
The Geography of Innovation and Economic Clustering: Some Introductory Notes

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1. *The Resurgence of Research in the Geography of Economic Activities*

During the last decade or so, the geography of economic activities has resurged as one of the key issues in the research agendas of scholars from quite diverse economic fields. Although the idea dates back to Marshall (1920) and has been developed subsequently by other economists, such as Hirschman (1958), Perroux (1950) and Jacobs (1961) to mention a few, the resurgence of geography is not casual and takes on today a special significance. Without rehashing the controversy between regional economists and new economic geographers (Martin and Sunley, 1996), the rediscovery of space and territory as crucial economic factors springs from the increasing awareness that variations across regions in economic growth and performance are ultimately dependent on a set of relatively immobile resources—knowledge, skills, institutional and organizational structures—whose role has now been recognized as very important. Partly triggered by such awareness, and partly as a reaction to Krugman's (1991) dismissal of such knowledge-related factors as agglomeration force, an increasing number of industrial and innovation economists have undertaken the task of carefully studying the geographic dimension of innovative activities and its implications for economic clustering, particularly those clusters of small and medium-sized enterprises in technology-based or high-technology industries. This has typically involved a blending of creative empirical work and appreciative theorizing, with relevant contributions coming not only from economics, but also from sociologists and organizational scholars. Moreover, as these developments were unfolding, regional economists and policymakers have also started giving technology a prominent place in their research and policy agendas.

Following successful cases in the United States (e.g. Silicon Valley) as well as Europe (e.g. Baden-Württemberg), many regions in industrialized

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countries have been trying to mimic these examples, setting up science parks, technopoles, venture capital and financial innovation support schemes. At the supranational level, the European Union has also launched several programmes with the aim of supporting regional innovation policies, particularly those directed to small and medium-sized enterprises.

As a result of these growing research efforts and policy experiments, a number of different theoretical frameworks have been developed to analyse the geographical dimension of innovation and its implications for the clustering of economic activities.

One line of thinking has developed around the question of assessing whether and to what extent innovation clusters geographically. Drawing on insights produced by the economics of innovation and the 'system' approach to innovative activities, the authors in this tradition argue that innovation is likely to cluster geographically in areas where those specialized inputs, services and resources necessary for the effective working of innovative processes are concentrated.

However, the actual reason for the major impact of this stream of literature and its widespread acceptance among mainstream economists has to be found in the importance attached to the notion of 'knowledge spillovers' as a key explanatory factor for the clustering of innovative firms. The argument is based on the properties of the knowledge base used in innovative activities and the associated means of knowledge transmission and communication. Contrary to Krugman and others, who believe that knowledge flows are either unmeasurable or are spatially unbounded in a world increasingly linked by information highways, this literature forcefully claims that the transmission of new knowledge tends to occur more efficiently among proximate actors. In turn, the importance of proximity in lowering the costs of knowledge transmission has to do with some basic properties of the knowledge base relevant for firms' innovative activities, particularly its complexity and its tacit nature. Due to these features, knowledge can only be effectively transmitted through interpersonal contacts and interfirm mobility of workers, both of which are eased by close geographical and cultural proximity. Since Jaffe's (1989) seminal paper, this emerging field of research has reached some very robust conclusions. Several empirical works have convincingly shown, with reference to the United States and Europe, that the production of innovations presents a strong tendency to cluster in locations where key knowledge inputs are available (Audretsch and Feldman, 1996), that knowledge tends to spill over locally and takes time to diffuse across geographic distance (Jaffe *et al.*, 1993), and that the extent of spatial clustering varies across industries

depending on the stage of the industry lifecycle and the importance of tacit knowledge (Feldman and Audretsch, 1999).¹

