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Localiced Learning, Innovation and Regional Clusters

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Introduction

The globalising world economy is characterised by two partly contradictory tendencies. On the one hand we can identify the neo-Fordist development path, originating as the new international division of labour in the 1970s, of world-wide sourcing based on the principle of *comparative advantage* of lowest possible input costs (i.e. the relative best access to, and most efficient use of, "natural" production factors). Its rise was enabled by developments in transportation and communication technologies, and further stimulated by liberalisation and de-regulation of international trade and financial markets. On the other hand, we have the post-Fordist development path of the learning economy, in which global competition is based on the far more dynamic principle of *competitive advantage*, resting on "making more productive use of inputs, which requires continual innovation" (Porter 1998, 78).

The new, post-Fordist understandings of industrialisation as a territorial process, i.e. underlining the importance of location, agglomeration and non-economic factors, such as history, culture and institutions (i.e. constituting the social capital of a society) for economic development, and of innovation as a socially embedded process, represented a substantial contribution from heterodox economics (i.e. evolutionary economics and economic geography) to the economic orthodoxy. This challenge of bringing territoriality (back) into economics focused on learning as a localised process, pointing at the importance of historical trajectories. It regards innovation as an interactive learning process, involving a critique of the linear model of innovation, and clusters as the most efficient material contexts for interactive learning. Following this train of thinking, the specific aim of the article is to discuss how and why regional clusters can promote and support innovation and competitiveness in post-Fordist learning economies.

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Post-Fordism as a Learning Economy

As pointed out in the introduction, global competition in post-Fordist learning economies is based on the principle of competitive advantage, which refers to the productive use of localised and unique combinations of inputs. These are often the result of specific historical and technological trajectories in regions and nations. According to Porter, "the building of a "home base" within a nation, or within a region of a nation, represents the organizational foundation for global competitive advantage" (as referred in Lazonick 1993, 2). Thus, the post-Fordist development path represents a seemingly paradoxical situation where "the enduring competitive advantages in a global economy lie increasingly in local things – knowledge, relationships, motivation – that distant rivals cannot match" (Porter 1998, 78). This has been called "the globalisation of economic activity and the localization of industries" (Enright 1999, 1).

In this article it will be argued that the concept of a learning economy describes a qualitative change in the development of capitalist economies. This change is represented by the transition from Fordism to post-Fordism. Thus, the question of how real is the rhetoric of learning economies, depends very much on whether such a transition is really taking place or not. If one argues along with Lundvall (1996), Jessop (1994), Piore and Sabel (1984) and many others, it seems obvious that such an important transition is taking place, and the only theme for discussion is the speed, size and consequences of the transition, together with the way in which the changes in the economy effect the political and institutional set up. However, it should still be underlined that the transition to post-Fordism is not complete, as important sectors both globally and nationally, in the developed and underdeveloped worlds, are characterised by neo-Fordist development tendencies.

Lundvall and Johnson use the concept of "learning economy" when referring to the contemporary post-Fordist economy dominated by the ICT-related (information, computer and telecommunication) techno-economic paradigm in combination with flexible production methods and reflexive work organisations (i.e. learning organisations and functional, flexible workers) (Lundvall and Johnson 1994). In addition, the learning economy is firmly based on "innovation as a crucial means of competition" (Lundvall and Johnson 1994, 26). Lundvall argues that the concept of a learning economy can be used in two interconnected ways: partly as a theoretical perspective on the economy, and partly as a reference to a specific historical period in which knowledge and learning has attained an increasing importance in the economy, and, thus requires a new theoretical framework for it to be analysed (Lundvall 1996).

When reference is made to innovation as a crucial means of competition in the learning economy this refers not to the previous hegemonic linear model of innovation, but to a new theoretical understanding of innovation as basically

a socially and territorially embedded, interactive learning process, which cannot be understood independent of its institutional and cultural contexts (Lundvall 1992).

