



*What drives innovativeness in industrial clusters?
Transcending the debate*

Marjolein C.J. Caniëls and Henny A. Romijn

Eindhoven Centre for Innovation Studies, The Netherlands

Working Paper 03.04

Department of Technology Management

Technische Universiteit Eindhoven, The Netherlands

February 2003

What drives innovativeness in industrial clusters? Transcending the debate

Marjolein C.J. Caniëls¹ and Henny A. Romijn²

Date of submission: 28 February 2003

Abstract

The paper throws new light on the debate about the role played by local knowledge spillovers (LKS) as a driver of regional innovative activity. It transcends the regional level of analysis that has been commonly adopted in the literature so far, using insights from the evolutionary theory of the firm. This makes it possible to derive a typology of mechanisms through which regional agglomeration may stimulate learning and innovation. When this typology is brought to bear on the extant approaches in the debate, the contrasting viewpoints can be reconciled to some extent. The main conclusion is that little theoretical ground for the LKS debate remains.

Key words: Localised knowledge spillovers (LKS), evolutionary theory, firm-level learning, regions, clusters

JEL code: O18, O31, O32, R58

¹ Open University of the Netherlands (OUNL), Faculty of Management Sciences (MW),
P.O. Box 2960, 6401 DL Heerlen, the Netherlands. Tel: +31 45 572724; Fax: +31 45 5762103.
E-mail: marjolein.caniels@ou.nl

² Eindhoven Centre for Innovation Studies (Ecis), Faculty of Technology Management,
Eindhoven University of Technology (TUE), P.O. Box 513, 5600 MB Eindhoven, the Netherlands.
Tel: +31 40 2474026; Fax: +31 40 2474646.
E-mail: h.a.romijn@tm.tue.nl

1. Introduction

The role played by local knowledge spillovers (LKS) as drivers of innovative activity is currently hotly debated. Several competing points of view can be distinguished. Champions of LKS, of which Malmberg and Maskell (2002), Audretsch and Feldman (1996), and Jaffe *et al.* (1993) are notable examples, are pitted against LKS-sceptics, especially Breschi and Lissoni (2001a and 2001b). The latter argue that the importance of LKS has been highly overrated, and that the LKS-hype has come to overshadow traditional Marshallian pecuniary advantages operating in agglomerations. There are also contributions which are somewhere in between these two contrasting positions (for example, Martin and Sunley, 1996; Breschi and Malerba, 2001), while others don't take a clear stand on the issue at all (for example, Markusen, 1996; Morgan, 1997).

The debate has been raging for several years, with especially the anti-LKS camp trying to elucidate and entrench its own position. However, no attempts have been made so far to resolve the controversy. The objective of this paper is to advance the debate. We argue that the current deadlock is caused by the fact that all the main contributors, irrespective of their positions on the spectrum, have remained within the confines of the regional (i.e., meso) level of analysis. This has restricted their analytical perspective, which has led them to overlook potentially useful insights outside their own domain.

In our paper, we broaden the analytical lens beyond the regional level. We do this by bringing in the firm as an additional level of analysis, and show that this yields essential new insights which make it possible to some extent to reconcile the contrasting viewpoints in the debate. The logic of this procedure lies in the fact that regions are a collection of individual actors, notably firms, which are the key *loci* of decision making in processes of innovation and learning. Regional innovative performance therefore ultimately results from innovation decisions made by individual firms. Insight into the behaviour of the firm is therefore a *sine qua non* for understanding the innovation dynamism of regions. Evolutionary economic theory and associated resource-based views of the firm are especially suited to studying micro-level innovation and learning processes, and hence we use insights from these literatures to build our argument.

The plan of the paper is as follows. In section 2 the main strands in the LKS-debate are reviewed, and the current stalemate in the debate is highlighted. The analytical approach adopted in this paper to break the deadlock is elaborated in section 3. We then revisit the most important existing contributions and comment on them in the light of the insights furnished by our new framework in section 4. This brings out the added value of our approach. Conclusions are presented in section 5.

2. LKS: The debate and the deadlock

Prominent contributions to the pro-LKS camp have come from Malmberg and Maskell and writers in the so-called Economic Geography (EG) literature. Malmberg and Maskell's (2002) paper is an attempt to build a knowledge-based theory of spatial clustering, in which LKS are considered to be the true drivers of adaptation, learning and innovation and subsequent competitiveness. They start by noting that "...Analysis of innovative clusters ... seldom starts ... by identifying how knowledge is shared and technology transferred in a way that enhances the competitiveness of firms ..." (p. 434), and then proceed to fill this gap. The existence of traditional Marshallian cost-based approaches to explain the existence and development of spatial clusters is acknowledged in their paper, but these approaches are not seen to offer any relevant insights for their analysis. In the traditional Marshallian analysis no explicit link was made with *learning and innovation* in clusters as such, and Malmberg and Maskell simply take that at face value. They do not stop to consider the possibility that cost advantages could after all indeed have an effect on learning and innovation. Not in the same way that LKS do, but simply by lowering investment costs for innovation or by increasing innovation inducements. We will revert back to these issues in the following sections.

Many pro-LKS contributions are furnished by the EG literature. Audretsch and Feldman (1996) found support for the existence of LKS on the basis of empirical research. They show that the propensity of innovative activities to cluster is more pronounced than what one would expect on the basis of clustering patterns of economic activities alone. Feldman elaborated the theoretical

foundation for this finding, by spelling out how Dosi's five 'stylized facts of innovation'¹ are *a fortiori* applicable in spatial clusters (1994). Jaffe *et al.* (1993) also find empirical support for LKS, by showing that the geographic location of patent citations and that of the cited patents are often the same, while controlling for pre-existing concentration of research activity. Many other contributions in this line of work point towards the importance of LKS (see, for example, Glaeser, Kallal, Scheinkman and Shleifer, 1992; Baptista and Swann, 1998; Wallsten, 2001). Pecuniary advantages remain outside the scope of the research.

