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Regional innovation in the digital economy: an holistic conceptual framework

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**REGIONAL INNOVATION IN THE DIGITAL ECONOMY:
AN HOLISTIC CONCEPTUAL FRAMEWORK**

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Abstract

The main objective of this work is the set-up of a holistic, systemic and evolutionary framework to explore the issues of regional innovation in the new economic environment emerging from the transformation the world economy is undergoing. In our view this transformation is enabled by the evolution of the Information and Communication Technology (ICT), hence the definition Digital Economy to name the new economic environment.

In this paper, we focus mainly on how the Digital Economy could shapes the relationship between the digital innovation processes and the regional level of economic organization. We maintain that this relationship is crucial in understanding the issue of economic development and to take into account the different levels of development inside the same country.

A huge amount of literature faces the issues of economic development and innovation processes from different perspectives. Among these different perspectives we recall:

- The geography perspective based on general theory of location (Scott, 1998);
- The competitiveness perspective that address the role of location in competition (Porter, 1990);
- The institutional economic perspective (North, 1990);
- The learning regions perspective (Boekema *et al.*, 2000);
- The systems of innovation perspective, essentially in the form of National Systems of Innovation, NSI [(Lundvall, 1992), Nelson (Nelson, 1993) and Freeman (Freeman, 1995)].

This list of perspectives is obviously a not complete list of the several approaches have been developed about the economic development issue. From these different perspectives the following elements emerge:

- a) They share the view that space, innovation, knowledge, learning, institutions and related issues matter, explicitly or implicitly, in determining the economic development of a region;
- b) Some of these perspectives, like the learning regions and the systems of innovation perspectives, recognize, explicitly or implicitly, the distinguishing characters of the new economic environment assigning a prominent role to the learning processes;

- c) Some of these perspectives, like the institutional economics and the systems of innovation perspectives, assign a prominent role in their dynamics processes to the institutional set-up.

These elements require the search for an interdisciplinary approach in building a coherent and holistic conceptual framework to address the regional innovation issue in the Digital Economy. This paper is a tentative work to contribute to this search, starting from the existing literature and from some empirical evidences about the new economic environment, at firms and regional level. The results of this search are:

1. The relevance of intangible assets of regions in attracting and retaining new firms. In the future, the regions that perform the best will be those deploying their knowledge assets most effectively for innovation. In that regions, the ability to learn becomes the key asset of the Digital Economy;
2. The shift from traditional ‘external economies’ to ‘network externalities’ fostered by the growing relevance of intangible assets;
3. A shift from traditional technology policy towards innovation policy that will be much more demand based than technology policy has been until now.

1.1 Introduction

The deep transformation the world economy has undergone in the last two decades has been characterized in several ways by different scholars. Following their own scientific backgrounds and specific academic disciplines, each scholar may refer to the new economic environment using such terms as Global Economy, Digital Economy, Learning Economy, Knowledge-based Economy, Alliance or Flexible Capitalism, etc. In this paper, I focus mainly on how this transformation shapes the relationship between the innovation processes and the regional-national-global level of economic organisation. Concomitantly, I highlight the new regional foundations of economic performance, not only for the region as a whole, but also for the single firms located in that region. In my view, two main factors shape the new role of regions in the economic system:

- The mobility, across national boundaries, of firms’ created assets due to the globalisation processes which the world economy is undergoing;
- The increasing rate of learning processes inside and between organisations due to the emergence of a Knowledge-based Economy.

These factors require that regions provide immobile created assets to complement the mobile assets of firms. Among others, because learning is a collective and socially embedded process, regions should provide an institutional infrastructure in order to offer efficient support to learning processes within and among firms. Moreover, these factors represent a challenge to the management of firms because the choice of where to locate a branch, manufacturing plant, or home base is no longer a ‘definitive’ choice, but depends on the new opportunities offered by a region. In this sense, the new competitive environment needs an interdisciplinary approach through the convergence of different traditional disciplines such as management and economic geography. Concomitantly, these factors represent a challenge for the stakeholders of a region because they increase the competition between regions in attracting and retaining firms.