This more sociological view of innovation implies a criticism of the traditional dominating linear model of innovation, which has served as the main strategy for national R&D policies, as being too "research-based, sequential and technocratic" (Smith 1994, 2). The criticism implies another and broader view of innovation as a social as well as a technical process, as a non-linear process, and as a process of interactive learning between firms and their environment (Lundvall 1992, Smith 1994). This alternative model could be referred to as a bottom-up *interactive innovation model* (Asheim and Isaksen 1997). The interactive innovation model puts emphasis on "the plurality of types of production systems and of innovation (science and engineering is only relevant to some sectors), 'small' processes of economic co-ordination, informal practices as well as formal institutions, and incremental as well as large-scale innovation and adjustment" (Storper and Scott 1995, 519). In fact it could be argued that due to the rapid technological change characterising the globalising learning economy the linear model, which is timely and costly, can only be used efficiently in basic research in laboratories of universities and large firms in such R&D-intensive branches as pharmacy and the defence industry.

One of the consequences of the considerably more knowledge-intensive modern economies is that "the production and use of knowledge is at the core of value-added activities, and innovation is at the core of firms' and nations' strategies for growth" (Archibugi and Michie 1995, 1). Thus, in a learning economy "technical and organisational change has become increasingly endogenous. Learning processes have been institutionalised and feed-back loops for knowledge accumulation have been built in so that the economy as a whole [...] is 'learning by doing' and 'learning by using'" (Lundvall and Johnson 1994, 26).

Lundvall and Borras explicitly argue that they prefer the learning economy to the knowledge-based economy as it "emphasises the high rate of economic, social and technical change that continuously underlies specialised (and codified) knowledge. It makes it clear that what really matters for economic performance is the ability to learn (and forget) and not the stock of knowledge" (Lundvall and Borras 1999, 35). However, as knowledge, according to Lundvall and Johnson (1994), is considered the most fundamental resource, the learning economy is of course a knowledge-based economy. Furthermore, in order to underline the dynamic and rapid change in the contemporary globalising economy it is necessary also to pay attention to *knowledge creation* as a process of equal importance to learning and forgetting. Nonaka and Reinmöller emphasise that "organizational and inter-organizational

analysis of the conditions for innovation underlines the importance of knowledge and the key process of knowledge creation" (Nonaka and Reinmöller 1998, 410). In this context it is, however, important to remember that knowledge creation should not be restricted to formal R&D activities, but should also include how firms (e.g. in traditional industries) "are innovative in the way they handle and develop pedestrian activities such as production organisation, logistics, marketing, sales, distribution, and industrial relations" (Malmberg and Maskell 1999, 6).

One problematic aspect of the learning economy has been its focus on "catching up" learning (i.e. learning by doing and using) based on incremental innovations, and not on radical innovations requiring the creation of new knowledge. In a long-term perspective it will be increasingly difficult for the reproduction and growth of a learning economy to primarily rely on incremental improvements of products and processes, for example in the form of imitation, and not on basically new products (i.e. radical innovations) as a result of, for example, an invention, even if Freeman underlines "the tremendous importance of incremental innovation, learning by doing, by using and by interacting in the process of technical change and diffusion of innovations" (Freeman 1993, 9-10). This would, in fact, mean that imitation was considered more important than (a "real") innovation, which would be even more problematic if it was based on exogenous learning. According to Nonaka and Reinmöller, "no matter how great the efficiency and speed of exogenous learning, it will not substitute for the endogenous creation of knowledge. The faster knowledge is absorbed, the greater the dependence on the sources of knowledge becomes" (Nonaka and Reinmöller 1998, 425-26). Thus, what is increasingly needed in a competitive globalising economy is the creation of new knowledge through searching, exploring and experimentation involving creativity as well as more systematic R&D in the development of new products and processes.

This broad understanding of knowledge creation could be further substantiated by introducing differences with respect to the *origin* as well as the *character* of knowledge creation between industries (Laestadius 1998). Concerning the origin of knowledge creation one must distinguish between typical high-tech industries, which are based on academic R&D, while new knowledge in medium and low-tech industries is more often the result of "improved craft and traditional engineering skills on the shop floor" (Laestadius 1998, 222)

Concerning the character of knowledge creation Laestadius (1998) makes a distinction between *analytical* and *synthetical* activities. He defines analytical activities as "normal practice in the natural sciences. To a large extent, this consists of a narrowing of the focus to isolated phenomena and concentrating efforts on understanding and explaining the inner details of the system. This is

very close to the understanding of the creation of new knowledge, that is, 'real' R&D from a S&TP" (Laestadius 1998, 222-23). In contrast to this, synthetical activities "are directed toward building and designing systems through integrating components into complex wholes. This usually necessitates the understanding of the subsystems, although the intellectual efforts are directed toward the system and its interfaces rather than its components" (Laestadius 1998, 223).[18]