Notwithstanding the important findings and the remarkable success achieved in obtaining mainstream acceptance, this body of literature seems to overlook the richer set of factors and conditions that account for the clustering in some areas of innovative firms and, more generally, of firms in technology-based or high-technology industries. The task of thoroughly examining what makes firms located in clusters more innovative than isolated firms and what accounts for the uneven spatial distribution of technological capabilities has been undertaken by a number of different approaches, particularly in the field of regional economics.² A (possibly incomplete) list of such approaches include works on technological districts and new industrial spaces (Storper and Harrison, 1991; Storper, 1992), the research group formed around the notion of innovative milieu (Capello, 1999), the literature on regional innovation systems (Braczyk *et al.*, 1998), the French school on *proximité* (Rallet and Torre, 2000), the localized learning capabilities approach (Maskell and Malmberg, 1999), and numerous case studies and historical accounts of successful high-technology districts and clusters (e.g. Saxenian, 1994).³ As it is not possible to do justice to the nuances of the arguments put forward by these various perspectives, we mention briefly what are, in our view, the key issues raised in one way or another by all these approaches.

First, learning through networking and by interacting is seen as the crucial force pulling firms into clusters and the essential ingredient for the ongoing success of an innovative cluster. The ways firms learn in innovative clusters embrace user–producer relationships, formal and informal collaborations, interfirm mobility of skilled workers, and the spin-off of new firms from existing firms, universities and public research centres.

More generally, a key feature of successful high-technology clusters is related to the high level of embeddedness of local firms in a very thick network of knowledge sharing, which is supported by close social interactions and by institutions building trust and encouraging informal relations among

¹ For surveys and recent works in this tradition, see also the 1999 special issue on the geography of innovation of the journal *Economics of Innovation and New Technology*.

² An alternative approach to explaining the geographical clustering of economic activities is that of 'new economic geography' (Krugman, 1998). This approach aims to explain spatial concentrations of activities by modelling the relationship between centripetal and centrifugal forces. It recognizes the importance of innovation and knowledge-related factors, but considers them as intangible and therefore focuses on measurable relations between economies of scale and transport costs in order to develop formalized models. By contrast the main concern of this Special Issue is precisely on the role of these intangible factors (knowledge, capabilities and skills) in the formation and growth of clusters.

³ Several journals have devoted special issues to some of the approaches mentioned in the text. For example, *Regional Studies*, 1999, vol. 33(4); *Cambridge Journal of Economics*, 1999, vol. 99.

actors. This is the second crucial issue that is, almost invariably, associated with well-developed and effectively functioning technology-based clusters. The possibility for individual firms to tap into the body of localized knowledge and capabilities depends, in a fundamental way, on the ability to establish and maintain effective social links and lines of communication. At the collective level, the effectiveness with which knowledge can be shared is conditioned by the existence of common norms, conventions and codes for exchanging and interpreting knowledge. In this perspective, geographical proximity often overlaps and combines with institutional, organizational and technical proximity in fostering processes of collective learning.

Besides offering an industrial atmosphere favourable to innovation and entrepreneurship, and a social capital supporting trust and co-operative relationships, a further key feature of technology-intensive clusters is related to the availability of a common set of resources, some 'exogenously' given, like universities and public research centres, and some others endogenous to the clusters' development, like a pool of specialized and skilled labour, whose main effect is that of reducing the costs and the uncertainties associated with firms' innovative activities.

2. The Main Issues at Stake

The papers in this Special Issue draw upon and attempt to integrate these different perspectives on the clustering of innovation and technology-based firms.⁴ In particular, the papers presented here aim to contribute to this research field by bringing additional empirical evidence, identifying the relevant conceptual framework, the basic processes and the key variables, and reflecting upon the next research challenges. Before summarizing the individual papers, we wish to underline what we believe are the most important contributions in this direction. In our view, the papers in this special issue converge on a set of key issues, which can be summarized by the following points:

1. At a general level, many of the papers point out the need to concentrate more analytical and empirical efforts to understand the conditions and the process leading to the emergence of new technology based clusters. Much of the existing literature largely overlooks this question by focusing on the study of well-accomplished regional systems, like Silicon Valley.

