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# Industrial Clusters: Complexes, Agglomeration and/or Social Networks?

Ian R. Gordon and Philip McCann

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**Summary.** The concept of industrial clusters has attracted much attention during the past decade, both as descriptive of an increasingly important phenomenon and as a basis for effective public intervention in the economies of lagging city-regions. However, there is much ambiguity in the way in which this concept is used, presenting an obstacle both to empirical testing and to realistic assessments of policy relevance. In this paper, we distinguish three ideal-typical models of processes which may underlie spatial concentrations of related activities, with very different implications both in terms of relevant evidence and the scope for promotional policies. Survey data for the London conurbation are used to explore the relation between concentration and different forms of linkage, with results which point to the dominance of pure agglomeration effects in this context at least.

## 1. Introduction

Over the past decade, there has been a resurgence of interest in the nature of localised growth in the spatial economy. Firms and industrial activity in general tend to be spatially concentrated in certain locations. Observation suggests, however, that different groups and different mixes of activities tend to be clustered together in different places. The result is that spatial heterogeneity is to some extent associated with industrial specialisation, and this observed coincidence between spatial industrial clustering and regional specialisation is fundamental to the widespread adoption of the principle of increasing returns to scale in urban and regional economic analysis (Krugman, 1991a). The existence of localised increasing returns

to scale provides a rationale for industrial clustering, as firms and labour congregate in order to take account of increased factor rewards. Yet, these increased factor rewards are only exhibited over a limited spatial domain at the locations where such congregating takes place. The reason for this is that the transactions costs of overcoming distance, such as transport costs and spatial communications costs, imply that there must be a finite spatial limit over which such net benefits can accrue. The resulting balance between localised increasing returns to scale and spatial distance transactions costs can provide an explanation of the development of the types of hierarchical spatial industrial patterns typically observed (Krugman, 1993,

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1995; Fujita and Krugman, 1995; Fujita and Mori, 1997).

The renewed interest in localised spatial growth has come from a variety of disciplines. Within neo-classical economics, the interest in explicitly geographical issues has arisen primarily from applications of modern trade theory (Helpman and Krugman, 1985) to problems of spatial allocation (Krugman, 1991b; Venables, 1995), and this research agenda has largely superseded the traditional neo-classical model of interregional trade (Borts and Stein, 1964) or the traditional Ricardian model of international trade (Pomfret, 1991). Moreover, the development of trading blocs, and in particular those within common currency regimes, has accelerated this interest (Bliss and de Macedo, 1990). The focus of this research agenda is on the role played by increasing returns to scale and market structure in the determination of spatial investment patterns, and follows the more general renewal of interest in the role played by increasing returns to scale within the economy (Romer, 1986, 1987; Arthur, 1994). Within the business and management literature, the issue of location is seen as part of the broader question of constructing the optimal relationship between the modern firm and its customers and suppliers (Piore and Sabel, 1984; Porter, 1990). The recent focus on spatial issues essentially involves a rethinking of the relationship between the nature of the firm and that of transactions costs (Williamson and Winter, 1993; Pitelis, 1993), over space. The impetus for this rethinking had come originally from a growing awareness of the changes in the spatial organisation of modern manufacturing and distribution activities (Shonberger, 1982; Best, 1990; Nishiguchi, 1994) and the communication possibilities provided to the service sector in particular, by the advent of new information technologies.

Within the geography and spatial-planning literature, the interest in so-called new industrial districts arose primarily from observations of the spatial organisation of production in several key industries such as the electronics industry in California (Scott, 1993; Saxe-

nian, 1994) and the clothing industry in northern Italy (Piore and Sabel, 1984; Scott, 1988). For many analysts within these fields, much of the interest in modern forms of spatial clustering is motivated by a re-awakening to the possibilities for a renewed public-policy role in local economic development issues (Castells and Hall, 1994). Within the sociological literature, the recent interest in spatial clustering is underpinned by an interest in the relationship between an individual's environment and the development of 'embedded' social networks of communication and influence (Granovetter, 1985, 1991, 1992) which may transcend either firm or industry boundaries. Many of these sociological and geographical themes have subsequently become somewhat entwined under the rather vague umbrella notion of 'innovative milieux' (Aydalot, 1986; Aydalot and Keeble, 1988; Camagni, 1995), which attempts to relate questions of spatial clustering to the process of innovation.

This widespread appearance of new analytical work on spatial-growth issues needs some explanation, given the body of earlier work on these questions by authors such as Marshall, Hoover, Isard, Perroux, Chinitz and Mills, many of whose original insights still appear to be valid. In the case of mainstream neo-classical economists, the Krugman (1995) explanation in terms of the lack (until recently) of appropriate formal methods with which to analyse the implications of increasing returns presumably has some validity, but this would hardly apply to the authors cited immediately above. A second more general explanation is that substantial changes in the economic environment over the past 25 years or so (involving internationalisation, greater instability in product markets and more intense competition with a greater emphasis on quality/variety, at least for First World producers) have increased the importance of flexibility, encouraging greater reliance on external than internal economies of scale. The sharpness and pervasiveness of such a break can be much exaggerated, but there is little doubt that changes of this kind have been occurring (however unevenly) and

that these could well increase the salience of spatial clustering.