The starting point of my analysis is the identification of the special character of the new economic environment in which the evolution of Information and Communication Technology (ICT) is a driving force enabling the transformation, hence the use of the term ‘Digital Economy’ to define the new environment. In this sense Digital Economy is the new techno-economic paradigm (Freeman and Perez, 1988) whose key factors are the microprocessor and the Internet.

1.2 Some stylised facts on the Digital Economy

In this section, I highlight some of the most striking facts about the Digital Economy at macro level. The view taken in this paper is that the transformation which the world economy is undergoing is emerging by the co-evolution of ICT and institutions. Here, by institutions I use the very broad definition given by Coriat and Dosi (Coriat and Dosi, 1998): formal organisations, patterns of behaviours that are collectively shared, negative norms and constraints.

This co-evolution is generating several changes in the structures:

- Changes in the organisation of firms. The old hierarchical firm gives way to a new flexible form of semi-independent groups linked laterally rather than vertically, as shown with the empirical evidence of Virtual Clusters (Romano, Passiante and Elia, 2001);
- Changes in the economies of scale. In the manufacturing sectors, the introduction of ICT has drastically lowered the minimum efficient scale of production for many individual product lines; fixed costs are covered by producing many product lines so that economies of scope become more important than economies of scale;
- Shift to services. The proportion of the labour force in the manufacturing sector is steadily declining, whereas the proportion of the labour force in the services sector is steadily growing, to the point that the services sector is now the largest single sector by employment in all industrialised economies;
- Locational effects. As the Virtual Clusters phenomenology shows, the massive adoption of ICT allows production to be disintegrated into a series of independent operations, and moreover, it allows independent units to be co-ordinated in ways that were impossible in the past. These transformations, together with the improvements in transportation technologies, today allow component parts to be produced anywhere in the world and to be shipped to arrive when and where they are needed.

Moreover, the co-evolution of ICT and institutions is giving rise to two relevant phenomena: the Global Economy and the Knowledge-based Economy.

1.2.1 The Global Economy

Many of the structural adjustments enabled by the ICT revolution can be interpreted as an increased globalisation of the world's economies. According to Kobrin (Kobrin, 1997), in the Global Economy national markets are fused transnationally rather than

linked across borders through flows of trade and investment as in the previous International Economy.

This shift from International Economy to Global Economy is characterized by:

- The adoption of ICT as a means of integrating and co-ordinating geographically-dispersed extra-firm activities within Virtual Clusters;
- A strong international economic interdependence due to trade and financial market linkages. Among these linkages, financial linkages are stronger because of the growing rate of Foreign Direct Investments (FDI). The main drivers of FDI growth are: (a) the access to basic factors (capital, raw materials, etc.) from a foreign outlet, (b) the access to markets, and/or (c) the selective tap of particular skills, technologies, or learning experience (Dunning, 1997). In the new environment, more and more developed countries are in competition to attract high-quality FDI based on the last driver;
- The dramatic increases in the scale of technology: in its cost, risk, and complexity that are the most important (but obviously not the only) motivation behind the formation of strategic alliances, especially in some industries, such as automobiles, pharmaceuticals, biotechnology, aerospace, and information technology. Cross-border strategic alliances, together with FDI, are the main drivers behind the geographical dispersion of economic activities;
- The emergence of networks as a basic mode of organisation of international economic transactions, hence the definition: “Network Economy”. The Network Economy is conceived in terms of a complex web of transactions (Kobrin, 1997) based on alliances linking various parts of an organisation (for example an MNE) with others.

