
Towards a Knowledge-based Theory of the Geographical Cluster

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Co-located firms within related industries enhance the ability to create knowledge by variation and a deepened division of labour. The interdependent development between economic activities and local institutions make the cluster attractive to some industries and hostile to others. The very reasons why cognitive distance might be small within the cluster tend to make cognitive distance great between clusters and make interfirm co-operation across bodies of knowledge more costly. The additional value created when clustering may justify the additional cost.

1. *Introduction*

One of the most significant consequences of the present process of globalization is the way in which it continues to turn inputs, previously crucial to the competitiveness of firms, into ubiquities.¹ Ubiquities are inputs equally available to all firms at more or less the same cost almost regardless of location (Weber, 1909). A large domestic market is, for instance, no longer an unquestioned advantage when global transport costs are becoming negligible; when the loyalty of customers toward national suppliers is dwindling; and when most trade barriers have eroded. Domestic suppliers of the most efficient production machinery are, similarly, no longer a solid competitive advantage, when the sales and marketing strategies of the suppliers reach across borders, and their equipment becomes available world-wide at

¹ Globalization has increasingly been associated with the 'unbundling' of the previous relationship between sovereignty, territoriality and state power (Ruggie, 1993) and, as a consequence, steadily weakening nation states (see Maskell, 2000), but it is arguably the many economic consequences of ubiquitousness that has contributed most in making globalization the favourite business buzzword at the turn of the 20th century.

essentially the same cost. The omnipresence of organizational designs of proven value, furthermore, makes a long industrial track record less valuable. So when input becomes ubiquitous, all competing firms are, in a sense, placed on an equal footing. What everyone has cannot constitute a competitive advantage.²

Firms cope with this situation in various ways. Some invest heavily in order to increase productivity, while others outsource, leaving the old industrial areas in a slowly more and more desolate and jobless state. 'Automate, emigrate or evaporate', as the saying goes. Other firms, in contrast, confront the new competitive situation by sharpening their abilities to learn and create knowledge a little faster than their competitors.

The creation of knowledge is usually seen as a process that requires dedicated investments either as pre-competitive research and education through universities, etc., or at the level of the individual firm through R&D activities. At least as important is, however, the investment in incremental 'low-tech' learning and innovation (Laestadius, 1996; Maskell, 1998) that takes place when firms, also in fairly traditional industries, create strongly corroborated knowledge while handling and developing mundane day-to-day operations like resource management, logistics, production organization, personnel, marketing, sales, distribution, industrial relations, etc. (Malerba, 1992). The possessors might know little or nothing of the origin of the knowledge or how they have come to know it, but 'it's here' and 'it works' (Baumard, 1996; Spender, 1996).

However, scholars and policymakers have increasingly come to suspect that the specific spatial arrangement of economic activities might also *in itself* somehow influence the creation of knowledge and, consequentially, economic growth (OECD, 1999).

Broadly, we may recognize two major categories of agglomeration economies (Estall and Buchanan, 1961). First are those that accrue from the geographical propinquity of industries and services in general, usually referred to as 'urbanization economies' (Hoover, 1970). The second category is usually referred to as 'locational economies' and embraces those economies that arise from the geographical agglomeration of related economic activities. It is the second category of geographical agglomerations or 'clusters' that in particular have been selected in recent years by scholars from a number of different disciplines as *the* territorial configuration most likely to enhance learning processes.³

² The role of ubiquities in changing the competitive environment is discussed in more detail in Maskell *et al.* (1998) and in Maskell and Malmberg (1999).

³ The terms 'geographical agglomeration' or 'cluster' are used almost synonymously in the literature

Some justification for this choice has been found in empirical studies showing, for instance, how 'innovative activity, as measured by patent data, and the location of high-tech industries is . . . highly concentrated' (Breschi, 1995), and how the agglomeration of firms within one or a few interrelated industries in Italian industrial districts gave rise to superior performance and some of the highest regional income levels in Europe (Bellandi, 1989).⁴ Today Silicon Valley and Hollywood are probably the world's best-known examples of successful, non-random, market-led clusters.⁵

Presumably, clusters of related firms have been contributing to economic growth for quite a while, but the contemporary turn towards a knowledge-based economy (Carter, 1994) in many parts of the world has certainly sharpened our interest in understanding the nature of this process.⁶

The existing literature provides two types of understanding of the phenomenon. One source of insight is to be found in ideographic, historical work on how clusters have originated and developed into fruition, occasionally accompanied by accounts of subsequent descents (Malmberg and Maskell, 2001). Another attempts to specify conceptually the mechanisms that provide advantages to be reaped by firms located in a cluster. The present article is concerned with the latter aspect. It suggests a way of structuring our perception regarding how the cluster might partake in knowledge creation. In dealing with this issue, it moves mainly within the world of concepts,

together with 'industrial agglomeration' or 'localization', while the term 'industrial district', initially used by Marshall (1890) for the result of locational economies, is now often applied when wishing explicitly to emphasize the values and norms shared by co-localized firms (see, for instance, Brusco, 1982).

⁴ Nevertheless, it must be admitted that while the cluster discourse is characterized by an overabundance of valuable case studies, the lack of solid empirical evidence across cases, sectors and countries is still profound. The present article can be seen as an attempt to provide a renewed platform for subsequent empirical investigations.

⁵ In order to exclude 'random' agglomerations, the number of co-localized firms must be larger than if no locational economies are present. Ellison and Glaeser (1994) note that if firms in an industry choose locations by throwing darts on a map, only six darts must be thrown at a map of the US before it is most likely that two will hit the same state (see also Malmberg and Maskell, 1997).

⁶ The growing interest has occasioned a number of distinct schools of thought to develop, including the GREMI approach (Maillat, 1991, 1998; Camagni, 1995; Ratti *et al.*, 1998), the many largely Marshallian studies of the Italian industrial districts (Brusco, 1986, 1999; Brusco and Righi, 1989; Beccatini, 1990; Garofoli, 1992a,b, 1993; Dei Ottati, 1994a,b, 1996; Bellandi, 1996; Gottardi, 1996; Belussi, 1999a,b), the French 'proximité' tradition (Blanc and Sierra, 1999; Kirat and Lung, 1999), an econometric type of cluster analysis (Swann *et al.*, 1998), different 'systemic' analyses (Markusen *et al.*, 1986; Malecki, 1991; Saxenian, 1994), some of which have focused explicitly on the geography of innovation (Feldman, 1994; Stenberg, 1999; Breschi, 2000), as well as the cherished approach applied by Porter (1990). Until we have found the 'serene and luminous region of truth where all may meet and expatriate in common', it is impossible within the frame of a single article to take into consideration the diversity in these and other schools of thought and to pay due respect to even important distinctions and points made in this vast literature. I apologize for this when allowing myself a certain degree of simplification in the following sections.

raising a set of questions regarding the way in which economic performance is related to space in general, and to the role of localized learning in particular.

The aim of the article is thus to investigate the nature of the cluster when knowledge creation becomes key. It does not necessarily assert that learning and innovation takes place in the cluster only, or deny that a good portion of all firms is happily located outside the cluster. Neither does the focus on the cluster exclude the fact that circumstances, events and decisions in distant parts of the world heavily influence many firms today. The article merely presupposes that the cluster play a role in knowledge creation that is by and large sufficiently important to affect what is going on in the world to warrant analysis.