A third significant factor seems to be a sense of the inadequacy of conventional approaches to spatial policy in the face of the macroeconomic and structural developments of the 1980/90s, requiring innovative strategies to stimulate endogenous growth in redundant or marginal areas. This has encouraged various attempts to draw general lessons from a rather limited number of success stories about possible windows of opportunity and creative ways of exploiting these. Important though this effort is, the policy context has not always encouraged the analytical clarity which is required both for empirical testing of these propositions, and for assessing the broad scale of benefits which the various kinds of policy initiative might be expected to yield in different contexts. In particular, there has been a tendency to use terms such as 'agglomeration', 'clusters', 'new industrial areas', 'embeddedness', 'milieux' and 'complex' more or less interchangeably, with little concern for questions of operationalisation, which are actually far from straightforward, and should be different for each. Part of the difficulty stems from the different theoretical contexts out of which these ideas have emerged, but even two such commonly linked economic concepts as industrial clustering and increasing returns to scale within the spatial economy are not necessarily synonymous, and distinguishing between situations where this is the case and where it is not, becomes a major analytical challenge.

The argument of our paper starts from the position that discussion of industrial clustering has tended to conflate ideas arising from quite different perspectives, which are sometimes complementary and sometimes contradictory. Empirical observations of industrial clustering can then be interpreted in quite different ways, depending on the observer's initial perspective, with little consciousness of alternative ways in which these might be understood. The effect can be to buttress a rather generalised notion of the benefits of clustering, by conflating elements for which

there may actually be little evidence and other elements to which the evidence more directly relates. To encourage greater clarity and more critical investigation, we offer a framework in which a range of ideas about the significance of spatial clustering—from Isard's historic work on industrial complex analysis, and the Marshall–Hoover–Mills approaches to agglomeration, through to the more recent Aydalot–GREMI 'innovative milieux' and 'new industrial spaces' literature—are seen as relating to a number of distinct types of industrial clustering in the spatial economy. In contrast to Markusen's (1996) essentially inductive approach to classification of the varied forms of industrial district, the approach here is essentially deductive, and focuses on processes rather than structures. More or less pure examples of each of these types may be found in the real world, though elements of several may occur together in particular clusters, while some types may be more common or significant than others. Specifically, we suggest that there are three basic forms of clustering. Two of these have developed from the (neo-) classical traditions of economics: the classic model of pure agglomeration, and the industrial-complex model. The third model, which is that of the network (or club), was developed initially outside mainstream economics and owes rather more to sociological perspectives.

Defining analytically which of these types is the dominant structural characteristic of a particular cluster (or set of clusters) is essential, in order to be able to discuss their performance empirically, and to determine what more general lessons may be drawn from that. In the next three sections of this paper, we therefore discuss in turn the logic of each of these ideal types, starting with the two economic models, and drawing out contrasts between these and the 'network' model. The issue of how these models can be related to evidence on patterns of linkage among spatially clustered businesses will then be addressed in section 5 in the context of data from the London region. Finally, in section 6, we will discuss the significance of

the distinction between these models in relation to the policy attention currently given to the promotion of clusters and industrial milieux as a strategy of regional development and urban regeneration.

## 2. The Model of Pure Agglomeration

Although early spatial analytical systems (Weber, 1909/1929) acknowledged the existence of industrial clustering, the first attempt at a formal classification of the reasons for this phenomenon was made by Marshall (1925) whose analysis followed directly from Adam Smith's initial observation of labour specialisation (Blaug, 1985). Marshall proposed three reasons why firms would continue to be localised within the same area. These related to the development of a local pool of specialised labour, the increased local provision of non-traded input specific to an industry, and the maximum flow of information and ideas (Krugman, 1991a). In terms of modern thinking, Marshall's observation of the advantage of a specialised local labour pool can be described in terms of a labour-market system which maximises the job-matching opportunities between the individual worker and the individual firm (Simpson, 1992) and thus reduces the search costs for both parties. This implies that local firms are able to hire workers and adjust their labour-employment levels in response to market conditions in a more efficient manner than would be the case if the firm was more locationally isolated. The extensive local provision of non-traded inputs implies that the area experiences economies of scale in the employment of particular capital infrastructure, while the maximised flow of information and ideas implies that product and market knowledge can be shared more easily between agents in the same spatial grouping than would be the case if the firms were dispersed.

Nowadays, these two advantages would be described, respectively, as the achievement of service economies of scale or scope in the employment of either public or private capital, and the efficient transfer of technology.

The key to Marshall's approach is that what links each source of economic benefits is the fact that this accrues to firms within the local area primarily because of their geographical proximity. None of the sources or results of these benefits is internal to a particular firm, but each is external to all the firms. The actual sources of such benefits are quite different, and the mechanisms by which these are transmitted also differ substantially. It is solely the issue of geographical proximity which is the common element determining their being grouped together under the general heading of 'external economies' of industrial clustering, more commonly referred to as 'economies of agglomeration'.