The dissenting view has been most prominently voiced by Breschi and Lissoni. They argue that the role of LKS has been highly overrated, and that market-mediated cost advantages in clusters are much more important as drivers of innovation in clusters. The pro-LKS contributions made by the EG researchers are criticized for using the LKS-buzzword "...as if it could encompass any kind of 'localised knowledge flows', no matter whether such flows are the outcome of economic transactions, free sharing agreements or some agents' failure to appropriate the outcome of their own innovation efforts" (Breschi and Lissoni, 2001b, p.976). In effect, Breschi and Lissoni argue that the econometric EG studies claim to find evidence of LKS, which, however, may partly reflect cost advantages. Too much of cluster dynamism is thereby ascribed to LKS. Andersson & Ejerme (2002) have put forward the same view.²

A number of writers have taken a less extreme position, particularly people working within the so-called New Industrial Geography (NIG) stream of research. The term has commonly been used to denote a large and heterogeneous body of literature in which innovation dynamics of regional agglomerations are studied from non-mainstream economic, geographical and institutional-sociological points of view. Influential case studies focus on US high-tech clusters such as Silicon Valley and Boston's Route 128 (for example, Saxenian, 1994; Dorfman, 1983); Italian industrial districts (for example, Piore and Sabel, 1984; Best, 1990), and more generally, a number of 'innovative milieux' (Maillat, 1995), and 'local innovation systems' (Braczyk *et al.*, 1998).

Martin and Sunley (1996) highlight the driving forces of innovation in the NIG research (and compare these to Krugman's work). LKS are listed as important, but various Marshallian pecuniary advantages are also identified, especially transaction costs and also specialised suppliers and economies of scope. A good illustration of an individual NIG study that has adopted this perspective is Markusen (1996). She distinguishes four different types of industrial districts, of which the traditional Marshallian/Italianate district is only one. Although all the specific mechanisms driving regional innovativeness are not clearly elucidated for all these settings, it is clear that both types of advantages play a role. In Italianate districts, for example, references to the importance of labour mobility hint at the importance of LKS, while examples of scale and scope economies are also given. For example, activist trade associations provide shared infrastructure – management, training, marketing, technical or financial help; and cooperation leads to sharing of risk and induces innovation (1996, p.301).

From Breschi and Malerba's (2001) summary of the main features of NIG approaches (pp. 819-20), the importance of both LKS and pecuniary advantages is also evident. Reference to LKS is made by pointing to the possibility that individual firms have "... to tap into the body of localized knowledge and capabilities [which] depends, in a fundamental way, on the ability to establish and maintain effective social links and lines of communication" (p. 820). Cost advantages are associated with an

¹ These are: Uncertainty, complexity, reliance upon basic scientific research, importance of learning by doing, and cumulativeness (Dosi, 1988).

² At first sight it would appear as if the *New Economic Geography* (NEG) approach (not to be confused with the EG approach discussed above) also belongs in the anti-LKS camp. Krugman, the most prominent exponent of this approach, has repeatedly voiced his scepticism of the localness of knowledge spillovers. In Krugman (1991), he argues that cluster dynamism is chiefly driven by traditional Marshallian cost advantages such as a large labour pool and specialised suppliers. Similarly, Ottaviano and Puga's (1988) survey of NEG literature features a number of models in which regional dynamism is explained solely in terms of cumulative causation and forward and backward linkages, combined with increasing returns (i.e., various pecuniary advantages), while LKS do not feature at all. On closer inspection, however, these NEG writers fall outside the debate, as they are not concerned with explaining regional agglomeration of *innovation*, but with regional agglomeration of *economic activity* in general. Naturally, the role of LKS would feature comparatively less prominently in their work than in that of the EG writers for that reason alone.

“... availability of common set of resources ... 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” (p. 820).

In an overview of important contributions to the industrial district literature, Keeble and Wilkinson (Reg. Studies, 1999) point out that older studies in this line (for instance, Piore and Sabel) still seem to be highly inspired by Marshall’s view, in which both pecuniary advantages and technology spillovers play a role in explaining cluster growth. In the course of the 1990s the role of knowledge spillovers becomes relatively more prominent. This has to do with a shift towards innovation and learning (away from economic growth in general) as a basis for cluster competitiveness, and an increasing focus on high-tech clusters. The increased prominence of knowledge accumulation also explains increased attention for ‘institutional thickness’ as a precondition for competitiveness. Social institutions such as trust are seen to be highly important for the effective transfer and inter-firm flow of tacit knowledge. However, traditional Marshallian cost advantages don’t disappear from view (see, for example, Capello, 1999).

Many NIG studies do not explicitly couch their analysis in terms of LKS and cost advantages. A well-known example is Morgan’s (1997) typical NIG study. A lot hinges on tacitness of knowledge, which facilitates innovation by co-located firms due to the presence of local ‘social capital’. One should be careful not to infer too much about the operation of the different mechanisms from such studies. There is a clear risk that one might ascribe a meaning which was not intended by the authors. We will come back to this in section 4.

Recapitulating the discussion, one can note that in the course of time, LKS appear to have gained ascendancy in academic discourse vis-à-vis pecuniary effects as drivers of co-location of innovative activities. However, we are still far from a consensus about the relative importance of LKS versus pecuniary advantages in the present-day economic reality. Some adhere to an near-exclusive LKS-driven view of innovation in clusters, while others take a more nuanced view, and still others are highly sceptical about the importance of LKS in practice.