Thus, instead of contrasting R&D-based knowledge to tacit knowledge, or knowledge creation to learning, it would be more theoretically adequate and empirically relevant to talk about the knowledge base of firms and the knowledge infrastructure of branches and regions. By so doing we can gain a better understanding of the complex interactions and relationships which characterise the innovation processes of firms in different industries within vertical disintegrated, global and local production systems of the post-Fordist learning economy. All economic activity is based on knowledge, which can be formal, codified (scientific or engineering knowledge) and informal, tacit (embodied in skilled personal routines or technical practice), or any combinations thereof. Knowledge infrastructures are constituted by a variety of institutions and organisations such as universities, other R&D institutions, training systems, production knowledge of firms etc., "whose role is the production, maintenance, distribution, management, and protection of knowledge" (Smith 1997, 94-95). According to Smith (1997), "any analysis of the technological performance of a country or region should therefore have the infrastructure clearly in focus" (Smith 1997, 94). This would represent a cluster perspective on firms' knowledge bases where the whole value system of a firm or value chain of a product is taken into consideration when evaluating the knowledge intensity of a product or organising the relevant knowledge infrastructure in support of its innovative activity is organised. For example, in fish farming the product (salmon) may not seem to be very advanced as such, but a closer examination discloses that the knowledge base of the production to a large extent is R&D-based.

Interactive Innovation and Localised Learning

Porter emphasises that the reproduction and development of competitive advantage requires continual innovation, which in a learning economy is conceptualised as a localised interactive learning process, promoted by clustering, networking and inter-firm co-operation. This new and alternative

[18] Laestadius maintains that "the traditional Schumpetarian understanding of innovation as new combinations in fact is very close to our concept of synthetical activities" (Laestadius 1998, 223).

conceptualisation of innovation as an interactive learning process means an extension of the range of sectors, firm-sizes and regions that can be viewed as innovative, to include traditional, non R&D-intensive branches, often constituted by SMEs and located in peripheral regions. The basic critique of the linear model is precisely the equation of innovative activities with R&D-intensity. The majority of SMEs are in branches which are not R&D-intensive, but which could still be considered to be innovative (e.g. the importance of design in making furniture manufacturers competitive and moving them up the value-added chain). One further, important implication of this view of innovation is that it makes the distinction between high-tech and low-tech industries and sectors, which is a product of the linear model, irrelevant, as it maintains that all industries and sectors can be innovative in this broader sense. According to Porter, "the term *high-tech*, normally used to refer to fields such as information technology and biotechnology, has distorted thinking about competition, creating the misconception that only a handful of businesses compete in sophisticated ways. In fact, there is no such thing as a low-tech industry. There are only low-tech companies – that is, companies that fail to use world-class technology and practices to enhance productivity and innovation" (Porter 1998, 85-86). Following Porter, this implies that it is possible in all branches and sectors to find productive and innovative firms enjoying competitive advantages on the global markets. Thus, this theoretical perspective even broadens the scope for a policy of strong competition for post-Fordist learning economies (Storper and Walker 1989), i.e. competition building on innovation and differentiation strategies, in contrast to weak competition based on price competition.

In interactive innovation processes interaction takes place a) between different steps of the innovation process, involving the mobilisation of different forms of knowledge and information (e.g. science-based knowledge, market information, technical skills); b) with different firms and organisations involving inter-firm collaborations between suppliers and subcontractors in local and/or global production systems as well as with customers; c) with different knowledge production centres and organisations, representing a wide variety from R&D-institutions regionally, nationally and internationally via other parts of the knowledge infrastructure broadly defined to other firms or departments within a corporation (i.e. if the firm belongs to a TNC); and d) interaction between different departments of the same enterprise, involving the co-operation between different groups of employees with different forms of knowledge (e.g. R&D-based, artisan and tacit knowledge; see next section) (Asheim 1999; Lundvall and Borras 1999).