The most evident effect of the dynamics described above is a relentless erosion of the borders between individual national economies and a shift in the pattern of world development from a network of interacting national economies toward a single globally integrating economic system (Scott, 1998). This shift represents a challenge for national governments and they generate new governance mechanisms and patterns through reallocations of power (Lipsey, 1997). Reallocations are tending to transfer some of the powers of national governments upwards to supranational bodies and others downwards to more local levels of government. These processes cause the emergence of a fourfold spatial hierarchy of economic and political relationships (Scott, 1998):

- The global level constituted by different networks of economic activity;
- The pluri-national level represented by a group of multination blocs, such as the EU, NAFTA, etc.;
- The national level focused on the classical sovereign state;
- The regional level that, according to Scott, is re-emerging as a modern articulation of economic organisation.

Despite the name, in the Global Economy it is the strong interdependence between the levels of this hierarchy that matters, rather than the global level alone.

1.2.2 The Knowledge-based Economy

The Knowledge-based Economy is another relevant subset of the structural adjustments which the world economy is undergoing as result of the ICT revolution. The empirical evidence about Virtual Clusters highlights the role of knowledge and of learning processes in the dynamics of Virtual Cluster formation and growth.

In the evolutionary perspective, knowledge and learning processes are strictly related to innovation and, hence, to value creation. Learning processes are the first step in producing innovation, and, similarly, each innovation triggers new learning processes due to the need to deal with the change. In some sense, learning processes and innovation form a wheel like the one shown in Fig. 1, whose revolution speed is increasing in the Knowledge-based Economy.

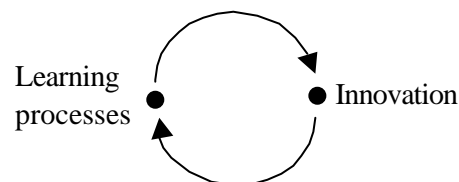


Figure 1: The ‘wheel of learning’ formed by learning processes and innovation according to an evolutionary approach.

At global level, the search, creation, and deployment of knowledge assets are mainly transforming the economic environment for MNE activities and, particularly, they shape the FDI and strategic alliance activities. In this sense, there is a strong interdependence between these processes and the globalisation processes described previously. Some stylised facts on this interdependence are as follows:

- Increasingly firms are investing abroad, to protect or to increase their core competencies, accessing foreign created assets, i.e. technological capacity, information, human creativity, and markets. As remarked in the previous section, the selective tapping of particular skills, technologies, or learning experiences is overriding other factors as a driver of FDI growth in the Digital Economy;
- Some of these created assets are proprietary to particular foreign firms, others are more generally accessible to firms but immobile across geographical space;
- Concerning the created assets owned by foreign firms, the modalities of seeking created assets are mainly: FDI that takes the form of mergers and acquisition of foreign firms; cross-border strategic alliances especially within knowledge- and information-intensive sectors (Dunning and Wymbs, 1999);
- Immobile created assets are part of the technological, educational, and legal infrastructure that provides general inputs to firms.

1.3 Regional innovation in the Digital Economy

A huge amount of literature deals with the issue of economic development – at regional, national, and global level – from different perspectives. Among these different perspectives I recall:

- The geography perspective based on the general theory of location in which “the central question is how and why different types of production occur at different levels of quantitative resolution in different places, and how any specific locational outcome affects the performative qualities of the economy” (Scott, 1998);
- The competitiveness perspective that addresses the role of location in competition, and is strongly influenced by Porter’s theory (Porter, 1990) of the competitiveness of nations, regions, and other geographic areas. Through his diamond metaphor, Porter depicts the nature of a location’s business environment offered to firms, and how this environment affects the firms’ competitiveness. Moreover, Porter shows how the prevalence of clusters in economies, rather than isolated firms and industries, determines the nature of competition and the role of location in competitive advantage;
- The institutional economic perspective in which the pathway to economic growth and development is set by the character of established institutions and their ability to

adjust to change in the most cost-effective way. In particular, the 1995 Nobel Prize winner Douglass North (North, 1990) highlights how the role of institutions is to minimize the transaction costs through high-trust institutional framework and co-operation;