How can the debate be taken forward? We start by examining Breschi and Lissoni’s recent work more closely, since they are the ones who have initiated the debate by criticising the pro-LKS approaches. In their (2001a and 2001b) papers, they put forward the view that market-mediated (i.e., cost) advantages have continued to play a major role, and that these are now being overlooked because of the LKS fashion. However, the arguments which they then marshal to support their point of view are not quite convincing. They concentrate on the measurement methodologies used by the pro-LKS EG researchers. These are criticized for adopting too broad a definition of the LKS concept, which has led them to misinterpret the empirical patterns in the geographical distribution of innovation which they found. In particular, they say, these patterns are assumed to be caused by LKS, while they might actually be the result of the operation of pecuniary advantages.

This criticism might be partly valid, but Breschi and Lissoni overshoot in the opposite direction. In their zeal to bash the LKS hype, they assess the EG research with such a narrow definition of LKS that only externalities caused by pure public goods are subsumed under it. According to them, “knowledge that spills over is a (pure) public good, i.e., it is freely available to those wishing invest for searching it out (non-excludability), and may be exploited by more than a few users at the same time (non-rivalry)” (2001a, p. 258). However, many positive real externalities (especially those arising from investment in knowledge) are not associated with pure public goods. In addition to having positive effects on the receiving party, these externalities in turn give rise to negative consequences on the part of the originator of the actions. Curiously, Breschi and Lissoni left these out of their LKS definition, even though common definitions of technological (i.e. real, as opposed to pecuniary) externalities include them (Scitovksi, 1954, Viner, 1931, Meade, 1952). Not surprisingly, the adoption of their overly strict public good-based definition leads them to identify knowledge flows that do not meet its criterion. Curiously, they conclude that these knowledge flows must then necessarily represent market-mediated mechanisms. They observe that “... it might be that what standard methodologies ... and data sets [as used by the EG researchers] ... suggest to be pure externalities will turn out to be, at more careful scrutiny, knowledge flows that are mediated by market mechanisms... . These mechanisms influence local firms’ innovation opportunities indirectly, that is via pecuniary, rather than knowledge externalities” (Breschi and Lissoni, 2001a, p. 259). Apparently, in their view, knowledge externalities that are not pure public goods do not exist.

More seriously, Breschi and Lissoni reduce the debate to an issue of definition and measurement. Apparently, they assumed that the theoretical foundation for the research is already complete and adequate to the task, and that ‘the problem’ boils down to adoption of proper concepts and definitions, followed by more accurate empirical measurement and careful analysis.

While acknowledging the importance of additional research of this kind, we argue that pursuing this strategy by itself is unlikely to lead us out of the morass any time soon. In our view, there is also a need for further theorizing on the subject. This is because, so far, all the existing approaches in the debate have adopted a regional (i.e., meso) level of analysis, without looking closely at the behaviour of the individual actors (notably firms) that make up a region. Yet, firms are the key actors in innovation and learning processes. It follows that a good grip on the micro-economic processes that underpin innovativeness is essential for gaining a better understanding of the driving forces of regional dynamism. In the next section we elaborate a framework which puts the innovating firm centre stage. We then show how this can generate new insights with which to answer the question which mechanisms drive innovation in clusters.

3. Opening the black box: the firm-level underpinnings of innovative regions

In this section we delve into the micro-economic processes that underly regional innovative performance. We do this by investigating the different advantages which clusters generate for innovation at the firm level. Increased innovation at the firm level in turn enhances regional performance.

We use key insights from evolutionary theory to conceptualize firm behaviour.³ The leading contributions in this literature concur that firms’ economic performance is the consequence of a continuous learning process. The basis for this learning process are a firm’s resources -- a stock of human skills and knowledge, physical assets, and organizational routines. Routines are defined by Nelson and Winter “...as a set of ways of doing things and ways of determining what to do”, which are built into organizations at any one time (1982, p. 400). Routines have the function of coordinating the other resources of the firm in particular ways, leading to their productive utilization (Dosi et al., 2000, p. 5). The economic environment generates continuous pressures on firms to subject their routines to evaluation, to ensure that the firm’s competitive position is maintained.

Routines change in response to two mechanisms (Cohendet *et al.*, 1998). The first is trial and error. In the words of Cyert and March: “Any decision rule that leads to a preferred state at one point is more likely to be used in the future than it was in the past; any decision rule that leads to a non-preferred state at one point is less likely to be used in the future than it was in the past.” (1963, p. 99). The second mechanism is organizational search (Nelson and Winter, 1982; Radner, 1986). In contrast to trial and error, which is an accidental process, search implies intentional activities to improve routines for better economic performance. Nelson and Winter use the term search “... to denote all those organizational activities which are associated with the evaluation of current routines and which may lead to their modification, to more drastic change, and to their replacement.”(1982, p. 400).

This process of involvement in the selection of routines by firms is commonly referred to as learning. In this way, firms accumulate so-called capabilities, bundles of related routines governing the exploitation of their resources. According to Javidan (1998), the distinctive characteristic of capabilities is that they are functionally based, i.e. resident in a particular function. Examples are marketing capabilities, production capabilities, and human resource management capabilities. Capabilities that are cross-functionally integrated and coordinated are denoted as competencies (*Ibid.*).⁴ Competencies express what a firm is able to do well (Prahalad en Hamel, 1990). A subset of

³ The interpretation of the essential features of evolutionary theory offered here is based on insights from a number of leading contributions in the field. However, it should be noted that individual writers in this line of research differ considerably in the terminology they use. This has given rise to much confusion and internal inconsistencies. In addition, relationships between concepts are often left imprecise and implicit (for a discussion of some of these problems, see the introductory chapter in Dosi et al, 2000). The purpose of this paper is merely to develop a workable framework in which the essential features of evolutionary thinking are reflected adequately, without going into the ins and outs of these conceptual and terminological problems.