The article is structured along the following lines. Section 2 looks briefly into previous cost-based accounts of how firms might benefit when being part of a cluster. It is suggested that such approaches often fall short when addressing the more fundamental question of the cluster: the existence of many co-localized firms in related industries rather than a single, but larger entity, carrying the same tasks. It is proposed that the reason for the existence of the cluster can be found in the enhanced knowledge creation that takes place along its horizontal and vertical dimensions. In Section 3 the learning advantages stemming from the intrinsic variation between co-localized firms with similar capabilities is discussed, while Section 4 deals with the division of labour and the interaction taking place among firms along the cluster's vertical dimension. The various factors contributing to the growth of the cluster are sketched out in Section 5 before moving to the more detailed discussion on the boundaries of the cluster. In Section 6 it is suggested that the boundaries can be defined by the interdependence between certain kinds of economic activities on the one hand and their appropriate institutional framework on the other. An institutional endowment favourable towards one kind of economic activity can be hostile to others. The very reasons for why cognitive distance might be small within the cluster will, it is asserted, make the cognitive distance between clusters very great. When access to dissimilar bodies of knowledge is required in product innovation, too much clustering becomes perhaps a burden and further clustering ceases. The final section points to areas where future research is needed to expand and elaborate on the theory of the cluster.

2. *Existence of the Cluster*

At least since Alfred Marshall's initial reflections on localized industries and the industrial district were published in his *Principles of Economics* in 1890

scholars from a range of different fields have regularly concerned themselves with the issue.⁷ The bulk of the studies in most of the 20th century were, however, mainly ideographic, and the reasons why firms cluster were assumed or implied rather than carefully investigated and specified. It was almost as if the benefits associated with the cluster were considered self-evident enough to require little discussion (Feser, 1999). When an explanation was offered it was usually based on a model where the balance between centripetal and centrifugal forces determined the locational pattern of firms. The dispersing forces normally included the costs of congestion, or the bidding-up of prices for land and labour. The concentrating forces were, in contrast, often identified as the cost advantages in transportation or when sharing an environment made particularly agreeable by, for instance, a dedicated infrastructure, a pool of notably skilled labour, an educational systems of distinctive relevance, etc.

This model largely disappeared as the swelling interest in clusters towards the end of the 20th century occasioned a number of novel research propositions to unfold.⁸ Instead, the main emphasis shifted towards explanations more or less explicitly based on transactions costs, including search and information costs, bargaining and decision costs, as well as policing and enforcement costs (Babbage, 1832; Dahlman, 1979).⁹ As Coase pointed out:

In order to carry out a market transaction, it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up a contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on. These operations are often extremely costly, sufficiently costly at any rate to prevent many transactions that would be carried out in a world in which the pricing system worked without cost. (Coase, 1960, p. 15)

Much in this spirit, some of the recent cluster studies have emphasized how the local activity will rise and the economic growth rate increase when the co-localization of firms benefits from the information easily available on potential partners in the vicinity and, perhaps more importantly, by the ease of conducting business with such local firms. The reason for the latter is found

⁷ Since the outstanding contributions by Marshall (1890, 1919), major works have been published by Weber (1909), Hoover (1948), Perroux (1950), Hirschman (1958), Ullman (1958), Jacobs (1961), Chinitz (1961), Greenhut (1970) and Pred (1976, 1977).

⁸ Accounts of this literature can be found in Harrison (1992), Norton (1992), Storper (1995), Baptista (1998), Bianchi (1998) and Yeung (2000).

⁹ Other costs of using the market include the cost of establishing the appropriate incentive arrangements (Foss, 1993).

in the behavioural constraints imposed on co-localized firms by the knowledge of the unattractive consequences of misbehaving. In a cluster it will immediately be noticed if a firm attempts to overutilize asymmetrical information; or pass defective or substandard goods as first class; or create hold-ups in order to benefit at the expense of others in the local milieu. Information about such misbehaviour will be passed on to everyone, who in future will tend to take their business elsewhere. Worse still, by becoming a local outcast the firm is deprived of the flow of knowledge, including its tacit parts, which can prove very difficult to substitute. Co-localized firms will, therefore, it is asserted, often benefit from the emergence of a general climate of understanding and trust¹⁰ that helps (i) to reduce malfeasance, (ii) to induce the volunteering of reliable information, (iii) to cause agreements to be honoured, (iv) to place negotiators on the same wavelength, and (v) to ease the sharing of tacit knowledge.

The cluster thus exists, it is often implied, because the co-location of firms cuts the cost of identifying, accessing or exchanging products, services or, not least, knowledge between firms.¹¹

However, it is not always realized that such costs might be eliminated altogether by joining the different activities and placing them under one common authority or ownership. When it comes to reducing transaction costs only, the single firm is superior to all market configurations imaginable—even to the high-trust cluster. The benefits of substituting interfirm interaction with the managerial authority of a single firm is, incidentally, one of the most significant reasons identified in the management literature for the birth and rise of the successful multinational enterprise, as Teece, among others, has observed:

Internal trading changes the incentives of the parties and enables the firm to bring managerial control devices to bear on the transaction, thereby attenuating costly haggling and disruptions and other manifestations of non-cooperative behaviour. Exchange can then proceed at lower cost and with higher returns to the participants. (Teece, 1980, p. 232)

The joining together of co-localized firms in related industries under one

¹⁰ Trust is in most of this literature defined along the lines suggested by Glaeser *et al.* (1999) as the commitment of resources to an activity where the outcome depends upon the co-operative behaviour of others.

¹¹ An overview of the broad literature emphasizing knowledge exchange is given in Malmberg (1996, 1997). Two major journals have recently devoted special theme issues to research along these lines. *European Urban and Regional Studies*, Vol. 61(1), January, 1999, brought out an issue on 'Localised Learning and Regional Economic Development', while the *Cambridge Journal of Economics*, Vol. 23(2), March, 1999, published on 'Learning, Proximity and Industrial Development'.

common ownership will, in addition to possible scale economies,¹² both help to align incentives and to diminish transaction costs.¹³ It seems to follow that no theory attempting to explain the existence of the cluster can be based only on the reduction of transport, information and transaction costs.

In order to get a grip on the problem at hand we need to start by recognizing how the continued formation and survival of the cluster attest that the total economic effect of curtailed information and transaction costs as well as of scale advantages are *inferior* to the locational economies available when *being separate firms*.¹⁴

But what *are* then the advantages of N co-localized firms of size S undertaking related activities that are not transferable to a single firm of size $S \times N$ doing the same? This is arguable the single most important question for understanding the existence of the cluster, yet largely ignored in discussions on the subject.

In order to structure the discussion that follows Richardson's (1972) now classical dichotomy can be helpful when distinguishing between the horizontal dimension of the cluster, consisting of firms with similar capabilities that carry out similar activities, and the vertical dimension composed of firms with dissimilar but complementary capabilities that carry out complementary activities.¹⁵ Richardson explains:

Now it is quite clear that similarity and complementarity . . . are quite distinct; clutch linings are complementary to clutches and to cars but, in that they are best made by firms with a capability in asbestos fabrication, they are similar to drain-pipes and heat-proof suits. Similarly, the production of porcelain insulators is complementary to that of electrical switch-gear but similar to other ceramic manufacture. And while the activity of retailing toothbrushes is complementary to their manufacture, it is similar to the activity of retailing soap. (Richardson, 1972, p. 889)

¹² Economies of scale might be defined as those that result when the increased size of a single operating unit reduces the unit cost of production or distribution.