- The learning regions perspective based on the assumption that economic growth is dependent on innovation, and innovation, in turn, is dependent on learning processes; learning processes are generally believed to be connected with space, hence learning regions [for a review of learning regions see for example (Boekema et al., 2000)]. According to Florida, learning regions function as collectors and repositories of knowledge and ideas, and provide an underlying environment or infrastructure that facilitates the flow of knowledge, ideas and learning (Florida, 2000);
- The systems of innovation perspective (essentially in the form of National Systems of Innovation, NSI) – based on an evolutionary approach to technological change – was developed mainly by Lundvall (Lundvall, 1992), Nelson (Nelson, 1993) and Freeman (Freeman, 1995) [see also an excellent review by Edquist (Edquist, 1997)]. A broader definition of NSI includes all parts and aspects of the economic structure and the institutional set-up affecting learning and involved in searching and exploring (Lundvall, 1992).

This list of perspectives is obviously an incomplete list of the several approaches to the economic development issue. From these different perspectives the following elements emerge:

1. They share the view that space, innovation, knowledge, learning, institutions and related issues matter, explicitly or implicitly, in determining the economic development of a region;
2. Each of these perspectives addresses a specific point of view, some of them have an interdisciplinary approach, and in my opinion, they stimulate the search for a coherent and holistic conceptual framework to deal with the issue of the regional development.

These elements drive the set-up of a holistic conceptual framework to explore the issues of regional innovation in the Digital Economy.

1.3.1 Towards a conceptual framework

The organisation of production in the Digital Economy involves regions in a transformed way compared to their role in previous modes of economic co-ordination.

Indeed, localised processes of growth and development are emphasized by globalisation, and the world economy is characterized by strongly interconnected regional economies.

The Digital Economy is boosting a shift in the nature of external economies (external economies are at the heart of regional foundation): from static towards dynamic efficiencies based on innovation and rate of learning. Generally, regional theories stress the relevance, for locational advantages, of cost minimisation due to the proximity to natural resources, related firms, customers, or skilled pool of labour. These advantages have been superseded by the globalisation of markets, technology, and supply sources, and by lower transportation and communication costs. Today, external economies are based on the availability and quality of location-specific created assets that complement the mobile created-assets of firms; among these assets there are the institutions that foster entrepreneurship, knowledge accumulation (Dunning, 1997) and learning processes.

As consequence of the above considerations, some facts emerge:

- Since learning is an interactive and socially embedded process, the institutions, as defined previously in this paper, shape the learning efficiency of an organisation;
- Organisational learning critically depends on sharing knowledge (tacit, codified or both) but it also depends on trust and commitment among the members of the organisation itself, or among members of different organisations;
- The role of trust relationships and of collective value systems in affecting regional development emerges in the ‘social capital’ concept popularised by Putnam (Putnam, 1993): the institutions and organisations of regional communities in Northern Italy, with their social relationships, form ‘networks of civic engagement’, that facilitate the activities of politics, production, and exchange;
- In Silicon Valley, social capital can be understood in terms of the collaborative partnerships that emerged in the region fostered by economic and institutional actors in search of objectives related specifically to innovation and competitiveness. This model ‘underscores the importance of cooperation between firms and institutions and, thus, the role played by links and networks involving different organisations’ (OECD, 1992). The innovation networks (Rallet and Torre, 1998), (Cohen and Fields, 1999) link firms, banks, research organisations, universities, government, and any kind of public and private institutions. In these innovation networks, the linkages

among the actors are knowledge-based ones (Nonaka and Takeuchi, 1995), (Rallet and Torre, 1998) which enable learning processes in an organisation or in a region.

According to Cohen and Fields what these innovation networks in Silicon Valley share with the networks of civic engagement is simply and only a common network-like structure. The fact that economic and institutional actors in Silicon Valley fostered the creation of innovation networks provides encouragement for efforts to create an innovative milieu in other regions.