⁴ Although there are other authors who use the concepts of capability and competency interchangeably (e.g., Lawson and Lorenz, 1999).

such competencies are the basis for a firm's unique competitive advantage at a given point in time. These distinctive competencies are called *core* competencies. They encompass what the firm is able to do better than others (Lawson and Lorenz, 1999, p. 306). The ability to adapt core competences quickly to changing opportunities is what ultimately drives competitiveness over time. In the words of Prahalad and Hamel, "In the long run, competitiveness derives from an ability to build, at lower cost and more speedily than competitors, the core competencies that spawn unanticipated products." (1990, p. 81). Teece *et al.* (1997) refer to this ability as the *dynamic capabilities* of a firm (p. 516).

The key question is now, in which ways the acquisition of these capabilities at the level of the individual firm could be enhanced by co-location in a regional industrial agglomeration. A convenient starting point for analysing this question are the three Marshallian reasons for localization in clusters: (1) the presence of a labour pool with specialised skills; (2) the phenomenon that "an industrial centre allows the provision of non-traded inputs specific to an industry in a greater variety and at lower cost" (Krugman, 1991, p. 37); and (3) the occurrence of technology spillovers – a concept equivalent to the currently accepted term of knowledge spillovers. We follow Jaffe's definition of knowledge spillovers as intellectual gains through exchange of information for which a direct compensation for the producer of the knowledge is not given, or for which less compensation is given than the value of the knowledge (Jaffe, 1996, p. 5).⁵ When firms settle into an agglomeration, they expect to realise advantages arising from these three phenomena.

These agglomeration advantages can be expected to have an impact on the firm-level processes at the level where a firm modifies its organizational routines, in other words in the course of undertaking trial and error and organisational search. It is at this basic point in the capability building process that external knowledge inputs play a crucial role alongside internally generated knowledge.

We discuss the linkages between agglomeration advantages and firm-level learning mechanisms with the help of Table 1. Marshall's advantages are represented by the rows, while intra-firm learning mechanisms are depicted by the columns. The two first-mentioned Marshallian advantages – presence of a specialised labour pool, and presence of specialised suppliers – have been amalgamated into one row. Both point to various cost advantages with respect to inputs into the production process. They are therefore essentially similar in the way they affect in-firm technological learning, namely through economies of scale, scope and transaction. This leaves us with two basic categories of agglomeration benefits, namely cost advantages (pecuniary advantages) and knowledge spillovers (real agglomeration advantages), and four cells in the table.

Starting in the upper left (Cell I), trial and error is an unintentional and ad hoc process, which does not require systematic investments in organizational improvement. In other words, it does not involve costs. Hence, pecuniary agglomeration advantages cannot affect trial and error in any way. Since no costs are incurred, no cost *savings* can be realised either.

In contrast, pecuniary regional advantages may affect organizational search in several different ways (Cell II). Firstly, clusters can generate a critical minimum demand for new, specialised products or services that cannot be produced profitably elsewhere (IIa) (Stewart and Ghani, 1991). This will stimulate organisational search within specialised supplier firms, leading to new and improved routines and capabilities needed to bring about these innovations successfully.

A second important link between pecuniary advantages and organisational search runs through the local presence of suppliers of specialised inputs (including labour) who are attracted by large local demand (IIb). The presence of specialised suppliers may lower transaction costs associated with procurement of specialised inputs, for example, costs associated with finding skilled workers, technical consultants, institutions providing training courses, government extension services, and suppliers of specialised machinery, materials and components. Marshall already discussed such cost-reducing effects with reference to *production* activities. Naturally, the same holds for *knowledge accumulation* activities which are the main focus of this paper. In this way, clusters act to reduce costs of specialised knowledge inputs in firms' organisational search.

⁵ This definition thus encompasses more than the pure public goods spillovers emphasized by Breschi and Lissoni (2001a).

Table 1: Linking agglomeration advantages with firm-level learning mechanisms

Marshall's agglomeration advantages	Firm-level learning mechanisms	
	Trial and error	Organizational search
Pool of specialised skilled labour & Specialised suppliers	<p>I</p> <p>No costs involved in trial and error. Therefore there can be no cost advantages from agglomeration either.</p>	<p>II</p> <p><i>Non-cooperation based advantages (pure location-based):</i></p> <p>a) Large local market gives rise to critical minimum demand for better products and processes (i.e., econs of scale & scope), inducing more org. search (in specialised suppliers).</p> <p>b) Presence of specialised suppliers lowers transaction costs, which facilitates easy and cheap access to specialised knowledge inputs into the organisational search process (in user firms).</p> <p><i>Cooperation based advantages (location-induced cooperation spurs further cost advantages):</i></p> <p>c) Low transaction costs facilitates collaboration in innovation projects, lowering costs of organisational search.</p> <p>d) Low transaction costs enable the collaborative realisation of lumpy innovation projects (econs of scale & scope), giving rise to <i>additional</i> organisational search in the collaborating firms.</p>
Technology spillovers	<p>III</p> <p>Higher probability that trial and error will lead to improvement of routines, due to the ease with which information can be picked up in the local environment (stylized facts).</p>	<p>IV</p> <p>Higher probability that search will lead to improvement of routines, due to the ease with which information can be picked up in the local environment (stylized facts).</p>

The advantages arising from the operation of mechanisms IIa and IIb for organisational search occur spontaneously, that is, no collaborative activities are needed on the part of the actors in a cluster in order to bring them about. Inter-actor cooperation may lead to capturing of additional pecuniary externalities, with further positive effects on organisational search. One such mechanism is that clusters offer possibilities for firms to join networks of innovators because of low transaction costs associated with local interaction (IIc) (Freeman, 1991; DeBresson and Amesse, 1991). This leads to cost-advantages from sharing costs and risks associated with firms' knowledge accumulation activities, lowering the costs of their organizational search.