⁴ Some of the papers in this special issue have been presented at the International Conference on Regional Economic Development: New Interpretative Paradigms and New Policy Instruments, sponsored by LIUC University, Castellanza (Italy).

Similarly, most of the attempts to create new clusters have often tried to replicate locally the set of conditions found in existing successful regions. On the contrary, the key point in several papers of this Special Issue is that the examples provided by mature and successful regional systems are likely to be of little help to address the question of how to spark entrepreneurship and let the new clusters emerge and thrive.

2. Among the critical conditions for sparking off the growth of a new cluster, the availability of a highly skilled labour force and of university-trained human capital has been identified as one of the most important factors. If the existence of a pool of skilled workers is a key ingredient for successful clusters, the localized mobility of people (either among firms or from existing firms, universities and public research centres to new firms) is equally relevant. The mobility of skilled workers represents, in fact, the crucial source of new firm formation as well as the main mechanism through which technical and market knowledge flows locally. These remarks suggest, therefore, that the working of regional labour markets (and, more specifically, the labour markets for technical, managerial and academic employees) is a very promising area, which deserves more careful study, both with reference to nascent and to established clusters.
3. A further point of convergence of many of the studies collected in this issue is that, by putting a great deal of emphasis upon the role of proximity and the local environment, a good part of the existing approaches ends up looking at clusters as isolated and self-contained entities. On the contrary, external linkages are vital in order to establish and maintain a dense, local network of relationships, for both emerging and established clusters. These linkages may, however, differ in the two cases. For emerging clusters, external links allow access to knowledge, skills, contacts, capital and information about new technological opportunities and new markets. The mobility of labour across large distances, particularly through the repatriation of scientists, engineers and managers trained elsewhere, is a crucial means to establish these external links. For established clusters, external links with other regional systems or with sources of new knowledge and technology may allow upgrading of the industrial base (by specializing and developing distinctive and highly complementary capabilities) and reduction of the risk of lock-in (by keeping the cluster open to radical new ideas and technologies from outside).
4. At a more theoretical level, some papers point out that the dichotomies of knowledge vs. information and tacit vs. codified knowledge seem to provide an oversimplified explanation for the high degrees of localization

of knowledge creation and diffusion. In particular, more theoretical and empirical work should be devoted to examining the shared rules and the codes used by the technical and epistemic communities and the role they play in mediating the transmission of knowledge across different firms and institutions. This line of research would allow for a more precise and detailed understanding of the role that geographical proximity plays in the creation of language and codebooks that define the boundaries of the technical communities and would also permit evaluating the circumstances under which physical proximity does not constitute an insurmountable obstacle to the long-distance transmission of (apparently tacit) skills and knowledge. Moreover, to the extent that the codification process entails costs and can be strategically manipulated to exclude competitors, one could go beyond the often idealized model of the cluster as providing an unrestricted and free pool of knowledge and address the more realistic question of assessing how much co-operation and how much competition among firms and among networks of firms takes place in clusters.

5. A more controversial point concerns how multinational corporations relate to the clusters in which they locate their activities and, more specifically, the role that these companies play in transferring knowledge and skills across national borders and distant clusters. Multinational corporations can engage in network relationships with localized firms, thus benefiting the local area and contributing to a broadening of localized technological capabilities. Moreover, to the extent that large established firms internally provide managerial and technical training, an important source of spillovers encouraging entrepreneurship and spin-offs is added. However, multinational corporations may no longer be the privileged vehicle through which knowledge and skills can be transferred over long distances. Rather, this task is better accomplished by transnationally mobile managers, venture capitalists and entrepreneurs who embody the relevant knowledge about new markets and opportunities. This is particularly relevant in those contexts that require close communication and timely response. Of course, it remains to be seen how much this argument applies only to specific sectors—e.g. information and communications technology (ICT)—or can be generalized to a broader spectrum of industries.
6. A final point concerns public policy and the role of government. In this respect, the papers presented in this special issue show a remarkable convergence in pointing out the ineffectiveness of public policies attempting to direct the formation of new clusters through top-down interventions,

such as technopoles, science parks and firm incubators. Rather, government policies can play a very important role in cluster development by accommodating the formation of new firms, investment in education and the provision of support infrastructures. This is particularly important in the case of several European regions where the intervention of public actors has been quite heavy and directive.