¹³ Babbage (1835), for instance, observed how flour could be purchased cheaper on the market than if the government produced it themselves. Nevertheless the latter course of action was preferred rather than carrying the costs of verifying each sack of flour purchased. Information asymmetries give rise to monitoring costs that make authority more efficient than market governance.

¹⁴ The advantages of proximate specialized suppliers and customers in the cluster is in principle equally available to one big firm as to, say, 20 smaller doing similar things, just as most of the advantages in relation to the skills developed in the local labour market might be just as big or small for 20 co-localized firms of a given size as for a single firm, 20 times bigger.

¹⁵ Activities are defined broadly by Richardson (1972, p. 888) as 'related to the discovery and estimation of future wants, to research, development and design, to the execution and co-ordination of processes of physical transformation, the marketing of goods and so on'.

Complementarity signals scope for fruitful exchange while similarity in activities spells contest and market encounter. The firms in the vertical dimension of the cluster will, accordingly, often be business partners and collaborators. The horizontal dimension will, on the contrary, consist mainly of rivals and competitors. Both dimensions contain features that might contribute in explaining the existence of the cluster, and both will in turn be looked into below.

3. *The Horizontal Dimension of the Cluster*

Marshall (1890) long ago hinted at an explanation for the existence of the cluster along the horizontal dimension of the cluster.¹⁶ Marshall's reflection concerns the advantages of variation that are caused by the parallel performance of similar tasks. It is based on the conjecture that firms (i.e. owners, managers and employees) have different perceptive powers, divergent insights and dissimilar attitudes. Their different valuation of the information at hand results from an idiosyncratic and at least partly tacit way by which the information is initially assembled and interpreted (Casson, 1982). Consequently, firms develop a variety of solutions as an intricate part of their daily operations when holding dissimilar beliefs about their chances of success if using one of several possible approaches to similar problems (von Hayek, 1937).

Even when trying hard it would be extremely difficult, and often impossible, for a single, multidivisional firm to replicate internally the process of parallel experimentation and testing of a variety of approaches that take place among a group of independent firms doing similar things in the cluster. For as Loasby points out:

Competing visions between firms are necessary features of an evolutionary or experimental economy. But competing visions within firms, unless very carefully managed, and limited in scope, cause trouble. (Loasby, 2000, p. 11)

Co-localized firms undertaking similar activities find themselves in a situation where every difference in the solutions chosen, however small, can

¹⁶ For some reason or another Marshall's explanation never really entered the discussion of the cluster before Brian Loasby (1999, 2000) recently reintroduced it. A crude and unsubstantiated hypothesis could be that those who has been occupied with clusters have focused their attention on Book IV in Marshall's *Principles of Economics* while those who also cared to read Book V did so as part of a different agenda and never felt inclined to become engaged in the cluster discourse.

be observed and compared. While it might be easy for firms to blame the inadequate local factor market when confronted with the superior performance of competitors located far away, it is less so when the premium producer lies down the street. The sharing of common conditions, opportunities and threats make the strengths and weaknesses of each individual firm apparent to the management, the owners, the employees and everyone else in the cluster who cares to take an interest. Co-location, furthermore, provides firms with an arsenal of instruments to obtain and understand even the most subtle, elusive and complex information of possible relevance developed along the horizontal dimension of the cluster.

It is by watching, discussing and comparing dissimilar solutions—often emerging from everyday practices—that firms along the horizontally dimension of the cluster become increasingly engaged in the process of learning and continuous improvement, on which their survival depends. Harrison C. White saw this very clearly in his account for the essence of competition:¹⁷

Markets are self-reproducing social structures among specific cliques of firms and other actors who evolve roles from observing each other's behavior. I argue that the key fact is that producers watch each within a market. Within weeks after Roger Bannister broke the four-minute mile, others were doing so because they defined realities and rewards by watching what other 'producers' did, not by guessing and speculating on what the crowds wanted or the judges said. Markets are not defined by a set of buyers, as some of our habits of speech suggest, nor are the producers obsessed with speculations on an amorphous demand. I insist that what a firm does in a market is to watch the competition in terms of observables. (White, 1981, p. 518)

If the firms operating along the horizontal dimension of the cluster were to be spread thinly throughout a large city among many unrelated businesses, their ability to monitor and subsequently learn from each other's mistakes and successes would be severely restricted. In the focused and transparent environment of the cluster, successful experiments can more easily be distinguished from the less successful by knowledgeable local observers. Sharing a communal social culture—including collective beliefs, values, conventions and language—often significantly assists them in this process. Promising avenues identified by one firm become available to others. Even when carefully guarded or protected by a patent, enough information often

¹⁷ White's proposition can be found in several later works and his idea is at the core of Porter's (1990) concept of rivalry.

leaks out to set local competitors on the track and enable them to ‘invent around’ the protection (Maskell, 2001). Firms along the horizontal dimension of the cluster are constantly given the opportunity to imitate the proven or foreseeable success of others while adding some ideas of their own.

The resulting enhanced knowledge creation following from the ongoing sequence of variation, monitoring, comparison, selection and imitation of identified superior solutions is in essence why N similar firms of size S are not equal to one firm of size $N \times S$ doing the same.

The advantages suggested stem from the specific forms of knowledge creation available to the individual firm when pursuing self-defined objectives, but not to the division of a larger entity where instructions are received and actions restrained by some procedure or limitation imposed from above.

It might be worth emphasizing an essentially Darwinian feature of the process of variation: as long as the firms share a common language and certain codes that ease their interpretation of local events no trust is required as a prerequisite for learning. The sequence of variation, monitoring, comparison, selection and imitation can take place without any close contact or even an arm’s-length interaction between the firms. While suppliers and customers simply *need* to interact with each other in order to do business, competitors don’t. Most relationships in the cluster will therefore be along the vertical dimension.¹⁸ This is not the same as implying that the firms in the horizontal dimension of the cluster never co-operate by helping each other in overcoming technical problems, by lending materials and swapping surplus capacity or by exchanging information. In fact, they may interact regularly, even intimately so, in order to forward some particular scheme (Allen, 1983). On the other hand, they might just as well hate each other intensely, never exchanging anything useful.

The proposition put forward here simply suggests that the cluster exists because of locational economies *that are independent of the internal degree of interaction* at least in principle. The sole requirement is that *many firms undertaking similar activities* are placed in circumstances by co-locating where they can monitor each other constantly, closely and almost without effort or cost.

Other arguments for the existence of the cluster can be found along the vertical dimension of the cluster and we shall turn to these next.