Pooling resources for organisational search will also induce *more* search. This happens because clusters make it feasible for firms to embark on large, costly innovation projects that are beyond the capacity of individual investors (IId) (Baptista, 1998).

The lower row in Table 1 indicates how a firm's own learning process may be complemented by knowledge spillovers from other firms, thereby increasing the efficiency of the learning process. Implementing knowledge from outside the firm increases its chances of success (Nelson, 1993; Feldman, 1994; Von Hippel, 1988; Baptista, 1998). Local knowledge spillovers essentially affect trial and error (Cell III) and organisational search (Cell IV) in the same way. In both cases, firms might benefit from complementarity and synergy effects that arise from the knowledge accumulation processes of other firms in the cluster.

Underlying this idea are essential features of evolutionary theory, namely bounded rationality and heterogeneity (Simon, 1986). Economic agents have imperfect knowledge and have a selective perception of their environment. Moreover, each actor is different from others in its behavioural routines and knowledge base. This provides the basis for knowledge spillovers across firms.

Feldman (1994) has provided the theoretical arguments why knowledge spillovers could be expected to be facilitated by short geographical distances across the actors, using Dosi's five stylized facts of the innovative process (see also footnote 1).⁶ Complexity and uncertainty associated with innovation can be expected to be more easily dealt with due ease of personal communication. Reliance on basic research could be facilitated through face-to-face interaction with university scientists, so that basic scientific research is translated more easily into practical applied knowledge. Possibilities for learning-by-doing are expected to be greater because of direct contact with customers and suppliers, which makes it easier to share new knowledge which is still highly tacit. Finally, clusters are seen to function as a storehouse of accumulated capabilities in particular innovation areas, which promotes the generation of new innovations.

In conclusion, by joining up key theoretical insights from regional innovation literature with core principles from the evolutionary theory of the firm, it is possible to distill a comprehensive framework mapping out a range of mechanisms through which regional agglomerations could enhance firm-level knowledge accumulation. Several of these mechanisms operate through cost advantages, while others run through knowledge spillovers. This framework thus provides a broader perspective than the frameworks based on the regional ('meso') level of analysis alone. We will now revisit the most important contributions to the LKS debate, reexamining their arguments and conclusions in the light of our framework.

4. Revisiting the debate with our framework

Using the broader analytical lens which our framework affords, we discuss key contributions to the debate anew. We start with the pro-LKS contributions. It was already noted in section 2 that Malmberg and Maskell's 'knowledge-based theory of clustering' is based solely on the LKS mechanism, which primarily affects knowledge creation through facilitation of the learning process. We saw that these authors disregard the possibility that cost advantages might also have an effect on learning and innovation in clusters. From the perspective of our framework in section 3, Malmberg and Maskell's position can be traced to a failure to fully conceptualise intra-firm learning. Although they recognize the importance of firm-level processes in their paper, they do not actually probe the nature and operation of these processes. Thereby they miss out on an important insight, namely that intra-firm creation of new knowledge is driven substantially by organisational search, which is set in motion through purposive investments. Therefore they also fail to see that clustering of firms may reduce the costs and risks of such investment (as shown in the top right cell of our Table 1), which could increase the attractiveness of undertaking these investments. This, then, is another important way in which technological learning can be speeded up, and innovation can be increased, in addition to the learning-facilitating effects induced by LKS. Thus, with the benefit of our framework, Malmberg and Maskell's position in the debate seems untenable. Their discussion about the role of LKS is pertinent, but their contribution falls short of developing a comprehensive knowledge-based theory of spatial clustering.

The EG contributions might suffer from a slightly different kind of problem, which was already signalled by Breschi and Lissoni (2002a). These writers have not explicitly denied the existence of pecuniary advantages, but their aim was to find support for the existence of LKS as a driving force of agglomeration in innovative activity. From this analytical point of departure they set out to develop ways to measure LKS, and collect empirical support for the existence of LKS. Possibly, this analytical lens could have led them to ascribe too much of their empirical findings to LKS.⁷ The advantage of

⁶ We use Feldman's contribution merely to make it clear that the occurrence of LKS is theoretically plausible. However, one should not conclude from this that we follow the EG point of view in the LKS debate. The five stylized facts do not imply anything about the relative importance of LKS versus pecuniary advantages in agglomerations.

⁷ Even though Breschi and Lissoni's criticism of the EG research on this point is not entirely convincing.

our micro-meso framework is that it highlights a comprehensive range of innovation-enhancing mechanisms that could operate in regional clusters, and thereby raises awareness of the possibility that there may be mechanisms other than LKS at play. It thus contributes to maintain a balanced assessment of regional innovation patterns observed in empirical research.

Moving to the anti-LKS contributions, at first sight Breschi and Lissoni's conclusion about pecuniary advantages being important drivers of innovation in clusters seems to be compatible with our framework. However, Breschi and Lissoni's conclusion relies on a narrow "public goods" definition of knowledge spillovers. Our approach shows that it is perfectly possible to arrive at the same outcome with a more suitable broader spillover concept that goes back to conventional definitions of real externalities à la Viner and Scitovski. Taking firm-level learning as an analytical starting point (as we have done in Table 1), one can see that there are a number of possibilities for pecuniary advantages to influence that learning, even when one adopts a conventional broad spillover definition. This full range of possibilities comes into view only because we look at the learning process from a micro-economic point of view.