3. The Papers in this Special Issue

The issue opens with the paper “‘Old Economy’ Inputs for ‘New Economy’ Outcomes: Cluster Formation in the New Silicon Valleys’ by Timothy Bresnahan, Alfonso Gambardella and AnnaLee Saxenian. This paper investigates the forces that account for the emergence of new clusters of technology-based firms. A key distinction in the paper is that starting a cluster is quite different than sustaining a cluster in terms of processes and economics. In examining the emergence of clusters, the authors draw upon and summarize the findings of a large study on a number of nascent clusters, both in and outside the United States (e.g. Ireland, Taiwan, Israel, India and Scandinavia). The paper claims that the existing theories about clusters of innovative activities, shaped as they are by cases of successful regions and focused on network effects and the resulting agglomeration economies, can explain very well the workings of a well-established cluster (such as Silicon Valley), but are unable to tell how nascent clusters start and take hold. The reason is that none of the elements yielding increasing returns and positive feedback network effects is yet in place in a cluster at its beginning. Although no recipe can be given for starting and sustaining a cluster, the paper argues that some deep regularities arise from the cases studied. In the first place, a plentiful supply of skilled labour is a critical precondition in forming the basis for entrepreneurship. In this respect, universities may certainly play a crucial role, but the supply of skills can come from other sources, including large incumbent firms and foreign-educated people. Moreover, the relevant skills include not only technical, but also managerial ones. In the second place, the successful start of a cluster seems also to involve the ability (and the fortune) to take advantage of technological and market opportunities not yet exploited. In most of the clusters analysed (with the exception of the Scandinavian countries), this has involved a positioning in technological and product spaces of the ICT industry that were complementary to those in the leading clusters (e.g. Silicon Valley). For many of these rapidly growing clusters, the establishment of co-operative connections with the leading centres of technology and demand has represented the most important mechanism for sparking off

entrepreneurial opportunities in existing and new ICT niches and segments. These two elements—highly skilled labour and connections to technological and market opportunities—feature in all the nascent ICT clusters. The transition from the early phase of cluster emergence to a well-structured cluster yielding positive network effects implies a long and risky process of firm-building and market-building. In other words, the mere growth in the number of firms located in a cluster is unlikely to give rise to those agglomeration economies associated with existing successful regions, unless coupled with significant and systematic efforts and investments by the early actors in the cluster to build the organizational and technological capabilities required for growth, and to create and nurture those institutions (e.g. venture capital) that fuel the development of the cluster.

After the general discussion by Bresnahan, Gambardella and Saxenian, the paper that follows by Maryann Feldman discusses in depth one case of cluster emergence: the US Capitol region. In 'The Entrepreneurial Event Revisited: Firm Formation in a Regional Context', Feldman starts from the important point that the examples provided by well-developed and fully functioning regional innovative systems, such as Silicon Valley, may provide little help in devising appropriate policies for regions lacking industrial capabilities and an entrepreneurial tradition. Rather, a more fruitful approach for these regions is to look at the conditions and factors that spark entrepreneurship and foster the initial development of a new cluster. The paper examines the specific case of the US Capitol region, which was able to transform itself during the 1980s and the 1990s into one of the most successful clusters of internet- and biotechnology-related firms. Tracing back the origins of the cluster to the beginning of the 1970s, the author notes that the region was at that time almost completely lacking in supportive conditions—such as the availability of venture capital, business services, social capital and universities engaged in industry-oriented research—that are typically associated with local environments promoting the formation of new firms. On the other hand, a distinctive feature of the region was the presence of a number of government agencies and research institutions, mostly related to the health and defence departments, which constituted a reservoir of skilled and yet under-used employees. The critical factor unleashing entrepreneurial forces has thus to be found, according to the author, in a series of exogenous shocks, mainly related to policy initiatives such as the downsizing in federal employment, the public procurement and outsourcing for services, changes in intellectual property regime, and policies supporting small and medium-sized enterprises. Overall, the effect of these shocks was to provide incentives as well as opportunities for employees in the public sector, but also from private industry, to engage