From the perspective of the new understanding of innovation as culturally and institutionally contextualised, strategic parts of learning processes emerge

as localised, and not placeless, processes, and thus constitute important parts of the knowledge base and infrastructure of firms and regions, which points to the role of historical trajectories. This view is supported by Porter, who argues that "competitive advantage is created and sustained through a highly localised process" (Porter 1990 19). Localised learning is not only based on tacit knowledge, as we argue that contextual knowledge also is constituted by "sticky", codified knowledge. This refers to "disembodied" knowledge and know-how which are not embodied in machinery, but are the result of positive externalities of the innovation process, and generally based on a high level of individual skill and experience, collective technical culture and a well developed institutional framework, which are highly immobile in geographical terms (de Castro and Jensen-Butler 1993), and, thus, can represent important context conditions of regional clusters with a potentially favourable impact on their innovativeness and competitiveness. Such "disembodied" knowledge is often constituted by a combination of place-specific experience based, tacit knowledge and competence, artisan skills and R&D-based knowledge (Asheim 1999).

Other researchers have also recognised the need for an intermediate form of contextual knowledge transcending the dichotomy of codified and tacit knowledge. Nonaka and Reinmöller maintain that "industrial regions can provide the necessary combination of explicit knowledge and tacit knowledge through collocation" (Nonaka and Reinmöller 1998, 421), and Lundvall and Borras argue that "tacit knowledge may be shared through human interaction and this may be the major force behind the formation of business networks. This means that codified and tacit knowledge are complementary and co-exist in time" (Lundvall and Borras 1999, 33).

In an earlier paper, Lundvall (1996) maintains that "the increasing emergence of knowledge-based networks of firms, research groups and experts may be regarded as an expression of the growing importance of knowledge which is codified in local rather than universal codes. The growing complexity of the knowledge base and the more rapid rate of change makes it attractive to establish long term and selective relationships in the production and distribution of knowledge. The skills necessary to understand and use these codes will often be developed by those allowed to join the network and to take part in a process of interactive learning. Perhaps one of the most fundamental characteristics of the present phase of the learning economy is the formation of knowledge based networks some of which are local while others cross national boundaries" (Lundvall 1996, 10-11).

Disembodied knowledge can thus be both tacit and codified, which implies that some codified knowledge can be a product of localised rather than placeless learning. This implies that the adaptability of this localised form of

codified knowledge is dependent upon, and limited by artisan skills and tacit knowledge (Asheim and Cooke 1998). In a similar way, Malmberg (1997) argues that "one of the few remaining genuinely localized phenomena in this increasingly 'slippery' global space economy is precisely the 'stickiness' of some forms of knowledge and learning processes" (Malmberg 1997, 574; Markusen 1996).

Following this line of reasoning it could be argued that the combination of contextual disembodied knowledge and "untraded interdependencies", i.e. "a structured set of technological externalities which can be a collective asset of groups of firms/industries within countries/regions" and which represent country- or region-specific "context conditions" of fundamental importance to the innovative process (Dosi 1988, 226), can constitute the material basis for the competitive advantage of regions in the globalising learning economy. Storper (1997) defines such contexts as "territorialization", understood as a distinctive subset of territorial agglomerations, where "economic viability is rooted in assets (including practices and relations) that are not available in many other places and cannot easily or rapidly be created or imitated in places that lack them" (Storper 1997, 170). This would represent an important modification of the argument that "ubiquitification" (i.e. the global availability of new production technologies and organisational designs at more or less the same cost (Malmberg and Maskell 1999), as an outcome of globalisation and codification processes, in general tends to "undermine the competitiveness of firms in the high-cost areas of the world" (Malmberg and Maskell 1999, 6). Such an argument is implicitly based on the dominance of a near free-market situation in the global economy, leaving no room for the importance of networks and clusters, creating external economies and increasing returns, as the economic basis for imperfect competition (Krugman 1991), as well as on the principles of comparative advantage, based on cost advantages, for example, through the exploitation of a supply of cheap labour (Porter 1998). Thus, we agree with Lundvall and Borras, who claim that "it is the constitution of new ensembles of codified and tacit knowledge which is in question rather than a massive transformation of tacit into codified knowledge" (Lundvall and Borras 1999, 33).