The range of intermediate positions taken up by NIG researchers in the debate seem to be broadly in line with the results of our framework. However, contributions in this field tend to highlight just one or two mechanisms, while our table lists a whole range of them. Moreover, individual NIG researchers differ on what those precise mechanisms should be. Thus, NIG contributors tend to adopt a partial view of the ways by which agglomerations could conceivably give an impetus for learning. Again, this can be traced to the absence of an analytical perspective, in the NIG research, on how firms actually accumulate new knowledge. This prevents them from systematically analysing the different forces in operation.

It now also becomes apparent that our assessment of the NIG position in the debate differs markedly from that of Breschi and Lissoni. The latter have suggested that the NIG body of research essentially supports the pro-LKS view. In their words, "... NIGs accept, and often openly propose LKSs as a very important agglomeration force. Indeed, many research efforts within NIG are placed upon explaining how and why knowledge spillovers are extremely likely to be highly localised" (Breschi and Lissoni, 2001a, p. 264). They motivate this observation with reference to the fact that NIG studies give great importance to tacit knowledge, trust, social networks, etc., which are believed to be important in agglomerations. According to Breschi and Lissoni, this would implicitly indicate that local knowledge diffusion (i.e. LKS) is considered important in the NIG literature about clusters. In particular, they argue that this is indirectly evident in the insistence, by the NIG researchers, on a number of preconditions necessary for knowledge to diffuse effectively on a local base – for example, the existence of local institutions and culture-promoting mutual trust, entrepreneurship, and possibly a sense of belonging to the local community of people and firms.

A rather different interpretation of the NIG position emerges when we bring our own analytical framework to bear on the NIG literature. The NIG researchers emphasize that a local milieu is a good basis for *co-operation* (e.g., Storper, 1992; Braczyk et al. 1998; Maillat, 1991; Schmitz and Nadvi, 1999). Such cooperation may indeed facilitate knowledge spillovers. However, it may also provide possibilities for sharing costs and risks of R&D and overcoming 'lumpiness' problems in large R&D investment projects, all of which may promote investments in R&D and (hence) firm-level search and learning. Since all these mechanisms are caused by pecuniary externalities, Breschi and Lissoni's attempts to rope NIG squarely into the pro-LKS camp appear to be a bit rash.

We conclude that all contributions to the debate so far appear to have missed out on something. When we supplement regional innovation theory with a micro-economic theoretical underpinning, these conceptual problems and measurement issues come to the surface. After analysing them in the light of our framework, it appears that there remains little theoretical ground for the LKS debate. There is no a priori theoretical reason to exclude either pecuniary advantages or knowledge spillovers as drivers of innovation in regional clusters. Thus, the opposing views can be reconciled on the theoretical level. Now, research is needed to shed light on the relative importance of both mechanisms empirically in different settings.

5. Conclusions

After reviewing the discussion about LKS in the literature so far, one cannot escape the impression that it would be difficult to take the debate forward while remaining within the confines of regional-level analysis. After all, spillovers impact on the technological innovation and learning processes of the firm. Gaining an understanding what happens at the level of the firm is therefore critical for getting a better grasp on the innovation dynamism at the regional level.

This paper throws new light on the debate by transcending the regional level. It does this by inserting new insights from the evolutionary theory of the firm. In this fashion it becomes possible to systematically derive a typology of different mechanisms through which regional agglomeration may stimulate learning and innovation. When this typology is brought to bear on the extant approaches in the debate, the limitations of the arguments advanced by both sides come clearly into view, and it becomes evident that little theoretical ground for the LKS debate remains.

More generally, the exercise conducted in the paper illustrates how the adoption of a particular theoretical perspective may influence one's focus of analysis, definition of concepts and approaches, and one's interpretation of empirical findings. By broadening the analytical lens, we obtain a more complete view of regional learning and innovation dynamics which makes us aware of factors that were overlooked in earlier research, which could in turn give a new impetus for empirical work. As Myrdal argued, theoretical analysis can never be value free, but the point is that we have to strive to be conscious of this fact, so that possible biases arising from the choice of a particular perspective are brought out into the open. "The only way in which we can strive for objectivity in theoretical analysis is to lift up the valuations into full light, making them conscious and explicit, and permit them to determine the viewpoints, the approaches, and the concepts used" (Myrdal, 1968, p. 33). Deliberately shifting one's analytical point of view is a good way of achieving this. Applying this general principle to the subject matter at hand, we are led to received theory which provides valid arguments leading to the conclusion that both knowledge spillovers and pecuniary externalities may be important for innovation in clusters. Needless to say, our own exercise is also still a limited one, and extensions in other directions may show yet new insights. Still, we believe that we have made a valuable step towards a comprehensive knowledge-based theory of innovation in regions.