4. *The Vertical Dimension of the Cluster*

The vertical dimension of the cluster consists of firms linked through

¹⁸ This theoretical point has been supported by empirical findings (Håkanson, 1987).

input/output relations.¹⁹ Specialized suppliers and critical customers become attracted to the cluster, once established, by the particular opportunities available. The vertical dimension of the cluster might, however, also be developed by task partitioning, which tends to evolve spontaneously when economic agents are free to pursue their own advantage, as pointed out by Adam Smith more than 250 years ago:

In a tribe of hunters and shepherds a particular person makes bows and arrows, with more readiness and dexterity than any other. He frequently exchanges them for cattle or for venison with his companions; and he finds at last that he can in this manner get more cattle and venison than if he himself went to the field to catch them. From a regard to his own interest therefore, the making of bows and arrows grows to be his chief business, and he becomes a sort of armourer. (Smith, 1979, p. 119)

Some firms will thus gradually move from the horizontal to the vertical dimension of the cluster by concentrating on some particular process, where they believe they possess or might develop certain lucrative capabilities, dissimilar to others. Such distinct capabilities, once developed, will gradually be improved through a continuing process of learning-by-doing. As the cluster's vertical dimension develops and firms become more specialized, they often find solutions to problems otherwise overlooked and bypassed, even when specializing in performing some particularly trivial tasks. An extended division of labour is therefore often closely associated with an acceleration of the growth of knowledge in the cluster.

The steady deepening of the division of labour is limited not only by the extent of the market,²⁰ but also by information asymmetries and the costs of co-ordination. Knowledge dispersed needs to be reassembled in order to be useful and firms need to co-operate in matching their related plans in advance since '... the one that make the heads of the pins must be certain of the cooperation of the one who makes the points if he does not want to run the risk of producing pin heads in vain' (List, 1841, p. 150).

In addition, firms hold asymmetrical knowledge about products and market opportunities. These asymmetries arise as an unavoidable consequence of the way in which knowledge is produced. Interfirm learning is, therefore, always subject to both thresholds, before the knowledge bases of divided firms

¹⁹ The product innovation literature has firmly established that firms learn from each other when interacting. See, for instance, Rosenberg (1972), Freeman (1982, 1991), Kline and Rosenberg (1986), Håkansson (1987), Hagedoorn and Schakenraad (1992) and OECD (1992).

²⁰ See Young (1928), Stigler (1951) and Smith (1979).

have diverged sufficiently for interaction to imply learning, after which the cognitive distance becomes too great for firms to bridge, and where learning will consequentially cease.

Firms in the cluster might have some advantages on both accounts compared to outsiders. The spatially defined community that often emerges when related firms co-locate makes it easier for them to co-ordinate and to bridge communication gaps resulting from heterogeneous knowledge endowments (Eliasson, 1996), and to understand motives and desires that in other circumstances would remain opaque. By reducing the costs of co-ordination and by overcoming problems of asymmetrical information, the process of clustering tilts the balance in favour of further specialization so that a higher level of knowledge creation might be obtained. The main advantages are not the ease of intra-cluster interaction as such, as our manner of speech sometimes seems to suggest, but the deepening of the knowledge base that it enables.

The analysis so far thus suggests a reason for the existence of the cluster along the vertical dimension supplementing the one offered in the previous section on the horizontal dimension. When creating an appropriate vertical differentiation, new economic activities become possible, knowledge creation is advanced, and the resulting extension of the internal market helps make the process self-reinforcing (Young, 1928).

It follows from the concept of variation dealt with in the previous section that if all firms in the cluster hold complementary capabilities, while no two firms hold similar capabilities, then all learning through variation and monitoring must necessarily cease. A continued division of labour among firms in the cluster might thus only be expedient for the overall knowledge creation up to a certain point. Beyond that, the benefits might be offset by the corresponding reduction in knowledge creation as variation is diminished and fewer possible avenues of progress are tried out in parallel. Only by a steady increase in the number of firms in the cluster would it be possible to create knowledge simultaneously by variation and by the division of labour.

5. The Growth of the Cluster

To the extent that incumbent firms in the cluster are able to reap the benefits of enhanced learning along its horizontal or vertical dimensions, a non-random improvement in performance is to be expected.

In addition to the expansion of incumbents the cluster might grow by an increase in the number of firms through three different processes. First, already existing firms located elsewhere might be tempted to relocate all or

a part of their activities to the cluster because of the real or imagined advantages of getting better access to the local knowledge base or to the suppliers or customers already present. As the Finnish CEO of Nokia-Mobira, J. U. Nieminen, once stoically noticed when commenting on these cluster-based advantages:²¹

When an inventor in Silicon Valley opens his garage door to show off his latest idea, he has 50 per cent of the world market in front of him. When an inventor in Finland opens his garage door, he faces three feet of snow. (van Tulder, 1988, p. 169)

Second, a dominant position will also attract entrepreneurs with ambitions to start firms in the particular industry. This is why many of the most talented wannabes within the film industry tend to end up in Hollywood and many of world's best specialists in information and communication technology at some stage find themselves in Silicon Valley. Immigrating individuals and firms can over time have quite spectacular effects by the way they fuel the growth of the cluster.

Third and finally, new firms come into being in the cluster by spin-offs; smaller or larger groups of former employees recognize a potentially profitable business opportunity and decide to exploit it by becoming entrepreneurs themselves (Belussi, 1999b).²²

By starting activities close to what is already going on in the cluster, all new spin-offs—newcomer or local independent entrepreneur alike—can safely skip the burdensome and costly process of gathering a lot of circumstantial knowledge about the business environment otherwise crucial. When it works for the neighbour why shouldn't it also work for me? New start-ups are thus given for free the advantages of a business environment tailored to their specific needs, even in situations when they might still be unaware of what these needs might be or how they may best be accommodated.

The availability of a suitable business environment is, of course, important not only for starts-ups but also for incumbents. By their everyday practices

²¹ Nokia, however, stayed in Finland and has by now become the world's leading developer and manufacturer of mobile or cellular phones.

²² Dalum (1995) shows how most of the many firms currently active in the communication cluster in Northern Jutland (Denmark) can be traced back to one initial firm producing off-shore radio equipment. Similar genealogical accounts for the emergence of many Canadian clusters have been established by a variety of local organizations. The general tendency for new firms to have their main activity within similar or complementary industries to the ones already operating in the area has been shown empirically for Denmark by Maskell (1992). If all incumbents were placed in a region by industry matrix with 2496 (12 × 208) cells, most cells would be empty but only 12% of the new firms established throughout a 20-year period would be located in an empty cell.

both simultaneously rely on and contribute to the further development of this particular environment. It is to this issue that we shall now turn.

6. *The Boundaries of the Cluster*

The processes of knowledge creation along the horizontal and vertical dimensions of the cluster are rooted in the day-to-day operations of the firms but influenced by a complex set of institutions developed over time.²³ Some of these institutions are of a general nature, equally applicable and useful for promoting the economic activity in all clusters, or at least in a large number of clusters, almost regardless of the particular activities carried out by the firms located there. The emergence of general formal constraints, communal regimes of appropriation and a common climate of understanding and trust, discussed above, belongs to this category.²⁴

Other institutions have, however, a definite scope and will differ from one cluster to the next.²⁵ It is reasonable to assume that the cluster's particular set of institutions has emerged as a response to the special requirements of the activities performed in the cluster.²⁶ There is thus a fundamental *interdependence* between the economic structure and the institutions of the cluster as they have developed over time.²⁷

It has been suggested that while the cluster's particular set of activities affects what is done within and among the firms in the cluster and therefore *what is learnt*, it is the institutions in the cluster that define how things are done and consequently *how learning takes place* (Lundvall and Maskell, 2000).