More modern descriptions of agglomeration generally tend to follow the classification proposed by Hoover (1937, 1948), in which the sources of agglomeration advantages are grouped together under three headings—namely, internal returns to scale, localisation economies and urbanisation economies. The key feature of this method of classification is that the external economies are defined according to the industrial sector in which they occur, with the scale of the local economy being the only explicitly observable variable. Internal returns to scale may accrue to a single firm due to production-cost efficiencies realised by serving a large market. There is nothing inherently spatial in this concept other than that the existence of a single large firm in space implies a large local concentration of factor employment. Whether due to firm size or the number of local firms, this high level of local factor employment may allow the development of external economies within the group of local firms in the sector concerned, these being termed 'localisation' economies, and/or the development of external economies available to all local firms irrespective of sector, known as 'urbanisation' economies.

This classification of the sectoral range of external economies cuts across Marshall's more functional typology, with each of his three potential sources of local external economies potentially obtaining within one or more groups of sectors, *or* across the whole

of a local economy. Since the spatial scales over which these externalities are potentially available may also vary by sector, type and area, there can be a complex combination of agglomeration economies operating within any city-region (Jacobs, 1960). And within each of Marshall's broad groupings, various more specific sources of external economy may potentially operate at any of these scales.

Within this first category, these include the beneficial local labour-market effects of efficient search and job-match possibilities (Simpson, 1992), the impacts of human capital-accumulation on labour skills (Arrow, 1962) and firm productivity (Romer, 1987; Scott, 1988), and the consequences of these for local efficiency-wage levels (Akerloff and Yellen, 1986; Blanchflower and Oswald, 1994). Within Marshall's category of non-traded inputs are the various ways in which businesses can benefit from the greater availability and efficiency of particular local services, these representing local pecuniary externalities in Scitovsky's (1954) terms, or from more favourable local availability of capital finance, including property-based asset appreciation in the small-firm sector (Barkham *et al.*, 1996). The emergence of a discriminating local clientèle and/or a spirit of rivalry among competing firms, which figure among the contributors to competitive advantage for successful regional clusters in Porter's (1990) analysis, also belong in this category. Finally, within Marshall's third category of potential local external economies, are a variety of ways in which information flows are mediated, including interfirm labour migration (Angel, 1991), informal contacts between members of different firms (Jaffe *et al.*, 1993) and restructuring of local businesses. Together, these may all contribute to an evolving localised environment of learning (Nelson and Winter, 1982; Dosi *et al.*, 1987; Dosi, 1988), but may well differ substantially in their salience not only between sectors, but also between firms with different national origins or particular decision-making structures (Cantwell, 1991).

The fundamental point here is that a var-

iety of mechanisms by which the external economies are achieved (alongside various off-setting diseconomies) operate simultaneously, often indirectly and cumulatively, so that individual sources of the agglomeration process cannot be isolated or individually identified (Glaeser *et al.*, 1992; Henderson *et al.*, 1995). The only observable manifestation of their existence may thus be the realised effects on productivity, growth and local factor prices. A continuing growth in local land and expected labour prices (Harris and Todaro, 1970) relative to other locations, which takes place simultaneously with relatively higher localised capital returns, would be the only confirmation of the existence of local agglomeration economies.

This pure model of agglomeration presumes no form of co-operation between actors beyond what is in their individual interests in an atomised and competitive environment. Profitable local interaction is made possible through a combination of chance, the law of large numbers (increasing the probability of suitable partners being available) and the natural selection of businesses benefiting from the opportunities on offer. Relevant measures of scale will thus reflect not simply the level of economic activity (sectorally or overall), but also the number of independent economic units (Chinitz, 1961). Since not all firms will benefit from every type of externality, there will be a variety of distribution and displacement effects between groups of agents with different characteristics. However, the actual relations between the firms and between firms and mobile factors are neither identifiable nor static. Firms and other actors will change suppliers, customers, products and inputs, simply in response to current advantage and to their very specific requirements. The system is without any particular observable organisation or interagent loyalty, and simply functions as an ecology of activities benefiting from proximity, and developing emergent forms of specialisation—possibly including distinct forms of economic culture.

Traditionally, agglomeration economies



are seen as being particularly important to businesses unable to exploit internal economies of scale, whether because of constraints on growth or unwillingness to incur sunk costs in an uncertain market situation. However, the availability of external economies may itself discourage certain forms of investment by businesses or individuals. Specifically, this is likely to apply where investments imply a commitment to a particular employment or business relationship beyond what is profitable in the short term. Where benefits are easily externalised, there will be limited incentive to develop human capital, for example, beyond that required by workers themselves to gain access to better jobs, though more investment may be made in job- and labour-search activities. Space is fundamental to the efficient working of this system which relies on co-location increasing the probability of trading linkages and employment matches being realised. However, none of these linkages and matches is permanent and each can be broken, substituted and re-formed an infinite number of times in response to any information or price shocks to the system. To the extent that random sectoral shocks in diverse activities are uncorrelated, this type of spatial clustering of activity also acts as a hedge against uncertainty for all contracting agents (Mills, 1980). From the perspective of both the observer and the actor, therefore, agglomeration fundamentally serves to increase the opportunities for exchange and to reduce the incidence of missing markets.