Concerning the question of the extent of codification of tacit knowledge in the globalising learning economy Lundvall and Borras argue that "there are two important limits to the codification process. First, the fact that codified and tacit knowledge are complementary and co-existing means that there are natural limits to codified knowledge. ... And second, increased codification does not necessarily reduce the relative importance of tacit knowledge - mostly skills and capabilities – in the process of learning and knowledge accumulation. Actually, easier and less expensive access to information makes skills and capabilities

relating to the selection and efficient use of information even more crucial than before. This means that tacit knowledge is still a key element in the appropriation and effective use of knowledge, especially when the whole innovation process is accelerating" (Lundvall and Borras 1999, 33).

Thus, the strict dichotomy normally applied between codified and tacit knowledge can be quite misleading both from a theoretical as well as from a policy point of view. This is especially the case if localised learning is primarily said to be based on tacit knowledge. A claim for the superiority of tacit knowledge on such a ground could lead to a fetishisation of the potentials of local production systems, not discovering the problems such systems could face due to their lack of strategic, goal oriented actions and strategies, which, basically, has to be supported by codified knowledge (e.g. formal R&D) (Amin and Cohendet 1999). The category of localised, disembodied knowledge represents a concept which could encompass the important basis for endogenous regional development, represented by firms relying on localised learning, but building this localised learning on a strategic use of codified, R&D-based knowledge in addition to tacit knowledge. In this context it is important to emphasise that "whilst knowledge in the form of embodied technical progress can be exported independently of social institutions, such knowledge in its disembodied form cannot be absorbed independently of such institutions" (de Castro and Jensen-Butler 1993, 3). The rationale behind promoting regional endogenous development is precisely "to use this social organization to generate innovation and economic development" (Lazonick and O'Sullivan 1995, 4).

Clusters and the Competitive Advantage of Regions

A dynamic understanding of competitiveness as a process clearly indicates that, in order to keep their position in the global market, enterprises must focus on developing their own core competencies (which also includes new competencies) through transforming themselves into learning organisations. But internal restructuring alone cannot sustain the competitiveness of firms in the long run. As firms are embedded in regional economies they are very much dependent on a favourable economic and industrial environment in general, and knowledge infrastructures at different geographical levels specifically. According to Porter "untangling the paradox of location in a global economy reveals a number of key insights about how companies continually create competitive advantage. What happens *inside* companies is important, but clusters reveal that the immediate business environment *outside* companies play a vital role as well" (Porter 1998, 78).

Thus, a strong case is made today that regional clusters are growing in importance as a mode of economic co-ordination in post-Fordist learning economies (Asheim and Isaksen 1997, Cooke 1994). The main argument for

this is that regional clusters provide the best context for an innovation based learning economy due to the existence of localised learning and "untraded interdependencies" among actors. In general, "geographical distance, accessibility, agglomeration and the presence of externalities provide a powerful influence on knowledge flows, learning and innovation and this interaction is often played out within a regional arena" (Howells 1996, 18). Close co-operation with suppliers, subcontractors, customers and support institutions in the region will enhance the process of interactive learning and create an innovative milieu favourable to innovation and constant improvement. This influences the performance of the firms and strengthens the competitiveness of the clusters, and is increasingly seen as an important aspect of fostering regional competitive advantage. Generally, the innovative capacity at the regional level can be promoted through identifying "the economic logic by which milieu fosters innovation" (Storper 1995a, 203). Specifically, it is important to underline the need for "enterprise support systems, such as technology centres or service centres, which can help keep networks of firms innovative" (Amin and Thrift 1995, 12).

This perspective on the importance of regional clusters can find support from modern innovation theory, originating from new institutional economics, which argues that "regional production systems, industrial districts and technological districts are becoming increasingly important" (Lundvall 1992, 3), and from Porter, who emphasises that "the process of clustering, and the interchange among industries in the cluster, also works best when the industries involved are geographically concentrated" (Porter 1990, 157). In 1998 Porter argues even more strongly that "a vibrant cluster can help any company in any industry compete in the most sophisticated ways, using the most advanced, relevant skills and technologies" (Porter 1998, 86).