Just as the set of firms undertaking similar and complementary activities differ between clusters, so do institutions. Different activities each have their own mode of learning that gives rise to different institutional outcomes. The

²³ See Cannan (1912). We might follow North (1994, p. 360) in defining institutions as 'humanly devised constraints that structure human interaction. They are made up of formal constraints (e.g., rules, laws constitutions), informal constraints (e.g., norms of behaviour, conventions, self-imposed codes of conduct), and their enforcement characteristics . . . ' while explicitly adding Smith's (1997) economic (knowledge) infrastructures that result from conscious policy decisions and investment programmes and include special programmes in local schools and universities, government-supported technical institutions and training centres, specialized apprenticeship programmes, etc.

²⁴ It might be argued that the specific way by which trust is obtained will make it differ from cluster to cluster and that very few 'general institutions' can therefore be expected to be found in practice.

²⁵ This is in line with much of the innovation systems literature (Lundvall, 1992; Nelson, 1993).

²⁶ On the national level recent research has proved the existence of such a correlation between patterns of specialization in production and trade, on the one hand, and the knowledge base, on the other (Archibugi and Pianta, 1992).

²⁷ Some argue that the differences emanate mainly from structural characteristics (Breschi and Malerba, 1997), while others look at how institutional specificities affect the location of certain industries (Guerrieri and Tylecote, 1997). See also Gertler (1995a, 1996, 1998) and Maskell and Törnqvist (1999).

resulting institutions in turn assist the firms of the cluster when facing the challenges and opportunities presented by changes in the outside world.

Recent research has established the close interaction between structure and institutions when investigating industrial failure in places with a particularly favourable factor endowment. Eskelinen and Kautonen (1997), for instance, demonstrate how Finland, with its bounteous supply of high-quality timber resources, high educational and training standards, and a long track record of world-class designers, has been losing out in wooden furniture production to countries with obviously inferior resources on some or all of these counts. The wooden furniture industry is generally characterized by very flexible, small-batch production, modest capital intensity, skilled or semi-skilled labour, integrated design, frequent contact with many different and shifting groups of customers, few long-term contracts, and periods of high activity alternating with inactive spells of uncertain length (Lorenzen, 1998; Maskell, 1998).

However, the relevant Finnish institutions of the wood-processing industry were defined *not* by the wooden furniture industry, but by the far larger user of wood as a primary input: the manufacturing of paper and pulp. This industry, in contrast, is characterized by long production runs, extremely high capital intensity, few highly skilled employees, many low or semi-skilled workers, no design, a rather stable set of very big customers, long-term contracts, and very structured systems of production and maintenance.

The dominance of paper and pulp has led to certain highly significant idiosyncrasies in business behaviour in the timber market. As a result, an institutional environment is created that is highly supportive of the paper and pulp industry, but distorting to the wooden furniture industry (Kautonen, 1996). Important institutional features hostile to the wooden furniture industry are: no distinction between quality classes of relevance to furniture production; fixed standard pricing practices for roundwood; large volume discounts on purchase of wood combined with long-term wood contracts and upstream vertical integration; emphasis in governmental policy and managerial ethos on technology, scale economies and process innovation rather than on market presence, design and product innovation; output markets seen as fixed once and for all; hierarchical labour relations supported by labour market agreements structured in ways that penalize small firms.

The institutions developed and refined to accommodate the needs of firms in the paper and pulp industry created so unfavourable a business climate for the wooden furniture industry that it stagnated and declined, while the same industry blossomed in the neighbouring country of Denmark. To the uninformed observer, Danish firms faced a considerable handicap as their insufficient local timber supply forced them to import most of the wood

needed from countries such as Russia, Sweden, Poland and—notably—also Finland. However, this cost disadvantage counted for very little compared to the advantages of *not* being burdened with an unfavourable institutional endowment created by a dominant industry like the Finnish paper and pulp industry (Lorenzen, 1998).

The lesson that can be learned by the fate of the Finnish wooden furniture industry is that the more helpful an institutional endowment becomes for one type of activity the less suitable it can be for others. The significance of an appropriate *fit* between industry and institution also suggests why certain types of activity are never found in the same cluster. A cluster producing fashion wear or financial services will simultaneously develop (dissimilar) institutions that most likely will turn out to be alien to the production of ships, coal or cars.

The restrained ability to ‘stretch’ an institutional endowment to serve different kinds of economic activities equally well might also help to explain why new clusters emerge; when knowledge grows and economic activities begin to diverge, requirements also start to diverge and new clusters are likely to be established with institutions of their own.

The boundaries of the cluster might therefore be defined by the *fit* between the economic activities carried out by the related firms of the cluster on the one hand and the particular institutional endowment developed over time to assist these activities on the other.²⁸ The expansion into new activities along the vertical dimension of the cluster ceases to be feasible when the fit begins to weaken.

This framework might also account for the dispersing forces at work when the additional value created from spanning across distant bodies of knowledge must justify the additional transaction costs involved. Firms heavily engaged in interfirm innovation across usually unrelated activities and bodies of knowledge might, perhaps, be better off by not being *too* embedded in a particular cluster in order to avoid being facing by an even greater cognitive distance to potential partners when interaction is required.

Furthermore, the framework might provide an explanation for the demise of clusters as exiting value chains at some point become fragile and new ones are being moulded. As the new vertical dimension is gradually developed, the required institutional adjustments will almost inevitably meet resistance from old incumbents struggling to survive. If some compromise is not found, the resulting tension can easily lead to steady decline.

²⁸ If no such mechanism restricted the cluster’s institutional endowment to a *certain kind of related industries only*, we would ultimately expect to end up with a single and rather large cluster containing all economic activity.

7. Final Comments

The core of the argument presented in this article is that any economic theory of the cluster must address certain basic questions in order to be satisfactory.

First, such a theory must at the very least contain an explanation for the *existence of the cluster*. The theory must specify the process or processes that impel related firms to assemble and stay together at one place and—by doing so—make them thrive. More specifically, the theory must provide an explanation for the advantages that *many* related and co-localized firms might accrue but which are not available to a hypothetical *single* firm carrying out precisely the same activities, even if at the same location, using the same suppliers, customers and workforce.

It is suggested that the cluster exists because of the enhanced knowledge creation stemming from the variation developed along the horizontal dimension of the cluster, supported by the reduced costs of co-ordinating dispersed knowledge, of overcoming problems of asymmetrical information and aligning incentives, as well as of easing the actual transactions taking place along the vertical dimension.

Second, a theory of the cluster must include an explanation for the *growth of the cluster*. It must identify how new firms emerge and add to the strength of the cluster.

It is argued above that the cluster, once established, acts as a selection device, attracting particular kinds of economic activity comparable with the incumbents and reducing the ambiguity and costs facing local entrepreneurs when keeping close to the activities already present.

This selection device carries with it a set of constraints that might hamper future prosperity when external changes make readjustments necessary.

