.

In case where local firms are not strong enough to build this capability by themselves, they have to be supported by the setting of local networks of intermediation, which can improve the transmission of knowledge between foreign and indigenous firms by the development of a "regional" absorptive capacity, mainly supported by local authorities, or helped by EEC funds.

Thus we have to verify the hypothesis that by removing organizational/institutional obstacles and creating appropriate enabling infrastructures, interactive learning and innovation processes in an European interregional/international framework may be enhanced.

In particular, coming research will have to confront the experience in the most developed regions with that in the less developed regions, both in the Objective 1 regions of the EU and the regions of the CEE countries, and examine the obstacles to be removed and the local potential to be enhanced for the less developed regions to take full advantage of the increasing integration at the European and international level.

In addition we should aim to show how the success of clusters in the most developed regions can be replicated elsewhere, especially in the case of the less developed regions in South and in Central and Eastern Europe. This raises the well-known problem of whether clusters can be artificially created. However, a more general objective of coming research is that to extend the lessons derived from the in-depth

analysis of knowledge and innovation networks in local clusters, in order to identify how interactive learning can occur at greater distance and promote a greater international/interregional integration between different national/local production and technology systems from the perspective of the model of the knowledge society.

Future research will not only have to indicate international benchmarks, which may relevant for the less developed regions, and promote an increasing harmonization of the local organizations and institutions, which may enhance innovation and knowledge accumulation. It will also have to focus on the dilemma of integration or exclusion of the less developed regions of an enlarged European Community from international/interregional knowledge and innovation networks, due to the fast technological change of the modern "learning economies".

Thus, we still have to analyze the mechanisms, which operate at the international/interregional level and may lead to the development of non-local networks capable of integrating the less developed and peripheral regions in the framework of an "European Knowledge Area".

c) New perspectives for Community innovation policies

From a policy perspective we have to assess the present state of technological and innovation policies with regard to these issues and develop strategies for an intensification of interactive learning processes and co-operation. We have to indicate a set of policy recommendations for the creation of new hard and soft infrastructures or institutions, both at local and European levels, which can enhance the way in which knowledge and innovation networks existing in the most developed countries of the EU, may extend to the economic lagging regions (particularly Objective 1) in South Europe and the candidate countries in Central and Eastern Europe.

Policies aiming to promote knowledge and innovation networks should take into consideration the characteristics and differences in the European economic, social and institutional models, with respect to other world areas. In particular, the European economy is characterized by large regional income disparities and, while

some regions are among the most advanced in the world in the adoption of new technologies, other regions have a high technology and productivity gap, increasing the risk of exclusion from transnational knowledge and innovation networks.

Moreover, the European economy is enriched by a wide diversity of social models and cultural and historical backgrounds. Thus the same policy framework may have different effects in different regions. In particular, the differences between the less-developed regions in South Europe and the regions/countries in Central and East Europe have to be identified and studied. Indeed, as indicated by the Communication from the Commission: "The Regional Dimension of The European Research Area": "Because European regions have very different profiles in terms of economic development, especially in relation to their capacity to generate, absorb and integrate technological innovation and transforming it into economic growth, adopting a single development model would be a mistake".

Clusters of industrial and service activities, networks of small and medium size enterprises, supported by a rich endowment of social capital and intermediate institutions, have a diffused role in all European regions and that seems also a characteristic with respect to other world areas. Clusters are often considered as the main drivers of regional development. Clustering is networking at large, with constituent parts developing strong, interdependent links. Knowledge "spill-overs" may be considered as the most important cluster "by-products".

Clearly, European regions are still characterized by a wide institutional distance, which represents an obstacle to international knowledge and innovation networks, since the national independence of the various countries leads to higher institutional differences, than it would exist within the same country, as is the case of the US.

A further difference is the existence in Europe and all the individual countries of a long and strong tradition of regional policy, i.e. of a policy aiming to promote economic and social cohesion and which has objectives and instruments distinct from those of other public economic and social policies.

Finally, even the concepts of the "knowledge society" and "leaning economy" are different with respect to related concepts, which are more widely used in other world areas, such as "new economy", "e-economy" and focus on a restricted set of high-tech sectors, such as ICT. Clearly the concept of knowledge and innovation networks includes both new, technologically advanced productions and traditional but complex

production, as well as private and public sector activities. Thus, it is important to foster partnership between the public and the private sector in order to contribute to the European knowledge-based economy and stimulate knowledge creation and diffusion.

d) New approaches for an appropriate institutional framework

According to a network approach, policy has to look for variety and diversity, not optimality as evolutionary policy makers shift away from efficiency toward creativity and patterns of adaptation move to market stimuli and technological opportunity. An evolutionary policy makers adapt rather than optimize, and their central concerns are the innovation system and the operation of the set of institutions within which technological capabilities are accumulated. The canonical policy problem is defined in terms of the dynamics of innovation in a world characterized by immense micro complexity.

A new approach in policy making based on the concept of international innovation and knowledge networks encourages study and identification of new measures and mechanisms of integration to:

- overcome the traditional “Regional Innovation System” approach, focused on the creation of technology transfer centres;
- shift policies from direct intervention (“pick the winner” approach) to a growth enhancing approach aiming to facilitate change and based on the governance of networks and territorial competitiveness policies;
- adopt a “territorial knowledge management” approach in steering the local knowledge networks and establish technological strategies for the regions;
- increase the potential of universities and research institutions;
- enhance science and technology projects carried out jointly by SMEs, universities and research centres;
- improve the quality of human capital formation and enhance education infrastructure;

- promote the creation of incubator organizations, start-ups and spin-offs of innovative firms;
- support the creation of networks of SMEs and their progressive “connectivity” at the international level;
- promote exports and “openness” in terms of exposure to changing markets;
- enhance the role of multinational corporations, international direct investments, international production decentralization, international subcontracting and know-how spill-over;
- support the creation of interfirm RTD and projects teams;
- promote the diffusion of good practice, the creation of benchmarking procedures, of specialized consultants and intermediaries and the setting up of information systems;
- promote the development of new financial instruments (venture capital) for business start-ups and efficient capital markets; promote the modernization of infrastructures;
- bridge the gap between the public and private sector;
- identify the role of major cities as international gateways;
- support the process of institution building and institution harmonization;
- support the role of local governments and interregional and reinforced co-operation.
- stimulate experience exchange with other successful regions in specific fields and foster networking and transregional co-operation.

An appropriate institutional framework at the European level may have a key role in determining the rate and direction of technological learning. Thus, it is important to promote an environment conducive to research and innovation, through the introduction of accompanying legal, financial and fiscal conditions that would prove necessary.

Supranational institutions may become an important actor in setting policies, which do not merely support particular innovative activities, but create a framework by

which knowledge dynamic processes are harnessed. Transregional infrastructures could allow greater share of information through more frequent face-to-face contacts, common culture and greater opportunities for collaboration. These policy indications may contribute to the European RTD policy and to the European regional policy in economic lagging regions.

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