The absence of formal structures or strong long-term relations between businesses in this model means that the local system (or cluster) has essentially 'open membership', for any business establishment located in the area—i.e. for all those willing to pay a market rent level which reflects the net value of spatial externalities (as well as other inherent locational advantages). The assumption is, however, that those willing to incur this cost, because of the value which they attach to potential interaction, are *ipso facto* likely to be producers as well as consumers of these external economies. Though there may be

need for regulation of external diseconomies, the system is thus not generally prone to subversion through the attraction of free-riders.

The pure form of agglomeration depicted here is evidently the model underlying modern urban economic theory (Fujita, 1989), but many of its key elements are also recognisable features of the economies of metropolitan areas and other cities producing high-order services. Moreover, these are features which are widely supposed to be of enhanced importance to businesses seeking to maintain flexibility in an era of increased uncertainty and change.

### 3. The Industrial-complex Model

The second type of model of spatial clustering to emerge from the classical and neo-classical economic tradition is that of the industrial complex. These industrial complexes are characterised by sets of identifiable and stable relations among firms which are in part manifested in their spatial behaviour. The relations are conceived primarily in terms of trading links, and it is these patterns of sales and purchases which are seen as principally governing their locational behaviour. The earliest insights into the relationship between production and the spatial organisation of industry discussed the question of the relationship between the optimal location of the firm, the level of transport costs and the price of local production factors (Weber, 1909/1929). The focus of the analysis here is on how the location of the firm is related to the spatial transactions costs faced by the firm, which are perceived to be clearly identifiable. In the 19th-century literature, these spatial transactions costs were assumed to be solely transport costs, although in more modern thinking it is quite possible to adapt these approaches to include also telecommunications costs (Salomon and Schofer, 1990) and a broader definition of shipment costs such as logistics-costs (McCann, 1998). Since in this type of approach, the characteristics of the products being produced and consumed by each firm are known, the only

information requirements for analytical purposes concern the relationship between spatial transactions costs and geographical distance, as well as the nature of the production function characteristics of the firms in question, defined in terms of their input–output requirements.

All of the subsequent development of neo-classical location theory has been entirely within this general framework (Isard, 1951; Moses, 1958; Miller and Jensen, 1978). The reason for this is that these models formed the spatial counterpart to the aspatial input–output models of regional structures (Isard and Kuenne, 1953), and the purpose of these models was to provide insights into how the expenditure patterns and the spatial behaviour of firms are interrelated. Within this approach, the only reason why we might observe spatial industrial clustering is that the individual firms, in aiming to minimise their observable spatial transactions costs, have implicitly or explicitly determined that this is best achieved by locating close to other firms within the particular input–output production and consumption hierarchy of which they are part (Isard and Vietorisz, 1955; McCann, 1995). This outcome may emerge incrementally, but where there are strategic interactions among the locational decisions of a few firms, and/or where viability depends on co-location, concerted planning of these decisions by the firms concerned (and long-term production/contracting arrangements) is necessary, with or without state encouragement.

This type of model is essentially static and predictable in nature, and is primarily concerned with cost-saving in relation to production links. The notion of space in these models is not explicitly urban or related to the potential for new forms of exchange, but is rather concerned with the minimisation of distance costs in the formation of crucial, pre-planned (and hence identifiable) linkages. In this model of the industrial complex, the principal actors are also identifiable, since this is an essentially privately organised system which is constructed in order to generate internal monopoly profits for

each of the actors. All the firms in the complex will have made substantial capital investments in order to set up the appropriate trading links, and these will be in the form of fixed-capital expenditure and possibly also research-capital expenditure. However, the system in principle is not reducible to the smallest units possible, and no subset of actors can recreate the system, because they do not have all of the necessary information about technology, labour specialisation, product innovation and markets. The complex is in effect a ‘closed club’, and in the same way that the individual organisation monopolises the ability to innovate in certain products or processes, the organisation of the complex monopolises the ability of the firm to realise the benefits of those innovations. The monopoly profits generated by this co-location of the firms will be more or less symmetrically distributed between all agents within the complex, although the existence of the complex will not in any way discourage individual firms from making investments in research or human capital in order to boost their own profits. There should be no problem of search costs and the internal monopoly profits due to existence of the complex should not affect local land values, given that there is no incentive for the firms in the complex to encourage the immigration of other firms, which would generate competition and inflation in the local real-estate markets. Oil refining, chemicals and pharmaceuticals complexes are typically of this type, but there are also important examples in automotive engineering, including the Japanese JIT complexes, notably Toyota City.

#### 4. The Social-network Model

The social-network model developed within the sociological literature (Granovetter, 1985, 1991, 1992) was primarily a critique of the neo-classical approach to the existence and development of institutions (Williamson, 1975, 1985). The ‘neo-institutionalist’ school had perceived the creation of hierarchical organisations and institutions to be a rational



response to the transactions-costs problems caused by bounded rationality and opportunism in a pure market-contracting economy (Pitelis, 1993). From this perspective, the development of organisations which allow transactions to be internalised and co-ordinated, means that trust (i.e. non-opportunism) becomes institutionalised within the economic system. For sociologists, however, the implicit and explicit contracts between agents within the individual organisation primarily act as a substitute for trust (Harrison, 1992), as evidenced by the existence of internal incentive and penalty schemes. The sociological response to the institutional school is the 'social-network model', in which it is argued that there is more order to interfirm interactions and less order to intrafirm interactions than the economic models would imply (Granovetter, 1985). The reason for this is that social networks of certain strong interpersonal relationships can transcend firm boundaries, with the result that many interfirm social interactions may be stronger than their intrafirm counterparts.