References

- Andersson, M. en Ejermo, O. (2002) 'Knowledge production in Swedish functional regions 1993-1999', paper presented at the Ljungby Workshop on Knowledge Spillovers and Knowledge Management in Industrial Clusters and Industrial Networks, 19-21 Sept. 2002.
- Audretsch, D.B. and M.P. Feldman (1996) 'R&D spillovers and the geography of innovation and production', *American Economic Review*, Vol. 86 (3), pp. 630-52.
- Baptista, R. (1998) 'Clusters, innovation and growth: A survey of the literature', in: G.M.P. Swann, M. Prevenzer and D. Stout (Eds) *The Dynamics of Industrial Clusters: International Comparisons in Computing and Biotechnology*. Oxford, Oxford University Press, pp. 13-51.
- Baptista, R. and P. Swann (1998) 'Do firms in clusters innovate more?', *Research Policy*, Vol 27, pp. 525-40.
- Best, M.H. (1990) *The New Competition. Institutions of Industrial Restructuring*. Cambridge, Polity Press.
- Braczyk, H., P. Cooke and M. Heidenreich (Eds) (1998) *Regional Innovation Systems*. London, UCL Press.
- Breschi, S. and F. Lissoni (2001a) 'Localised knowledge spillovers versus innovative milieu: Knowledge "tacitness" reconsidered', in: *Papers in Regional Science*, 80, pp. 255-73.
- Breschi, S. and F. Lissoni (2001b) 'Knowledge spillovers and local innovation systems: a critical survey', *Industrial and Corporate Change*, Vol 10, no. 4, pp. 975-1005.
- Breschi, S. and F. Malerba (2001) 'The geography of innovation and economic clustering: some introductory notes', *Industrial and Corporate Change*, Vol. 10(4), pp. 817-33.
- Cappello, R. (1999) 'Spatial transfer of knowledge in high technology milieu: Learning versus collective learning processes', *Regional Studies*, Vol 33 (4), pp. 353-65.
- Cohendet, P., P. Llerena and L. Marengo (1998) 'Theory of the firm in an evolutionary perspective: A critical assessment', paper presented at the 2nd Annual Conference of the International Society for New Institutional Economics, Paris, 18-19 September.
- Cyert, R.M. and J.G. March (1963) *A Behavioural Theory of the Firm*. Prentice-Hall, Englewood Cliffs.
- DeBresson, C. and F. Amesse (1991) 'Networks of innovators: A review and introduction to the issue', *Research Policy*, Vol. 20, pp. 363-79.
- Dorfman, N. (1983) 'Route 128: The development of a regional high-technology economy', *Research Policy*, Vol. 12, pp. 299-316.
- Dosi, G., C. Freeman, R. Nelson, G. Silverberg and L. Soete (Eds) (1988) *Technical Change and Economic Theory* Pinter Publishers, London and New York.
- Dosi, G., R.R. Nelson and S.G. Winter (Eds) (2000) *The Nature and Dynamics of Organizational Capabilities* Oxford University Press, Oxford.
- Jaffe, A.B. (1996) *Economic Analysis of Research Spillovers. Implications for the Advanced Technology Program*, National Institute of Standards and Technology, Gaithersburg, MD.
- Jaffe, A., M. Trajtenberg and R. Henderson (1993) 'Geographic localization of knowledge spillovers as evidenced by patent citations', *The Quarterly Journal of Economics*, Aug., pp. 577-98.
- Javidan, M. (1998) 'Core competence: What does it mean in practice?', *Long Range Planning*, Vol 31 (1), pp. 60-71.
- Feldman, M.P. (1994) *The Geography of Innovation*. Boston, Kluwer Academic Press.
- Freeman, C. (1991) 'Networks of innovators: A synthesis of research issues', *Research Policy*, Vol. 20, pp. 499-514.
- Glaeser, E., H. Kallal, J. Scheinkman, and A. Shleifer (1992) 'Growth in cities', *Journal of Political Economy*, Vol. 100, pp. 1126-52.
- Keeble, D. and F. Wilkinson (1999) 'Collective learning and knowledge development in the evolution of regional clusters of high technology SMEs in Europe', *Regional Studies*, Vol. 33 (4), pp. 295-303.
- Krugman, P. (1991) *Geography and Trade*. MIT Press, Cambridge Mass.
- Lawson, C. and E. Lorenz (1999) 'Collective learning, tacit knowledge and regional innovative capacity', *Regional Studies*, Vol. 33 (4), pp. 305-17.