in the formation of new companies. Most of these newly founded firms localized in the region, because of the locational inertia of entrepreneurs and the need to locate near the originating laboratory or agency in order to secure contracts, licenses and partnerships. Moreover, even though the earliest start-ups were mainly service firms acting as government contractors, later generations of new firms and spin-offs realized the opportunities to develop commercial products and to engage in autonomous R&D activities. Although further research is needed before generalizing, the paper stresses two broad implications that can be derived from the case examined. First, the transition from a state-anchored region to a private sector high-tech cluster was a rather spontaneous and bottom-up process of reaction and adaptation to changes that were exogenous to the regional system. Second, the conditions supporting entrepreneurship lagged, rather than led, the development of the cluster. They developed over time, following the region's success and were actively built by pioneering entrepreneurs attempting to cope with, and adapt to, changes in the local environment.

The following paper by AnnaLee Saxenian and Jinn-Yuh Hsu adds a new key factor responsible for the emergence of a cluster: the international mobility of highly skilled technical and managerial labor. In 'The Silicon Valley-Hsinchu Connection: Technical Communities and Industrial Upgrading', Saxenian and Hsu provide a careful analysis of how knowledge and skills can be transferred across large distances and thus contribute to the reciprocal industrial upgrading of regions located far away in space. The paper examines two frequently cited cases of successful high-tech clusters, Silicon Valley in California and the Hsinchu-Taipei region of Taiwan, suggesting that the dominant accounts for the emergence of successful new regions, such as Taiwan's Hsinchu, by focusing exclusively upon local factors (such as the role of state policies, the availability of skills and specialized inputs, and competition and vertical co-operation among local firms, or by stressing the sourcing strategies of multinational corporations) fall short of explaining the emergence of indigenous innovative capabilities in peripheral areas. Although the role played by all these factors should not be overlooked, the authors argue that a key ingredient to their success has been the contributions made by a community of US-educated engineers who have built social and economic links between the Silicon Valley and Hsinchu economies. This technical community formed during the 1970s and 1980s as US-educated Taiwanese engineers started to organize collectively and form professional networks and organizations. The reversal of this 'brain drain', spurred by the accelerated growth of the economy in the 1980s, thus brought back to Taiwan an increasing number of returnees with strong professional and personal ties

to Silicon Valley. Moreover, a growing population of new 'argonauts', constantly travelling between the two regions and including venture capitalists as well as engineers from companies with activities in both regions, also helped to establish and coordinate a sustained flow of technical knowledge, skills, contacts, capital and information on new opportunities and new markets. The development of this transnational technical community has also transformed the relationship between the Silicon Valley and Hsinchu economies from a one-way to more decentralized two-ways flows of technology, skills and capital, allowing producers of both regions to collaborate and to develop distinctive but highly complementary capabilities. The case studied suggests to the authors some important implications. First, multinational corporations may no longer be the privileged vehicle for transferring knowledge and skills across national borders, particularly in those contexts that require close communications and timely responses. These needs are better served by international technical communities, organizing production and innovation at the local and the global levels. Relatedly, localization and globalization have to be seen as increasingly complementary and mutually reinforcing phenomena, in which transnational communities of practice play the crucial role of recombining specialized components and knowledge produced at different localities. Finally, the Taiwanese case suggests to policymakers that investments in education and training and policies creating local conditions favourable to entrepreneurial activity by foreign-educated engineers and scientists can be at least as important in fostering a region's participation in global technology and production networks as are attempts to attract foreign investments.