These interpersonal relationships depend crucially on interpersonal *trust*, and the informality of these relationships is viewed as being a potential strength rather than a weakness, as in the case of incomplete contracts. Where there are relationships among individuals who have decision-making power in a group of different firms or organisations, the existence of these trust relationships will mean that the individual or collective actions of the group differ from the behaviour associated with either pure market-contracting or hierarchically organised relationships. There are three key features of this trust-based behaviour: the first is that firms within the social network are willing to undertake risky co-operative and joint-ventures without fear of opportunism; the second is that firms are willing to reorganise their relationships without fear of reprisals; and the third is that firms are willing to act as a group in support of common mutually beneficial goals. These behavioural features imply that the social network is comprised of a set of transitive

private relationships in situations where neither price signals nor monitoring are sufficient to ensure the implementation of a particular project or activity. The strength of these relationships is described as the level of 'embeddedness' of the social network. In fact, all economic relations (even the 'pure' market relations of the agglomeration model) are socially embedded in the sense that these depend upon norms, institutions and sets of assumptions shared among a group of actors and are not, in themselves, simply the outcome of economic decisions. But the size of these groups, the strengths of the norms and the nature of the shared beliefs vary, leading to unevennesses in the kinds of economic relations which can be sustained, the intensity of interaction and the willingness to take certain kinds of risk. Industrial clusters (whether spatial or not) differ from the agglomeration model in that there is a belief that such clusters reflect not simply economic responses to the pattern of available opportunities and complementarities, but also an unusual level of embeddedness and social integration.

There is nothing inherently spatial about the social-network model although it has explicit spatial applications. This is because social networks are a form of durable social capital, created (and maintained) through a combination of social history and ongoing collective action. In this sense, their strength is inherently problematic, depending upon a prior accumulation of trust, circumstances which facilitate monitoring of others' behaviour, a source of leadership and/or a sense of common interest, as well as the expectation of significant gains (Olsen, 1965). Many of these pre-conditions are made possible by propinquity, particularly where economic relations have historically been more localised and/or there is a distinctive local economic base and cultural or personal links among key actors. Past links tend to persist since, within this model, economic networks represent a form of club which is neither completely open nor fully closed. Access to the club will depend on past experience and routine interaction as well as on investments

of effort in developing personal relations and trust. These factors may favour the development and reproduction of location-specific networks, in which case co-location will be a necessary but not sufficient condition for access. Under these circumstances, the benefits of admission will be to some extent capitalised in local rental values, though this form of rationing will not ensure the reproduction of local networks, which are vulnerable to growth in the non-member element of the local economy or to any incursion of opportunists into membership.

The incentives for investing heavily in purely local networks may be rather limited in a world where competitiveness in international markets is thought to require a high degree of flexibility in business strategies as well as the cultivation of partners/suppliers with very specialised capabilities. This context seems to favour network development within agglomerations (whether specialised or diversified) offering a wide range of partners, as well as the neo-Marshallian nodes whose local members gain superior access to communication and potential links with other nodes within national and international networks (Amin and Thrift, 1992). More generally, it reinforces the importance of 'weak ties' (Granovetter, 1973), both direct and indirect, and more pluralistic and open-ended network-building strategies in which actors cultivate more extensive sets of links, particularly with better-connected actors, which may prove to be more useful than committing to any single 'club' (local or not). Such a tendency is encouraged by spatial agglomeration, with the notion of weak ties representing the micro-structure of such agglomerations more plausibly than pure atomism. Hence, we would expect that concentration of investment in particular partners and the emergence of strong local economic clubs (or communities) are more likely to be pursued where agglomeration economies are unavailable.

Much of the recent interest in embeddedness and in social capital as a productive asset, particularly within the field of spatial planning, arises from the fact that the social-

network model has been viewed as largely applicable to particular observations of spatial industrial clustering, such as those for Italy's Emilia-Romagna (Scott, 1988) and California's Santa Clara County (Larsen and Rogers, 1984; Saxenian, 1994). Moreover, this interest is driven by a belief that such a model may provide, analytically and empirically, both a new and a renewed focus for the role of space in more general questions of contemporary economic growth. Empirically, the applicability of this model is open to question in the case of both Silicon Valley (Suarez-Villa and Walrod, 1997; Arita and McCann, 1998) and the Third Italy (Amin, 1989; Trau, 1997, 1998). But, where the development of the social network is associated with the development of a place-specific industrial cluster, it is possible to view this model as exhibiting some of the characteristics of each of the two previous models of spatial industrial clustering. For example, the social network allows many of the external benefits to be internalised within the group, as in the case of the complex, although some of the benefits may be capitalised into local rental values, as in the case of a pure agglomeration. Similarly, both the mutual-trading linkages and the investment linkages of the firms within the social network will exhibit more stability than those of the pure agglomeration, but less than those of the complex. However, it would be wrong to see the social network as simply located somewhere between the other two models, since the fundamental basis of the network relationships is articulated neither through price signals nor organisational structures.