- Maillat, D. (1995) 'Territorial dynamic, innovative milieus and regional policy', *Entrepreneurship and Regional Development*, Vol 7, pp. 157-165.
- Malmberg, A. and P. Maskell (2002) 'The elusive concept of localization economies: Towards a knowledge-based theory of spatial clustering', *Environment and Planning A*, Vol. 34, pp. 429-49.
- Markusen, A. (1996) 'Sticky places in slippery space: A Typology of industrial districts', *Economic Geography*, Vol 72, pp. 293-313.
- Martin, R. and P. Sunley (1996) 'Paul Krugman's geographical economics and its implications for regional development theory: A critical assessment', *Economic Geography*, Vol 72, pp. 259-92.
- Maskell, P. (2001) 'Towards a knowledge-based theory of the geographical cluster', in: *Industrial and Corporate Change*, 10 (4), pp. 921-44.
- Meade, J.E. (1952) 'External economies and diseconomies in a competitive situation', *Economic Journal*, Vol 62, pp. 54-67.
- Morgan, K. (1997) 'The learning region: Institutions, innovation and regional renewal', *Regional Studies*, Vol. 31 (5), pp. 491-503.
- Myrdal, G. (1968) 'The beam in our eyes', prologue in: G. Myrdal *Asian Drama – An Inquiry into the Poverty of Nations/Volume I*. New York, Pantheon, pp. 5-35.
- Nelson, R.R. (Ed.) (1993) *National Innovation Systems. A Comparative Analysis*. Oxford, Oxford University Press.
- Nelson, R.R. and S.G. Winter (1982) *An Evolutionary Theory of Economic Change*. The Belknap Press of Harvard University Press, Cambridge Mass. and London.
- Ottaviano, G.I.P. and D. Puga (1988) 'Agglomeration in the global economy: A survey of the "new economic geography"', CEPR Discussion Paper 356, London School of Economics and Political Science, London.
- Piore, M. and C. Sabel (1984) *The Second Industrial Divide: Possibilities for Prosperity*. New York, Macmillan.
- Prahalad, C.K. and G. Hamel (1990) 'The core competence of the corporation', *Harvard Business Review*, May-June, pp.79-91.
- Radner, R. (1986) 'The internal economy of large firms', *Economic Journal*, Vol. 96 (Supplement), pp. 1-22.
- Saxenian, A. (1994) *Regional Advantage. Culture and Competition in Silicon Valley and Route 128*. Harvard. Harvard University Press.
- Schmitz, H. and K. Nadvi (1999) 'Clustering and industrialization: Introduction', *World Development*, 27 (9), pp. 1503-14.
- Scitovsky, T. (1954) 'Two concepts of external economies', *Journal of Political Economy*, April. (Reprinted in: A.N. Agarwala and S.P. Singh (Eds.) (1963) *The Economics of Underdevelopment*. New York: Oxford University Press, pp. 295-308).
- Simon, H.A. (1986) 'On the behavioural and rational foundations of economic dynamics', in: R.M. Day and G. Eliasson (Eds) *The Dynamics of Market Economics*. Amsterdam, North Holland, pp. 21-44.
- Stewart, F. and E. Ghani (1991) 'How significant are externalities for development?', *World Development*, Vol 19 (6), pp. 569-94.
- Storper, M. (1992) 'The limits to globalization: Technology districts and international trade', in: *Economic Geography*, 68, pp. 60-93.
- Teece, D.J., G. Pisano and A. Shuen (1997) 'Dynamic capabilities and strategic management', *Strategic Management Journal*, Vol. 18 (7), pp.509-33.
- Viner, J. (1931) 'Cost curves and supply curves', *Zeitschrift für Nationalökonomie*, Vol 3, pp. 23-46. (Reprinted in: American Economic Association (1953), *Readings in Price Theory*. London: Allen and Unwin)
- Von Hippel, E. (1988) *The Sources of Innovation*. Oxford University Press, New York.
- Wallsten, S.J. (2001) 'An empirical test of geographic knowledge spillovers using geographic information systems and firm-level data', *Regional Science and Urban Economics*, Vol 31, pp. 571-599.

WORKING PAPERS

Ecis working papers 2002-2003 (February 2003):

- 02.01 M. van Dijk
The Determinants of Export Performance in Developing countries: The Case of Indonesian manufacturing
- 02.02 M. Caniëls & H. Romijn
Firm-level knowledge accumulation and regional dynamics
- 02.03 F. van Echtelt & F. Wynstra
Managing Supplier Integration into Product Development: A Literature Review and Conceptual Model
- 02.04 H. Romijn & J. Brenters
A sub-sector approach to cost-benefit analysis: Small-scale sisal processing in Tanzania
- 02.05 K. Heimeriks
Alliance Capability, Collaboration Quality, and Alliance Performance: An Integrated Framework.
- 02.06 G. Duysters, J. Hagedoorn & C. Lemmens
The Effect of Alliance Block Membership on Innovative Performance
- 02.07 G. Duysters & C. Lemmens
Cohesive subgroup formation: Enabling and constraining effects of social capital in strategic technology alliance networks
- 02.08 G. Duysters & K. Heimeriks
The influence of alliance capabilities on alliance performance: an empirical investigation.
- 02.09 J. Ulijn, D. Vogel & T. Bemelmans
ICT Study implications for human interaction and culture: Intro to a special issue
- 02.10 A. van Luxemburg, J. Ulijn & N. Amare
The Contribution of Electronic Communication Media to the Design Process: Communicative and Cultural Implications
- 02.11 B. Verspagen & W. Schoenmakers
The Spatial Dimension of Patenting by Multinational Firms in Europe
- 02.12 G. Silverberg & B. Verspagen
A Percolation Model of Innovation in Complex Technology Spaces

- 02.13 B. Verspagen
Structural Change and Technology. A Long View
- 02.14 A. Cappelen, F. Castellacci, J. Fagerberg and B. Verspagen
The Impact of Regional Support on Growth and Convergence in the European Union
- 02.15 K. Frenken & A. Nuvolari
Entropy Statistics as a Framework to Analyse Technological Evolution
- 02.16 J. Ulijn & A. Fayolle
Towards cooperation between European start ups: The position of the French, Dutch, and German entrepreneurial and innovative engineer
- 02.17 B. Sadowski & C. van Beers
The Innovation Performance of Foreign Affiliates: Evidence from Dutch Manufacturing Firms
- 02.18 J. Ulijn, A. Lincke & F. Wynstra
The effect of Dutch and German cultures on negotiation strategy comparing operations and innovation management in the supply chain
- 02.19 A. Lim
Standards Setting Processes in ICT: The Negotiations Approach
- 02.20 Paola Criscuolo, Rajneesh Narula & Bart Verspagen
The relative importance of home and host innovation systems in the internationalisation of MNE R&D: a patent citation analysis
- 02.21 Francis K. Yamfwa, Adam Szirmai and Chibwe Lwamba
Zambian Manufacturing Performance in Comparative Perspective
- 03.01 A. Nuvolari
Open source software development: some historical perspectives
- 03.02 M. van Dijk
Industry Evolution in Developing Countries: the Indonesian Pulp and Paper Industry
- 03.03 A.S. Lim
Inter-firm Alliances during Pre-standardization in ICT
- 03.04 M.C.J. Caniëls & H.A. Romijn
What drives innovativeness in industrial clusters? Transcending the debate