What then is a cluster? In a recent article Porter defines clusters as:

> "Geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure. Clusters also often extend downstream to channels and customers and laterally to manufacturers of complementary products and to companies in industries related by skills, technologies, or common inputs. Finally, many clusters include governmental and other institutions – such as universities, standards-setting agencies, think tanks, vocational training providers, and trade associations – that provide specialized training, education, information, research, and technical support." (Porter 1998, 78)

This definition is rather similar to the one Brusco uses when he refers to "the progressive specialisation of all the firms working in the same sector in the same area" (Brusco 1989:259) as characteristic of industrial districts. With reference to products, it is possible to distinguish between three categories of firms in an industrial district: firms having a direct connection with the final market, "stage firms", and firms of the vertically integrated sector (Brusco 1990:14). These firms can be linked in three different ways: vertically or convergently, when different stages of a process are involved; laterally, where the same stage in a like process is involved; and diagonally, when service processes are involved (Bellandi 1989:137). In addition Porter adds organisations and institutions which resembles an "industrial district Mark II", which Brusco calls industrial districts with considerable government intervention, representing a development from the original "industrial district Mark I" without local government intervention (Brusco 1990). An important part of this extended cluster definition is the incorporation of governance structures, which, in general, refers to, "the degree of hierarchy and leadership (or their opposites, collaboration and co-operation)" in a network (Storper and Harrison 1990, 10).

In contrast, Porter's original cluster concept was basically an economic concept indicating that "a nation's successful industries are usually linked through vertical (buyer/supplier) or horizontal (common customers, technology etc.) relationships" (Porter 1990, 149). These ideas are more or less the same as the ones Perroux presented in the early 1950s. Perroux argued that it was possible to talk about "growth poles" (or "development poles" at a later stage in his writing) in "abstract economic spaces". These he defined as the vertical relationships of a production system as well as the horizontal relationships of an industry, i.e. firms which are linked together in an innovative "key industry" to form an industrial complex. According to Perroux, the growth potential and competitiveness of growth poles can be intensified by territorial agglomeration (Haraldsen 1994; Perroux 1970). However, in my view there is a need to operate with clusters in both conceptualisations, as it is a quite normal situation to find (geographical) clusters of specialised industries being part of a national (economic) cluster of the same industries (e.g. the Norwegian shipping cluster, which is a national economic cluster (Reve et al. 1992), but which is constituted in part by geographical clusters of specialised industries making up the Norwegian shipping cluster).

What this extension of the definition of the concept of cluster also indicates is a deepening and widening of the degree and form of co-operation taking place in a cluster. The original and simplest form of co-operation within a cluster can often be described as a *territorially* integrated input-output (value chain) relations, which could be supported by informal, social networking as is

the case with Marshallian agglomeration economies (see next section), but which could also take the form of arms-length market transactions between a capacity subcontractor and the client firm. A typical example of this would be the original industrial district ("industrial district Mark I"). The next step of formally establishing inter-firm networks is represented by a purposeful, *functional* integration of value chain collaboration as well as building up a competence network between the collaborating firms. A distinction between clusters defined as input-output relations and networks is that proximity is the most important constituting variable in the first case, while networking represents a step towards more systemic (i.e. planned) forms of co-operation. It also indicates development from vertical to horizontal forms of co-operation, which more efficiently promotes learning and innovation in the systems. The progression towards more systemic forms of co-operation is taken a step forward by establishing systems, either in the form of production or innovation systems, which are characterised by system integration, where the principle of integration is based on the system world of the economy and the state, which can extend across time-space. Or as Nonaka and Reinmöller put it, "the concepts of clusters of industrial districts and networks are also attempts to describe inter-organizational phenomena. Industrial districts are accumulations of interdependent companies located near each other (the condition of proximity). Networks are a concept focused on inter-organizational relations. ... Unlike the concept of industrial districts, the concept of networks does not necessarily entail the condition of proximity" (Nonaka and Reinmöller 1998, 406).