## 5. Patterns of Linkage and Specialisation in the London Region

The significance of the distinction between different types of clustering and the externalities which these generate can be illustrated with evidence on patterns of concentration and interaction in the London region. This region, comprising Greater London and the surrounding Outer Metropolitan Area (OMA) is the primary location for most of

the successful British sectoral clusters recognised by Porter (1990), notably in luxury consumer goods and services, finance, information, general business services and healthcare goods.

### *5.1 Activity Clusters in the Region*

In terms of conventional sectors of employment, relative to the country as a whole, the region displays a particular specialisation in: printing, publishing and reproduction of recorded media; some types of wholesaling (household goods and goods sold on a fee basis); hotels and catering; air, rail and sea transport and supporting services; money, finance and insurance; IT/computing; professional services; other business services; cultural and entertainment services; central administration and representative organisations.

Concentrations of these metropolitan activities are most marked in central London and the adjoining boroughs, though there are secondary concentrations around Heathrow airport (with extensions to Reading and Basingstoke along the M3 and M4 motorways) and a more local one around Gatwick airport, mainly concerned with airport-related activities. In fact, most of London (apart from the outer east) and much of the OMA (apart from Thames-side) exhibit some specialisation in the sectors listed above, though outside the central areas this is much more likely to involve IT/computing, wholesaling and air transport than money/finance, governance or cultural services. The outer areas also tend to have a wider manufacturing base, including some high-tech sectors such as electronics or pharmaceuticals in which the region as a whole has only a weak specialisation. Another type of knowledge-based industry displaying a more 'schizophrenic' locational pattern is book publishing, with a concentration in inner and west London, but also in a ring of towns 50 miles or so from the centre (though still within easy reach by rail), where the academic sector in particular is heavily represented.

The city's pattern of specialisation has several dimensions other than that of the standard industrial classification. A canonical regression analysis of location against establishment characteristics (using data from the TeCSEM-group surveys of 'locationally sensitive' sectors in Birmingham, Cardiff, Reading, Swindon and more/less central parts of London) showed that inner-London locations in particular were associated not only with a distinctive set of industries, but also with particular functions (administration and direct service provision), establishment types (single-plant enterprises, HQs and foreign-owned branches) and market areas (notably European) (Gordon, 1996a).

### *5.2 Evidence on Business Linkages*

In London, as elsewhere, the views of businesses about the key location factors for their type of activity tend to emphasise basic issues of accessibility and the cost/availability of relevant kinds of labour and premises, rather than more sophisticated aspects of the business milieu, which tend to be significant only for small minorities of businesses. Thus, in the TeCSEM surveys of London, Reading (in the OMA) and Swindon (in the more extensive Greater South East region), factors cited as important by over 25 per cent of businesses involved 4 types of accessibility (to the motorway network, to good rail connections, to major airports and to London), as well as proximity to customers, cost of premises and the availability of white-collar labour, while proximity to suppliers, competitors and general/specialised business services were each cited by less than 10 per cent (Cheshire and Gordon, 1995). In the canonical analyses referred to above, the location factors predictive of an (inner) London location were the importance of 'good access to London' and good rail connections (both positive), traded off against good access to the national road network and availability of premises (both negative for London). Clearly, the 'London access' variable is very broad, encompassing the whole range of agglomeration economies offered by the metro-

politan area, but it is still significant that it is this very general factor (rather than more specific questions about local customers, suppliers or business services) which is predictive of location (Gordon, 1996a).

More direct evidence on the significance of clustering and local linkages to London businesses (only) is available using unpublished data from the 1996 London Employer Survey (LES) (Feloy *et al.*, 1997). At a descriptive level, responses to this survey showed that just 25 per cent of private-sector employment in London was in businesses perceiving some advantage in proximity to related activities, with one-quarter of these also seeing disadvantages. Not surprisingly, such firms were more evident in the two central boroughs (the Cities of London and Westminster), where these represented 43 per cent of employment. By contrast, in much of outer London, businesses were as likely to see disadvantages (mostly from increased competition) as advantages.

Several distinct types of advantage were reported, but much the most important was shared intelligence, especially for financial services, professional activities (law, accountancy and architecture) and for representative organisations (Table 1). Within the finance sector, this was especially significant in the City and its fringe (Camden, Southwark, Tower Hamlets, Hackney and Islington, though not Westminster), where 'wholesale' operations are more closely linked to money markets. On the other hand, for retailing, hotels and catering, bringing in business was seen as the main advantage of clustering, and this was significant also for a proportion of businesses in the culture and recreation sector. So too were increased opportunities for interaction or co-operation, which were also important to financial services in the City. These classic 'milieux' effects, which evidently operate among smaller local clusters in other particular areas—such as Soho, Covent Garden or the White City—do, however, only seem relevant to a small minority of London firms. Even in financial services, only one-eighth of London activity was in establishments per-