In the next section, I introduce a network approach to regional innovation and I propose a shift from external economies to network externalities.

1.3.2 Networks of innovation and network externalities

The role of networks as new forms of economic organisation differing from markets and hierarchies has been emphasized in the Digital Economy. Hierarchies have limited learning abilities and markets have limited capacities to process information effectively. Networks and alliances are ways to counter these failures, ways to combine the benefit of being large and small at the same time (Acs, de la Mothe and Paquet, 2000).

The concept of network highlights the role of cognitive and social relationships among the firms in Virtual Clusters and between firms and other institutions in a region. Moreover, it highlights the role of a value network in which an organisation needs to collaborate not only on a peer level, department level, or organisation level but also needs to see and collaborate holistically at a system level. The only way to achieve this result is by creating a network of relationships between every part of its ‘business ecosystem’. At a time when the value chain concept is giving way to value networks, the emphasis needs to shift from minimizing transaction costs incurred by individual firms to maximizing transactional value created by networks of firms.

In a value network, due to the complex web of relationships among the participants, the boundaries of a firm are not well defined. If one focuses on an intangible asset such as social capital – i.e. the overall set of relationships that make organisations work effectively (Prusak and Cohen, 2001) – which part of the social capital is ‘internal’ to the firm and which part is ‘external’? In this case, what is the meaning of the ‘external economies’ defined previously in this section?

According to Saxenian, the concept of external economies is based on the view of the firm as an atomistic unit of production with clearly defined boundaries (Saxenian, 2000). In cluster theories, external economies help to explain the advantages that are

derived from the spatial clustering of economic activities. Saxenian, based on the different evolution and performances of Silicon Valley and Route 128, adopts a network approach to regions, in which the shift is from external economies to network externalities.

Here, I use the term network to mean a set of actors and the linkages among them. Learning and knowledge creation are interactive and collective processes that involve the creation of some kind of networks among individuals and organisations. According to Saxenian, Silicon Valley has a regional network-based industrial system and dense social networks that enable learning and mutual adjustments. In contrast, Route 128 is dominated by large vertical corporations, that internalise many productive activities within a hierarchic structure. The network approach helps to explain the differences in industrial adaptation of these two regions, under the same external forces. As seen in the previous section, Silicon Valley highlights the existence of 'regional innovation networks' in which the functional boundaries within firms are porous, as are the boundaries between firms, and between firms and local institutions such as trade associations, universities, etc. (Saxenian, 2000). In these networks, firms compete but also learn from each other through informal communication and collaborative processes.

The advantages of networks over other forms of organisation are the 'network externalities' features (Shapiro and Varian, 1999): they refer to the attraction power of large networks compared with small ones. Network externalities are what lie behind *Metcalf's law*: if there are n actors in a network then the total value of the network is proportional to $n(n-1) = n^2 - n$. So a tenfold increase in the size of the network leads to a hundredfold increase in its value. For example, communication or transportation networks have this feature: the more people or destinations they can reach, the more valuable networks become.

Despite Metcalfe's law, the extension of an innovation network cannot grow indefinitely. Indeed, in this case, the geographical extension is limited by the nature of the relationships involved in the linkages of these networks. Informal communication, trust, and commitment are strongly dependent on face-to-face interactions. Electronic communication enables some kinds of collaborative processes, but it cannot totally replace the networks of social relationships enabled by geographical proximity. In this sense, the regional extension of innovation networks is the result of two balancing forces:

- Network externalities foster the growth of the geographical extension of networks through the involvement of new actors and the establishment of new linkages;
- Social capital creation and maintenance limit the size of networks into a homogeneous institutional system. Networks crystallize around a unifying purpose, mobilizing independent members through voluntary links, around multiple leaders in integrated levels of overlapping and superimposed webs of solidarity (Acs, de la Mothe and Paquet, 2000).