Third, the theory of the cluster must be able to identify *the boundaries of the cluster* by specifying why the clustering of some economic activities precludes the integration of others.

The reason forwarded in this article is based on the idea of a closely interdependence or *fit* between the specific economic activity of a cluster and the particular institutional endowment developed. A growing mismatch leads to decreasing returns. Negative feedback loops start to develop.

Further work might reveal how some of the specific suggestions made in this article when attempting to flesh out a theory of the cluster are ill conceived, or that other issues than the three identified should be included. One such possible candidate will answer questions regarding the *external* fit between the characteristics of the cluster on the one hand and its broader environment on the other. The last decade's many research publications frequently perceive the cluster as the basically random outcome of present or

historical processes. Relatively few have so far taken care to ponder the factors that might have made certain environments more or less suited for the emergence of the cluster.²⁹ The evidence available so far does not constitute the foundation for any general *ex ante* statements about the suitability of a given economic environment to sustain the growth of a non-random, market-led group of co-localized firms doing similar things. The number of case studies produced during the last decade does, however, suggest that an effort to develop such statements might lead to interesting results.

There are other important aspects that require further consideration in subsequent research. The question of the *internal organization* will, for instance, be concerned with the ways that different configurations within the cluster might influence its knowledge-creating abilities. The theory of the cluster might also be asked to further specify the reasons for the decline of the formerly successful cluster.

Maybe, over time, new research will also make us able to tell whether the possible mismatch between a slowly adjusting institutional endowment and the highly dynamic requirements of many contemporary industries is the primary reason why innovative firms also survive and prosper without being supported by the many proposed advantages of the cluster. The theory of the cluster will not be complete before we more fully understand the successful solitary firm.

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References

- Allen, R. C. (1983), 'Collective Invention,' *Journal of Economic Behaviour and Organization*, 4, 1–24.
Archibugi, D. and M. Pianta (1992), *The Technological Specialization of Advanced Countries*. Kluwer: Dordrecht.

²⁹ For an exception see, for instance, Gertler (1993, 1995b).

- Babbage, C. (1832), *On the Economy of Machinery and Manufactures*. Charles Knight: London.
- Baptista, R. (1998), 'Clusters, Innovation and Growth: A Survey of the Literature,' in P. G. M. Swann, M. Prevezer and D. Stout (eds), *The Dynamics of Industrial Clustering. International Comparisons in Computing and Biotechnology*. Oxford University Press: Oxford, pp. 13–51.
- Baumard, P. (1996), 'Organizations in the Fog: An Investigation into the Dynamics of Knowledge,' in B. Moingeon and A. Edmondson (eds), *Organizational Learning and Competitive Advantage*. Sage: London.
- Becattini, G. (1990), 'The Marshallian Industrial Districts as a Socio-economic Notion,' in F. Pyke, G. Becattini and W. Sengenberger (eds), *Industrial Districts and Inter-firm Co-operation in Italy*. International Institute for Labour Studies: Geneva, pp. 37–51.
- Bellandi, M. (1989), 'The Industrial District in Marshall,' in E. Goodman and J. Bamford (eds), *Small Firms and Industrial Districts in Italy*. Routledge: London, pp. 136–152.
- Bellandi, M. (1996), 'Innovation and Change in the Marshallian Industrial District,' *European Planning Studies*, 4, 357–368.
- Belussi, F. (1999a), 'Path-dependency vs. Industrial Dynamics: An Analysis of Two Heterogeneous Districts,' *Human Systems Management*, 18, 161–174.
- Belussi, F. (1999b), 'Policies for the Development of Knowledge-intensive Local Production Systems,' *Cambridge Journal of Economics*, 23, 729–747.
- Bianchi, G. (1998), 'Requiem for the Third Italy? Rise and Fall of a Too Successful Concept,' *Entrepreneurship and Regional Development*, 10, 93–116.
- Blanc, H. and C. Sierra (1999), 'The Internationalisation of R&D by Multinationals: A Trade-off between External and Internal Proximity,' *Cambridge Journal of Economics*, 23, 187–206.
- Breschi, S. (1995), 'Identifying Regional Patterns of Innovation Using Patent Data,' paper presented at the workshop on Regional Innovation Systems, Regional Networks and Regional Policy, organized by the STEP group at Lysebu Conference Centre (Oslo), Norway.
- Breschi, S. (2000), 'The Geography of Innovation: A Cross-sector Analysis,' *Regional Studies*, 34, 213–230.
- Breschi, S. and F. Malerba (1997), 'Sectoral Innovation Systems,' in C. Edquist (ed.), *Systems of Innovation: Technologies, Institutions and Organizations*. Pinter: London.
- Brusco, S. (1982), 'The Emilian Model: Productive Decentralisation and Social Integration,' *Cambridge Journal of Economics*, 6, 167–184.
- Brusco, S. (1986), 'Small Firms and Industrial Districts: The Experience of Italy,' in D. Keeble and E. Wever (eds), *New Firms and Regional Development in Europe*. Croom Helm: London, pp. 184–202.
- Brusco, S. (1990), 'The Idea of the Industrial District: Its Genesis,' in F. Pyke, G. Becattini and W. Sengenberger (eds), *Industrial Districts and Inter-firm Co-operation in Italy*. International Institute for Labour Studies: Geneva, pp. 10–19.
- Brusco, S. (1999), 'The Rules of the Game in Industrial Districts,' in A. Grandori (ed.), *Interfirm Networks. Organization and Industrial Competitiveness*. Routledge: London, pp. 17–40.
- Brusco, S. and E. Righi (1989), 'Local Government, Industrial Policy and Social Consensus: The Case of Modena,' *Economy and Society*, 18, 405–424.
- Camagni, R. P. (1995), 'The Concept of "Innovative Milieu" and its Relevance for Public Policies in European Lagging Regions,' *Papers in Regional Science*, 74, 317–340.
- Cannan, E. (1912), *The History of Local Rates in England in Relation to the Proper Distribution of the Burden of Taxation*. P. S. King & Son, Orchard House: London.
- Carter, A. P. (1994), 'Measuring the Performance of a Knowledge-based Economy,' Working Paper no. 337, Departments of Economics, Brandeis University.
- Casson, M. (1982), *The Entrepreneur. An Economic Theory*. Martin Robertson: Oxford.