ceiving these as a significant advantage, while in business services and publishing, against our expectations, even fewer reported them to be relevant. Two other sets of relation with nearby firms in related activities were seen by respondents in more ambiguous terms. The first of these involved competition in product markets, which tended to be regarded more as a threat than as a route to enhanced performance (as expected in Porter's clusters), except in City and fringe financial services, and in printing and publishing. The other is in terms of access to a wider pool of labour, or of competitors for the firms' own labour force, where the balance of opinion was more even. The exceptions were City financial services (again) and representative organisations, both giving more weight to the benefits of concentration, and 'other manufacturing', where the emphasis was on the potential for labour poaching as a disadvantage. In terms of spatial variations within London, perceived opportunities for shared intelligence were the main reason for a more positive attitude to clustering in the CBD; while of the disadvantages, both competition and labour poaching were more frequently cited away from the centre.

A multivariate analysis of attitudes to clustering shows that firms seeing advantages in terms of shared intelligence are distinguished principally by sector, largely because of the positive attitude of financial services. They were also more likely to see advantages if their main market was abroad and, probably, if they were foreign owned. Size made no significant difference—although, in fact, large establishments were more positive about clustering—and this was also the case for independent/branch status, innovation or growth perceptions/experience and competitive strategy. Being located in the City or (to a lesser extent) in the extended central area increased the chances of a positive attitude (even when City finance was treated as a distinct sector), but this might well be effect rather than cause, since for most services any benefits of clustering would be maximised there. Those citing attraction of custom as an advantage of clustering seem only to be dis-

**Table 1.** London business perceptions of advantages and disadvantages of proximity to related activities, by sector (percentages)

Sector	Advantages from			Net advantage from	
	Shared intelligence	Interaction potential <sup>a</sup>	Customer attraction <sup>b</sup>	Competition <sup>c</sup>	Labour pool/poaching <sup>d</sup>
Printing and publishing	7	3	—	2	1
Other manufacturing	5	3	—	-2	-4
Construction	1	1	—	-10	—
Wholesale distribution	9	6	3	-7	2
Retailing	4	5	12	-6	—
Hotels and catering	2	6	37	-1	—
Non-air transport	9	4	1	-10	-1
Air transport	—	—	—	—	—
Financial services, City and fringe	37	10	3	8	6
Financial services, rest of London	18	12	—	-9	—
Professions	26	4	—	-4	1
IT and computing	3	3	—	-3	1
Other business services	6	3	2	-5	—
Education	6	—	3	-9	—
Health	1	3	1	-10	-1
Representative organisations.	20	7	—	—	4
Culture and entertainment	6	13	10	-9	—
All private sector	11	5	4	-4	1

<sup>a</sup>includes perceived advantages from co-operation, sub-contracting, potential contacts and convenience for meetings.

<sup>b</sup>includes bringing more business in and providing a greater choice for consumers.

<sup>c</sup>represents the difference between numbers citing greater competition as an advantage and as a disadvantage of proximity.

<sup>d</sup>numbers perceiving disadvantages in terms of poaching have been subtracted from those perceiving advantages from proximity to a larger pool of labour.

*Notes:* All responses have been grossed up to reflect the actual distribution of employment across areas, industries and establishment-size bands. The percentages relate estimated employment in each cell to totals for the sector.

*Source:* unpublished data from 1996 London Employers Survey (Feloy *et al.*, 1997).

tinguished by sector (as discussed above), selling directly to the public and being in the central area. In the case of labour pools, only being in the City is clearly significant, though there also seems to be a positive association with size. Finally, in the case of three interaction categories—potential for co-operation/sub-contracting, contacts and convenience for meetings—the only significant relation was with those businesses which saw their main competitive advantage as offering a fast response (particularly against those emphasising quality or design factors). On the negative side, disadvantages of clustering were most likely to be expressed by those firms: serving local markets; in the late phases of the product cycle (i.e. those perceiving a contraction in the market); emphasising customer care and fast response (rather than design/presentation/proximity to customers); engaged in retailing or catering activities; and/or located in outer east London.

Other evidence from this survey provides some less direct indication of the potential significance of local linkages and clusters. This includes information on the main market areas and supply areas and whether the links of a business to its customers and suppliers have a significant impact on its products or the way in which the business operates (which can be correlated, although the impact of local links is not separately distinguished), together with the location of any firms with which it has (or plans) joint-ventures. In the first case, the scale of the London economy, making it the main market area and/or supply area for a sizeable minority of firms, suggests that 10 per cent or so of businesses may have significant links with local suppliers, and a similar number with local customers. The likelihood of having such links actually seems rather lower for those firms doing business principally in London. In the case of customers, this is partly explained by the fact that such firms are more likely to sell directly to the public, but multivariate analyses (controlling for such factors as the importance of product/process innovation) suggest that significant links are no more likely where the main

market is local or in London as a whole, and actually a good deal more likely where the main supply area is further afield, notably in continental Europe. In the case of joint-ventures, in which roughly one-quarter of firms were involved, approximately 15 per cent were with other local businesses and a similar number with businesses elsewhere in London. Local or London-oriented joint-ventures were rather more common where these locations were the main market areas or supply areas, as they were among the small number who saw clustering as advantageous in aiding interaction. Such joint-ventures do seem to increase the probability of businesses making significant product/process innovations, but this applies more or less equally whatever the location of the other parties.