The following paper by Peter Maskell tackles the crucial problem of conceptualizing the advantages that benefit firms located in clusters. In 'Towards a Knowledge-based Theory of the Geographical Cluster', Maskell investigates the reasons that may explain the existence and the boundaries of clusters, and the role that knowledge creation and learning play in both respects. With regard to the former, the paper argues that contrary to much received wisdom, according to which the benefits accruing to co-located firms would be mainly related to the emergence of a culture of trust and reciprocal understanding lowering transaction costs, the real advantages of clusters are to be found in processes of knowledge creation and learning that take place along the horizontal as well as the vertical dimensions of the cluster. Concerning the horizontal dimension, the paper points out that a very important source of dynamic locational economies originates from the fact that co-located firms within an industry tend to experiment with a variety of approaches and solutions to similar problems, spurred in this activity by the

incentives and the opportunities provided by the possibility of constantly monitoring, comparing, selecting and imitating the solutions chosen 'next door'. Even more importantly, the paper argues that the advantages stemming from the enhanced knowledge creation do not require, in principle, any close interaction, as long as firms share common languages and codes. Interaction takes place mainly along the vertical chain, among firms in related industries and with complementary capabilities. As clusters take hold, an increasing division of labour gradually emerges, with some firms specializing in specific stages of the value chain, thus adding to the knowledge creation capabilities and deepening the knowledge base of the cluster. Concerning the boundaries of the cluster, the paper points out how innovation spurs the development of specific institutions shaped upon the learning regime that characterizes the activities undertaken in the cluster. In this respect, it is the fit between the specific economic activities and the particular institutional architecture that defines the cognitive boundaries of the cluster.

The paper by Philip Cooke also focuses on the issue of conceptualizing the working principles of technology based clusters from the analytical perspective of the regional innovation systems (RISs) approach. In 'Regional Innovation Systems, Clusters, and the Knowledge Economy', Cooke provides a detailed account of the concept of the RIS, focusing on the relevance of this notion with respect to innovative and technological activities. The paper starts by reconstructing the origins and the development of the notion of RISs, highlighting similarities and differences between this approach and the research and theorization based on the notion of national systems of innovation. A large part of the discussion is then devoted to defining the dimensions defining an RIS and to identifying the conditions and criteria to discriminate between strong and weak regional innovative systems. Concerning the former, the author points out that the nature and the extent of *systemness* any region actually presents should be evaluated on the basis of the degree and characteristics of learning capacity, networking and innovation interactions among firms, and between them and institutions operating in the region. From this perspective, the author stresses that very few regions in Europe can claim to have well-developed RISs, and less so showing outstanding economic and innovative performance. Moreover, large differences among European RIS can be also observed, ranging from heterarchical RISs, like Baden-Württemberg (in which interactions and learning involve a large variety of actors, both public and private), to more hierarchical RISs, like Wales (in which government takes the key role of orchestrating relationships among actors). With regard to the conditions and criteria that are associated with high-performing regional innovation systems, Cooke notes that one

should distinguish between infrastructural issues, like regional financial competence, regional policy influence on infrastructures and so on, and superstructural characteristics. These latter refer to the culture, values and norms shared by the institutions and organizations operating in the region. Systemic innovation at the regional level is generally associated with cooperative relations, networking, trustful labour relations and knowledge sharing. In a word, it is characterized by high levels of embeddedness. The last and more speculative part of the paper is then devoted to exploring the characteristics of the new economy innovation systems of the sort that emerged in many places in the United States. The key point raised by the author is that these highly clustered systems, with a driving role played by venture capital, the rapid transformation of scientific discoveries into commercialized innovations by start ups and the increasing importance of internal networks, are strikingly different from the kind of RISs that emerged in Europe. A salient feature of the European RIS is, in fact, the large degree of involvement of the public sector in the provision of those innovation support services and infrastructures that the market system is apparently unable to supply. The paper ends by suggesting that precisely here might reside the explanation for the innovation gap with the United States and that a policy option governments should carefully consider is to stimulate the growth of a strong private investing sector.