- Chinitz, B. (1961), 'Contrasts in Agglomeration: New York and Pittsburgh,' *American Economic Review*, **LI**, 279–289.
- Coase, R. H. (1960), 'The Problem of Social Cost,' *Journal of Law and Economics*, **3**, 1–44.
- Dahlman, C. J. (1979), 'The Problem of Externality,' *Journal of Law and Economics*, **22**, 141–162.
- Dalum, B. (1995), 'Local and Global Linkages. The Radiocommunications Cluster in Northern Denmark,' *Journal of Industry Studies*, **2**, 89–109.
- Dei Ottati, G. (1994a), 'Co-operation and Competition in the Industrial District as an Organisational Model,' *European Planning Studies*, **2**, 463–483.
- Dei Ottati, G. (1994b), 'Case study I: Prato and its Evolution in a European context,' in R. Leonardi and R. Y. Nanetti (eds), *Regional Development in a Modern European Economy: The Case of Tuscany*. Pinter: London, pp. 116–144.
- Dei Ottati, G. (1996), 'Trust, Interlinking Transactions and Credit in the Industrial Districts,' *Cambridge Journal of Economics*, **18**, 529–546.
- Eliasson, G. (1996), *Firm Objectives, Controls and Organization. The Use of Information and the Transfer of Knowledge within the Firm*. Kluwer: Dordrecht.
- Ellison, G. and E. L. Glaeser (1994), 'Geographical Concentration in the US Manufacturing Industries. A Dartboard Approach,' Working Paper no. 4840, National Bureau of Economic Research (NBER), Cambridge, MA.
- Eskelinen, H. and M. Kautonen (1997), 'In the Shadow of the Dominant Cluster—The Case of Furniture Industry in Finland,' in H. Eskelinen (ed.), *Regional Specialisation and Local Environment—Learning and Competitiveness*. NordREFO Report 1979:3, Stockholm, pp. 171–192.
- Estall, R. C. and R. O. Buchanan (1961), *Industrial Activity and Economic Geography*. Hutchinson: London.
- Feser, E. J. (1999), 'Old and New Theories of Industrial Clusters,' in M. Steiner (ed.), *Clusters and Regional Specialisation. On Geography, Technology and Networks*. Pion: London, pp. 19–40.
- Feldmann, M. P. (1994), *The Geography of Innovation*. Kluwer: Dordrecht.
- Foss, N. J. (1993), 'More on Knight and the Theory of the Firm,' *Managerial and Decision Economics*, **14**, 269–276.
- Freeman, C. (1982), *The Economics of Industrial Innovation*. Pinter: London.
- Freeman, C. (1991), 'Networks of Innovators: A Synthesis of Research Issues,' *Research Policy*, **20**(5), 5–24.
- Garofoli, G. (1992a), 'Industrial Districts: Structure and Formation,' in G. Garofoli (ed.), *Endogenous Development and Southern Europe*. Avebury: Aldershot, pp. 49–60.
- Garofoli, G. (1992b), 'The Italian Model of Spatial Development in the 1970s and 1980s,' in G. Benko and M. Dunford (eds), *Industrial Change and Regional Development*. Bellhaven Press: London, pp. 85–101.
- Garofoli, G. (1993), 'Economic Development, Organization of Production and Territory,' *Revue d'Économie Industrielle*, **64**, 22–37.
- Gertler, M. S. (1993), 'Implementing Advanced Manufacturing Technologies in Mature Industrial Regions: Towards a Social Model of Technology Production,' *Regional Studies*, **27**, 665–680.
- Gertler, M. S. (1995a), "'Being There": Proximity, Organization, and Culture in the Development and Adaptation of Advanced Manufacturing Technologies,' *Economic Geography*, **71**, 1–26.
- Gertler, M. S. (1995b), 'Manufacturing Culture: The Spatial Construction of Capital,' presented at the annual conference of the Institute of British Geographers (mimeo).
- Gertler, M. S. (1996), 'Worlds Apart: The Changing Market Geography of German Machinery Industry,' *Small Business Economics*, **8**, 87–106.
- Gertler, M. S. (1998), 'The Invention of Regional Culture,' in R. Lee and J. Wills (eds), *Geographies of Economies*. Hodder Headline: London, pp. 47–58.

- Glaeser, E. L., C. L. Laibson, J. A. Scheinkman and C. L. Soutter (1999), 'What Is Social Capital? The Determinants of Trust and Trustworthiness,' Working paper no. 7216, NBER, Cambridge, MA.
- Gottardi, G. (1996), 'Technology Strategies, Innovation without R&D and the Creation of Knowledge within Industrial Districts,' *Journal of Industry Studies*, 3(2), 119–134.
- Greenhut, M. L. (1970), *A Theory of the Firm in Economic Space*. Appleton-Century-Crofts: New York.
- Guerrieri, P. and A. Tylecote (1997), 'Interindustry Differences in Technical Change and National Patterns of Technological Accumulation,' in C. Edquist (ed.), *Systems of Innovation: Technologies, Institutions and Organizations*. Pinter: London.
- Hagedoorn, J. and J. Schakenraad (1992), 'Leading Companies and Networks of Strategic Alliances in Information Technologies,' *Research Policy*, 21, 163–181.
- Håkansson, H. (ed.) (1987), *Industrial Technology Development—A Network Approach*. Croom Helm: London.
- Harrison, B. (1992), 'Industrial Districts. Old Wine in New Bottles?,' *Regional Studies*, 26, 469–483.
- Hirschman, A. O. (1958), *The Strategy of Economic Development*. Yale University Press: Clinton, MA.
- Hoover, E. M. (1948), *The Location of Economic Activity*. McGraw-Hill: New York.
- Hoover, E. M. (1970), *An Introduction to Regional Economics*. Alfred A. Knopf: New York.
- Jacobs, J. (1961), *The Death and Life of Great American Cities*. Random House: New York.
- Kautonen, M. (1996), 'Emerging Innovative Networks and Milieux: the case of the Furniture Industry in the Lahti Region of Finland,' *European Planning Studies*, 4, 439–456.
- Kirat, T. and Y. Lung (1999), 'Innovation and Proximity: Territories as Loci of Collective Learning Processes,' *European Urban and Regional Studies*, 6, 27–38.
- Kline, S. J. and N. Rosenberg (1986), 'An Overview of Innovation,' in R. Landau and N. Rosenberg (eds), *The Positive Sum Strategy: Harnessing Technology for Economic Growth*. National Academy Press: Washington, DC, pp. 275–306.
- Laestadius, S. (1996), 'Technology Level, Knowledge Formation, and Industrial Competence within Paper Manufacturing,' Working paper, Department of Industrial Economics and Management, Kungliga Tekniska Högskolan.
- List, F. (1841), *The National System of Political Economy*. Longmans, Green: London.
- Loasby, B. J. (1999), 'Industrial Districts as Knowledge Communities,' in M. Bellet and C. L'Harmet (eds), *Industry, Space and Competition. The Contribution of Economists of the Past*. Edward Elgar: Cheltenham, pp. 70–85.
- Loasby, B. J. (2000), 'Organisations as Interpretative Systems,' paper presented at the DRUID Summer Conference, Rebild, Denmark (www.business.auc.dk/druidd).
- Lorenzen, M. (ed.) (1998), *Specialisation and Localised Learning. Six Studies on the European Furniture Industry*. Copenhagen Business School Press: Copenhagen.
- Lundvall, B.-Å. (ed.) (1992), *National systems of innovation: Towards a Theory of Innovation and Interactive Learning*. Pinter: London.
- Lundvall, B.-Å. and P. Maskell (2000), 'Nation States and Economic Development—From National Systems of Production to National Systems of Knowledge Creation and Learning,' in G. L. Clark, M. P. Feldmann and M. S. Gertler (eds), *The Oxford Handbook of Economic Geography*. Oxford University Press: Oxford, pp. 353–372.
- Maillat, D. (1991), 'Local Dynamism, Milieu and Innovative Enterprises,' in J. Brotchie, M. Batty, P. Hall and P. Newton (eds), *Cities of the 21st Century*. Longman: London.
- Maillat, D. (1998), 'Innovative Milieux and New Generations of Regional Policies,' *Entrepreneurship and Regional Development*, 10, 1–16.
- Malecki, E. J. (1991), *Technology and Economic Development: The Dynamics of Local, Regional and National Change*. Longman: Harlow.