In the promotion of innovation-supportive regions, the inter-linking of co-operative partnerships ranging from work organisations inside firms to different sectors of society, understood as "development coalitions", will be of strategic importance. Development coalitions refer to co-operation between different actors within and between firms and organisations but also generally to the mobilisation of the resources of society, to promote innovation, change and improvement (Ennals and Gustavsen 1999). The concept of development coalition incorporates all the previous forms of integration (i.e. territorial, functional and system integration), and adds social integration, as the formation of a regional development coalition takes place on a societal level of the system, where the co-existence and co-presence of actors in space and time is of vital importance, as "all participants must do their best to gain an understanding of others, to pool insights and strive for joint solutions" (Ennals and Gustavsen 1999, 16). This deepening and widening of the degree and form of co-operation constituted by a progressive organisational and institutional development from clusters to development coalitions within a region underlines the strategic role played by social capital in emphasising the social and cultural aspects

"encompassing the norms and networks facilitating collective action for mutual benefit" (Woolcock 1998, 155).

Types of Regional Innovation Networks and Systems

The growing interest in the role of national and regional innovation systems must be understood in the context of creating a policy instrument aiming at the systematic promotion of localised learning processes in order to secure innovativeness and competitive advantage of national and regional economies (Freeman 1995; Cooke 1995). According to Storper and Scott, "a new 'heterodox' economic policy framework has emerged in which significant dimensions of economic policy at large are being reformulated in terms of regional policies" (Storper and Scott 1995, 513). This is partly the result of the economic success stories of territorially agglomerated clusters of SMEs (e.g. in the Third Italy), which have become a major point of reference in the recent international debate on industrial policy promoting endogenous development, and partly the result of the new political initiatives towards a "Europe of regions", where the development prospects of the lagging regions of Europe in particular have been a great concern for the EU. Also academically, among researchers working within the fields of evolutionary/institutional economics, there is a heightened awareness of the importance of the regional level when formulating innovation policies (Storper 1995b). Thus, Carlsson and Stankiewicz maintain that sometimes it seems more accurate to refer to a regional technological system (in their words) than to a national one "as high technological density and diversity are properties of regions rather than countries. They are the results of local agglomeration of industrial, technological and scientific activities" (Carlsson and Stankiewicz 1991, 115).

However, it is important, analytically as well as politically, to distinguish between different types of regional innovation systems. On the one hand, we find innovation systems that could be called *regionalised* national innovation systems, i.e. parts of the production structure and the institutional infrastructure located in a region, but functionally integrated in, or equivalent to, national (or international) innovation systems, and more or less based on a top-down, linear model of innovation (e.g. science parks and technopolises). On the other hand we can either identify networked innovation systems, constituted by the parts of the production structure and institutional set-up that is territorially integrated in a particular region and constructed on a bottom-up, interactive innovation model, or innovation *networks*, which are embedded in the socio-cultural structures of a region, characterised by a "fusion" of the economy with society (Piore and Sabel 1984), and based on bottom-up, interactive learning (e.g. industrial districts Mark I of the Third Italy). To be able to talk about territorially integrated, regional innovation systems the national, functionally

integrated, techno-economic and political-institutional structures must be "contextualised" through interaction with the territorially embedded, socio-cultural and socio-economic structures (Asheim 1995).

The networked regional innovation system is different from the embedded innovation network due to the systemic dimension of the former, which requires that the relationships between the elements of the system must involve a degree of long-term, stable interdependence. This implies that it is based on system integration and not on social integration. A further consequence of this is that networked regional innovation system cannot be embedded in the community, as embeddedness builds on social integration (Granovetter 1985). However, it is still an example of a bottom-up, interactive innovation model and thus represents an alternative to regionalised national innovation systems. The systemic, networked approach to regional innovation systems brings together regional governance mechanisms, universities, research institutes, technology transfer and training agencies, consultants and other firms acting in concert on innovation matters (Asheim and Cooke 1999). As such it could be said to represent a development towards a "learning region" understood as a "development coalition" (Asheim 1996; 1998).

The networked regional innovation systems represent a planned interactive enterprise-support approach to innovation policy relying on close university-industry co-operation. Larger and smaller firms establish network relationships with other firms, universities, research institutes, and government agencies. Examples of such networked innovation systems can either be found in regions in Germany, Austria, and the Nordic countries, where this model has been the one more typically implemented (Asheim and Cooke 1999), or in later stages in the evolution of industrial districts, which were previously characterised by territorially embedded, innovation networks (e.g. industrial districts Mark II in Emilia-Romagna).