The last two papers, respectively by Stefano Breschi and Francesco Lissoni, and John Cantwell and Simona Iammarino, position themselves in the tradition of the geography of innovation literature. In 'Knowledge Spillovers and Local Innovation Systems', Breschi and Lissoni provide a critical reassessment of the theoretical concept of localized knowledge spillovers and econometric literature, based on the knowledge production function, that in recent years has made large use of such notion. The main claim of the authors is that, in spite of the undeniable merits of this literature in drawing attention to regions as meaningful units of analysis to study flows of knowledge, the insistence upon knowledge spillovers as the major analytical category to explain the localized nature of innovative activities risks diverting research from other mechanisms governing knowledge flows and inducing misleading policy implications. In particular, the authors criticize the argument that the benefits for firms located in highly innovative clusters is a pool of publicly available knowledge, whose accessibility is, however, bounded in space due to the tacit nature of the relevant knowledge and the consequent need to adopt informal means of knowledge transmission. The point raised in the paper is that this theoretical proposition contains a number of logical contradictions and leaves many questions open. On the one hand, it is argued, recent

developments in the economics of knowledge show that tacitness is not an inherent characteristic of knowledge, but refers to the way knowledge itself is transmitted within an epistemic community. When conceptualized in this way, tacitness may become a powerful exclusionary means, which can be wilfully manipulated to prevent a number of actors from understanding the content of scientific and technical messages. Depending on the sharing rules agreed upon by the epistemic community and the incentives facing individual agents, localized knowledge flows may encompass a large number of intermediate cases between the two extremes of pure private and pure public good, such as price-excludable public goods, common property and club goods. In addition, such a perspective allows one to decouple geographical and cognitive proximity, and so provide a rationale for knowledge links taking place among agents located far away in space. On the other hand, the paper also argues that the dominant position associating localized knowledge flows to pure knowledge externalities has also obscured the wide variety of mechanisms through which knowledge is exchanged among agents, many of which give rise to pecuniary, rather than pure knowledge externalities. In particular, the authors point to the need for investigating, with new methodologies and empirical indicators, the role played by localized and competing networks of firms, by the labour market and the interfirm mobility of skilled workers, and by the contractual arrangements linking local universities and firms.

In their paper 'EU Regions and Multinational Corporations: Change, Stability and Strengthening of Technological Comparative Advantages', Cantwell and Iammarino examine the impact that the locational strategies pursued by multinational corporations (MNCs) may have on regional profiles of technological specialisation. The paper focuses upon eight European regional innovation systems at the top of the regional hierarchy. Using US patent data granted to 784 of the world's largest industrial firms in the period 1969–1995, the paper analyses the evolution over time in the regional profile of technological competencies, as reflected in the patterns of technological specialization of large firms located in the selected regions. In particular, the authors argue that, depending upon the initial model of regional specialization and local capability to engage in institutional learning, the impact of MNCs may be highly differentiated across regions. On the one hand, multinational firms may simply fit into the regional profile of specialization, thereby supporting a process of local technological concentration in the established areas of expertise. On the other hand, multinational firms may also spur the broadening and diversification of the regional profile towards areas of interrelated technological competence, by drawing on the general capabilities found locally in leading regional centres. Results of the empirical

analysis show indeed that two different paths have characterized the eight European regions examined over the last decades. Some regions, like South East and Île de France, have proceeded in a highly cumulative way, becoming more narrowly specialized in their technological activities. For these regions, the consolidation of technological specialization carries the risk of locking them into mature clusters of activities, making it increasingly difficult to adjust to emerging technologies and eventually causing a decline in their competitiveness. On the contrary, a few other regions, notably Baden-Württemberg, Flanders–Brussels and South Netherlands, have considerably broadened their specialization, experiencing a faster process of convergence between old and new technologies and thereby improving their competitive position. Finally, the paper also points out that, as a result of these different evolutionary paths, higher-order European regions have developed increasingly distinctive capabilities over time. These different trends, coupled with the fact that only some regions seem to be able to adjust their profiles of specialization to the highest technological opportunities, imply that the competitive bidding between European regional systems for attracting MNC research and innovation activities is likely to become increasingly tougher.