The creation and maintenance of innovation networks are a concern of technology policy. Public actors try to develop regional technology policies directed towards supporting collective processes of research and innovation. In the evolutionary perspective, the goal of these policies would not be to eliminate market imperfections and lead back to equilibrium, but to move the system deliberately away from equilibrium (Saviotti, 2001) through discontinuous or qualitative changes that will lead to the formation of a completely different network, with new actors and new linkages. Indeed, as the new system develops, its connectivity (the density of existing links) and the role of different actors will undergo systematic variations, with the emergence of a new set of institutional infrastructures. But more than one institutional configuration can lead to an equivalent outcome (Saviotti, 2001), thus the problem would become how to create the right network.

1.4 Innovation policy in the Digital Economy

What follows from previous sections is that policy implications should be focused on the search for an enabling strategy for innovation network creation and maintenance. On the basis of the conceptual framework of the previous sections, several assumptions can be made:

- The distinction between industrial policy and technology policy is becoming less and less pronounced. Technology policy is becoming the main part of any industrial policy strategy, and it should influence all the factors that promote technological innovation, primarily the learning processes. According to Lundvall, in attempting to further technological innovation, one must start with the existing knowledge base, in the given institutional context (Lundvall, 1999);

- The gradual emergence of the Knowledge-based Economy should lead to a shift in the technology policy: from supply-oriented technology policy to innovation policy seeking a better balance with demand-oriented factors. A more balanced supply-side/demand-side technology policy is more appropriate for an innovation-driven economy focused on the distribution of knowledge, skill, entrepreneurship, and the facilitation of new forms of collaborating between firms, universities, and the government. This view highlights the network dimension of innovation processes and the needs for the establishment of innovation networks;
- Innovation networks must be analysed as a whole. A multiplicity of actors and relationships among them determine the performance of the system. In these networks, institutions enable and facilitate innovation and learning processes. Missing linkages between firms and other public and private organisations – universities, local government institutions, etc. – can produce a mismatch among the different components of the system;
- Networks are consensus and inducement-oriented systems (Acs, de la Mothe and Paquet, 2000). This logic does not abolish power but it means that power and leadership are distributed and there is a ‘voluntary’ adherence to norms. The dynamic of an innovation network is generated by trust and self-reinforcing mechanisms that enhance the social capital and generate increasing returns. Trust is the result of the complex web of relationships of the economic and institutional actors in pursuit of explicitly competitive aims, as in Silicon Valley (Cohen and Fields, 1999);
- Human capital is a critical component in an innovation network. Distributed leadership, as in innovation networks, calls for a collective capacity to start up and to sustain significant changes (Romano, Elia, and Passiante, 2001). In an innovation network, the role of human capital is to exploit the opportunities deriving from innovations reconfiguring the knowledge assets of the network itself;
- The impact of policy strategy on the social cohesion of the economy as a whole should be taken into account. The speed-up of change requires the capability to learn and adjust faster than in the past. Learning and adjustment processes stress the norms, the rules, and more generally the institutions of the system.

1.5 Conclusions

Starting from the stylised facts on the new competitive environment enabled by the evolution of ICT, and by the several approaches to the economic development of a region, I tried to develop an integrated and holistic approach to the regional foundations of economic organisation in the Digital Economy. This approach includes the following elements:

- The co-evolution of ICT changes and institutions is enabling a new economic and social environment for firms and for regional competition. The new environment manifests itself as the Global Knowledge-based Economy;
- In the Global Knowledge-based Economy, learning and knowledge creation processes are crucial at both firm and regional level. These processes involve a social dimension that can be represented through the concept of social capital;
- The new regional foundations of economic organisation are strongly connected to the creation of an economic and social environment to enable and to support learning processes inside firms and organisations;
- Regional innovation networks and network externalities are the main concepts involved in these new foundations. More in particular, network externalities and social capital represent the balancing forces determining the spatial extension of an innovation network;
- This new environment needs a shift in technology policy: from traditional supply-side technology policy to innovation policy with a more balanced supply-side/demand-side approach.

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