- Malerba, F. (1992), 'Learning by Firms and Incremental Technical Change,' *Economic Journal*, 102, 845–860.
- Malmberg, A. (1996), 'Industrial Geography. Agglomerations and Local Milieu,' *Progress in Human Geography*, 20, 392–403.
- Malmberg, A. (1997), 'Industrial Geography: Location and Learning,' *Progress in Human Geography*, 21, 573–582.
- Malmberg, A. and P. Maskell (1997), 'Towards an Explanation of Industry Agglomeration and Regional Specialization,' *European Planning Studies*, 5, 25–41.
- Malmberg, A. and P. Maskell (2001), 'The Elusive Concept of Localization Economies. Towards a Knowledge-based Theory of Spatial Clustering,' *Environment and Planning A*, forthcoming.
- Markusen, A., P. Hall and A. K. Glasmeier (1986), *High Tech America*. Allen and Unwin: Boston, MA.
- Marshall, A. (1890), *Principles of Economics*. Macmillan: London.
- Marshall, A. (1919), *Industry and Trade. A Study of Industrial Technique and Business Organization, and of their Influences on the Condition of Various Classes and Nations*. Macmillan: London.
- Maskell, P. (1992), *Nyetaableringer i industrien og industristrukturens udvikling [New Firm Formation and Industrial Restructuring in Denmark]*. Copenhagen Business School Press: Copenhagen.
- Maskell, P. (1998), 'Successful Low-tech Industries in High-cost Environments: The Case of the Danish Furniture Industry,' *European Urban and Regional Studies*, 5, 99–118.
- Maskell, P. (2000), 'Social capital and competitiveness,' in S. Baron, J. Field and T. Schuller (eds), *Social Capital. Critical Perspectives*. Oxford University Press: Oxford, pp. 111–123.
- Maskell, P. (2001), 'Knowledge Creation and Diffusion in Geographic Clusters: Regional Development Implications,' in D. Felsenstein, R. McQuaid, D. McCann and D. Shefer (eds), *Public Investment and Regional Economic Development*. Edward Elgar: London, forthcoming.
- Maskell, P. and A. Malmberg (1999), 'Localised Learning and Industrial Competitiveness,' *Cambridge Journal of Economics*, 23, 167–186.
- Maskell, P. and G. Törnqvist (1999), *Building a Cross-border Learning Region. The Emergence of the Northern European Øresund Region*. Copenhagen Business School Press: Copenhagen.
- Maskell, P., H. Eskelinen, I. Hannibalsson, A. Malmberg and E. Vatne (1998), *Competitiveness, Localised Learning and Regional Development. Specialisation and Prosperity in Small Open Economies*. Routledge: London.
- Nelson, R. R. (ed.) (1993), *National Innovation Systems. A Comparative Analysis*. Oxford University Press: New York.
- North, D. C. (1994), 'Economic Performance through Time,' *American Economic Review*, 84, 359–368.
- Norton, R. D. (1992), 'Agglomeration and Competitiveness: From Marshall to Chinitz,' *Urban Studies*, 29, 155–170.
- OECD (1992), *Industrial Policy in the OECD Countries*. Organisation for Economic Co-operation and Development: Paris.
- OECD (1999), *Boosting Innovation: The Cluster Approach*. Organisation for Economic Co-operation and Development: Paris.
- Perroux, F. (1950), 'Economic Space, Theory and Applications,' *Quarterly Journal of Economics*, LXIV, 89–104.
- Porter, M. E. (1990), *The Competitive Advantages of Nations*. Macmillan: London.
- Pred, A. (1976), 'The Interurban Transmission of Growth in Advanced Economies: Empirical Findings versus Regional-planning Assumptions,' *Regional Studies*, 10, 151–171.
- Pred, A. (1977), *City Systems in Advanced Economies. Past Growth, Present Processes and Future Development Options*. Hutchinson: London.
- Ratti, R., A. Bramanti and R. Gordon (eds) (1998), *The Dynamics of Innovative Regions. The GREMI Approach*. Ashgate: Aldershot.

- Richardson, G. B. (1972), 'The Organisation of Industry,' *Economic Journal*, 82, 883–896.
- Rosenberg, N. (1972), *Technology and American Economic Growth*. Sharpe: White Plains, NY.
- Ruggie, J. G. (1993), 'Territoriality and Beyond: Problematizing Modernity in International Relations,' *International Organization*, 47, 139–175.
- Saxenian, A. (1994), *Regional Advantage. Culture and competition in Silicon Valley and Route 128*. Harvard University Press: Cambridge, MA.
- Smith, A. (1979), *An Inquiry into the Nature and Causes of the Wealth of Nations* [1776]. W. Strahan and T. Cadell: London.
- Smith, K. (1997), 'Economic Infrastructures and Innovation Systems,' in C. Edquist (ed.), *Systems of Innovation: Institutions, Organisations and Dynamics*. Pinter: London.
- Spender, J.-C. (1996), 'Competitive Advantage from Tacit Knowledge? Unpacking the Concept and its Strategic Implications,' in B. Moingeon and A. Edmondson (eds), *Organizational Learning and Competitive Advantage*. Sage: London.
- Stenberg, R. (1999), 'Innovative Linkages and Proximity: Empirical Results from Recent Surveys of Small and Medium Sized Firms in German Regions,' *Regional Studies*, 33, 529–540.
- Stigler, G. J. (1951), 'The Division of Labor is Limited by the Extent of the Market,' *Journal of Political Economy*, LIX, 185–193.
- Storper, M. (1995), 'The Resurgence of Regional Economies, Ten Years Later: The Region as a Nexus of Untraded Interdependencies,' *European Urban and Regional Studies*, 3, 191–221.
- Swann, P. G. M., M. Prevezer and D. Stout (1998), *The Dynamics of Industrial Clustering. International Comparisons in Computing and Biotechnology*. Oxford University Press: Oxford.
- Teece, D. J. (1980), 'Economies of Scope and the Scope of the Enterprise,' *Journal of Economic Behavior and Organization*, 3, 223–247.
- Ullman, E. L. (1958), 'Regional Development and the Geography of Concentration,' *Papers of the Regional Science Association*, IV, 179–198.
- van Tulder, R. (1988), 'Small European Countries in the International Telecommunications Struggle,' in C. Freeman and B.-Å. Lundvall (eds), *Small Countries Facing the Technological Revolutions*. Pinter: London.
- von Hayek, F. A. (1937), 'Economics and Knowledge,' *Economica*, IV(N.S.) (13), 33–54.
- Weber, A. (1909), *Über den Standort der Industrien*. J. C. B. Mohr: Tübingen.
- White, H. C. (1981), 'Where Do Markets Come From?,' *American Journal of Sociology*, 87, 517–547.
- Yeung, H. W. (2000), 'Organising "the Firm" in Industrial Geography I: Networks, Institutions and Regional Development,' *Progress in Human Geography*, 24.
- Young, A. (1928), 'Increasing Returns and Economic Progress,' *Economic Journal*, 38, 527–542.