4. *Conclusions: The Main Lessons*

What are the main lessons that can be learned from the papers in this Special Issue? And which are the main research indications that could be drawn from them? First, the papers in this issue broadly share the analytical view that *economies of agglomeration and networks effects* are key explanatory variables for the existence and the success of a cluster. However, to these two factors they add a major focus on the emergence and dynamics of clusters, the role of knowledge and learning processes, the international specialization of clusters in terms of technology, sector and products, the tangle between the local and the global dimensions, the role of the national context, and the emergence of local institutions. We will briefly review these points below.

1. *Emergence and dynamics of clusters.* Clusters should not be examined only in a static framework and at a given point in time. Rather, clusters have specific stages of development. Their identification is a very important precondition for any serious analytical study. In particular, while a great deal of analysis has focused on established successful clusters, the start-up and emergence phases prove to be crucial and are characterized by different processes and mechanism compared to the stability or maturity stages.

2. *Knowledge and learning.* The knowledge and learning processes of the main actors are key elements for an understanding of the rise, growth and transformation of a cluster. They also provide explanations for the innovativeness and the organization of a cluster, and the horizontal and vertical interaction and division of labour.
3. *Accumulation of capability in key actors.* The accumulation of capabilities and the growth of successful firms are key elements in the growth and development of a cluster. During the initial stage of a cluster, some firms may emerge as global players in terms of international leadership and rate of innovation. The presence of these key actors has major implications for the creation of new firms through spin-offs, human capital formation and the creation of new skills.
4. *International specialization and demand linkages.* Clusters may position themselves differently on international markets in terms of sectoral, technological and product specialization. Not only do these differences greatly affect the specific organization of a cluster because of differences in the underlying knowledge and learning processes, but they may greatly affect also its development and success. In particular, the link with a large and advanced demand and the complementarity with existing clusters or international leaders may positively affect the growth of a cluster. On the contrary, cluster emergence through competition with existing leaders on the same products and markets has not always proven successful, particularly if the cluster is located in countries other than the leading ones.
5. *The coexistence of localization and globalization.* High-tech clusters have both a local dimension and an international one. These dimensions interact at various levels—knowledge, technologies, products, individuals, firm, institutions and so on—and have to be taken into account for an explanation of the dynamics of the cluster.
6. *The effect of the national context.* Clusters are embedded in specific national systems of innovation and production which differ in terms of development, actors, structure, government policy, and legal and social institutions. These differences do shape the start, growth and organization of a cluster.
7. *The emergence of local institutions.* In the initial phase, cluster-specific institutions and non-firm organizations may spring up and become key elements in the working and growth of a cluster. The processes of emergence (and eventual transformation) of these institutions and non-firm organizations are usually affected by, and in turn affect, national non-firm organizations and institutions (such as government policy and

national regulations) and international ones (such as multinational corporations).

8. *The replicability of successful clusters.* The evidence in this Special Issue points to some factors that are common to most high-technology clusters, thus representing strong regularities and therefore broad indications for public policy. The actual replicability of successful clusters may be something different, however. The emergence of successful clusters is in fact the result of the dynamic interplay of several different variables and dimensions. The identification of single factors indeed does represent a major step forward in the analysis (and in public policy suggestions) but it may not imply necessarily the understanding of a 'complete recipe' for the triggering of a phase of cluster emergence and growth. Moreover, this complete recipe is not what public policy should aim at in the first place. In fact all the policy indications stemming from this Special Issue clearly point to the role of accommodating policies and the creation of support infrastructure (in terms of education, institutions and so on), rather than to a well-structured, articulated and complete set of policy interventions aiming to directly affect the dynamics of a cluster.

We think that these are the basic lessons that can be drawn from the contributions in this Special Issue, which represent clear indications for future research in the realm of the geography of innovation and economic clustering.

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