Such territorially based regional innovation systems and networks build on different types of knowledge and view of innovative activities compared to the traditional national system of innovation. In addition to the informal, practical and tacit knowledge of learning by doing and learning by using, which is the basis of embedded Marshallian agglomeration economies, localised learning processes depend on the important category of disembodied knowledge (in contrast to codified knowledge of a universal character). Different industries, in terms of their type, size and forms of organisation, have different requirements with respect to knowledge infrastructures and innovation systems. Locally controlled, traditional SMEs on the one hand may benefit most from networked regional innovation systems or embedded innovation networks, based on an interactive innovation model, while high-tech SMEs and large firms on the other hand may need access to R&D based knowledge of the linear

national innovation systems or transnational (e.g. EU) sectoral innovation systems. Networked regional innovation systems often attempts to link and integrate these different types of knowledge through an interactive university-industry approach.

One way of solving the problem of improving the innovative capacity of the small-firm sector of regional clusters, to avoid having these firms remain with a low level of internal resources and competence, is to rely on collective capacity building by setting up centres for real services and regional innovation systems which could systematically assist firms in regional clusters to keep pace with the latest technological developments. This could be done either through a networking strategy between firms and public and private agencies, or through public intervention. However, for SMEs to carry out (especially radical) innovations there is often a need to supplement the informal, tacit and localised form of codified knowledge with R&D competence and more systematically accomplished basic research and development, typically taking place within universities and research institutes. In the long run most firms cannot rely only on localised learning, but must also have access to more universal, codified knowledge of, for example, national innovation systems. The strength of the traditional, place-specific and often informal competence and tacit knowledge must be integrated with codified, more generally available and R&D-based knowledge. According to Varaldo and Ferrucci (with reference to industrial districts), "long-term strategic relationships, R&D investments, engineering skills, new technical languages and new organizational and inter-organizational models are needed for supporting these innovative strategies in firms in industrial districts" (Varaldo and Ferrucci 1996, 32).

Thus, in spite of the important role of place-specific, local resources and regional innovation systems, firms in regional clusters are in need of innovative co-operation and interaction with world-class, national and international competence centres and innovation systems in order to stay competitive. This represents an example of a multilevel approach to innovation systems and knowledge infrastructures, since firms' innovation activities rely both on place-specific, experience-based, tacit knowledge and competence, artisan skills and R&D-based knowledge. In order for non R&D-intensive firms to be able to acquire formally codified knowledge available from national and international innovation systems, the operation of such systems must be stimulated to become more interactive. In this way, these innovation systems, originally organised according to the linear model, would become more accessible as well as responsive to the individual and collective needs of international competitive non R&D-intensive firms in regional clusters.

Conclusions

Finally, contrary to addressing the structural limits to learning in a capitalist economy (Hudson 1999), the focus should be on the new possibilities in a learning economy of creating conditions supporting a plus-sum game generating endogenous regional development in some regions without distorting the growth potentials of other regions (Lundvall 1996). Concerning the structural limits to learning, these are - within a capitalist economy - basically caused by a policy of weak competition. Thus, a strategy of strong competition, building on innovation understood as interactive learning in networks of SMEs in regional clusters, has considerable potential for learning, as it provides the best material context for an innovation based learning economy and, as such, represents the most dynamic, long-term growth oriented kind of capitalism.

However, it is necessary also to remember that a learning-based strategy of endogenous regional development cannot be applied across the board without some form of public intervention, stimulating cluster creation and network formation through the building up of social capital on a regional basis., The necessary requirements concerning socio-cultural and socio-economic structures are found in relatively well-off regions and the sufficient techno-economic and political-institutional structures only in relatively developed countries. Furthermore, in the discussion of transfer of experiences from one region to another it is important to distinguish between general and specific factors explaining the formation and development of regional clusters. The more important the specific factors are, the more difficult it is to transfer experiences from one region to another, since specific socio-cultural factors constituting the social capital of a particular region which are historically rooted cannot be repeated in another region. However, the rapid growth of industrial districts and other regional clusters has addressed the perspective of the post-Fordist learning economy on innovation as a socially and territorially embedded, interactive learning process. This constitutes the most significant general lesson to be learned from the particular experiences of various regional clusters and which can be feasibly transferred from one region to another, even if the contingent expression of these experiences can be very specific (Asheim 1994).

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