### *5.3 The Relation between Spatial Concentration and Forms of Linkage*

Comparative data on the significance of various types of externality and interlinkage between firms in London and those in other UK cities and regions are unfortunately not available. However, the LES data may be used to compare patterns of spatial dependence and advantage across sectors showing different degrees of concentration in London. In order to do this, each of the 3800 establishments in the sample was identified with a Census of Employment-based Greater London location quotient for the 3-digit industrial sector to which it was classified, which was then used as the dependent variable in multivariate analyses with survey responses from these establishments.

These analyses included both variables relating to potential forms of interaction between clusters of businesses in London (or particular parts of the city) and a set of control variables for other characteristics potentially predictive of London's specialisation in the activity concerned. Among these control variables, factors significantly associated with a concentration of employment in London included:



- (1) market areas (mainly outside the South East, particularly in Europe);
- (2) supply areas (either mainly in London or else no significant purchases from anywhere, together reflecting the absence of a constraint on London locations rather than a positive location factor);
- (3) market type (selling directly to firms, and not to government);
- (4) establishment size (larger numbers of employees);
- (5) product innovation (rated as very important);
- (6) establishment function (not mainly engaged in production or logistics, but administration, sales or service provision); and
- (7) product cycle (market not strongly declining).

Among the variables more directly linked to interfirm relations in London, several proved to be entirely unrelated to the degree of concentration there (when other factors were controlled for). These included:

- (1) the existence of particular links with either customers or suppliers that had a significant impact on the firm's products or operations;
- (2) firms' perception that proximity to businesses in related activities was an advantage because of either opportunities for interaction or the existence of a shared labour pool; and
- (3) innovation in product or processes associated with observation of or collaboration with other businesses.

More positive results included significant associations between concentration in London and:

- (1) a perception that proximity to businesses in related activities was advantageous because of access to shared intelligence (though this was only true for financial services in the City of London);
- (2) not regarding such spatial clustering as disadvantageous (in terms of competition);
- (3) having or planning joint-ventures with

London-based firms (rather than either the absence of such ventures or links with firms elsewhere); and

- (4) using private consultants/professionals for external advice (rather than only official bodies, or nobody).

Though clearly significant in statistical terms, these potential linkage factors made only a minor contribution to the explanation of the pattern of specialisation, for which the control variables are substantively much more important.

For several reasons these data cannot provide clear measures of the comparative 'fit' of the three ideal-typical models to the pattern of specialisation in the London economy. One reason, relating to 'social networks', is that general survey data cannot measure the degree of trust that businesses invest in other firms, locally and elsewhere, or the efforts expended in creating and validating that trust. However, the general impressions created by these data are consistent with the findings of Llewelyn Davies' more qualitative interviews with firms in new/emerging sectors, contained in the socioeconomic assessment of London by Buck *et al.* (1997). In particular, these emphasised the importance of referrals and personal contacts in developing business. Though few specific links were suggested, the significance of proximity to related businesses was downplayed, and more weight was given to the opportunities (both casual and through exhibitions, for example) which were available for new contacts. Another qualitative study of small business service firms in central London by Jones (1998) found only weak and unstable linkages, with suspicion of potential collaborators, and knowledge being transferred through competition rather than collaboration. Key advantages of a central location were claimed to be accessibility for clients, a wider recruitment pool and a more 'prestige' image.

A second reason, particularly relevant to 'agglomeration', is that firms may well be unconscious (or only vaguely aware) of key externalities which their locality af-

fords them (or fails to), relative to other places. While standard neo-classical analyses of location assume that profit-maximising firms would necessarily possess such comparative information, this could only be expected to be the case where two conditions apply simultaneously: that spatial externalities are a significant influence on profitability; and that relocation is a feasible and potentially profitable option. Typically, however, spatial externalities imply a degree of spatial dependence while, for any individual business, non-spatial influences on profitability are likely to appear more relevant. Only in relation to aggregate comparisons of growth or productivity across localities do the spatial effects become crucial, since the non-spatial influences then tend either to cancel out or (in the case of macroeconomics or government policy) to exert similar effects everywhere. Even then, differences arise more in relation to the performance of representative plants in different areas than through relocations between these. In the London case, where movement is predominantly outwards, the LES indicates that firms expecting to move outside their present borough during the next 3 years accounted for less than 5 per cent of employment, while for moves out of Greater London the corresponding figure was around 1 per cent. For those seeing any advantages in clustering, the probabilities of such moves were only half as great, while the reasons given for moving were dominated by issues related to premises or physical accessibility, with only a handful of firms referring to customer or supplier access, support services or skill availability (Feloy *et al.*, 1997). Outside London and to the west in the Thames valley, a similar pattern is evident with a (limited number of) movers, mostly stimulated by company reorganisation, being concerned essentially with premises and costs, and relatively insensitive to what other local firms perceive as positive locational attributes (Gordon, 1996b).

A third complicating factor is that in heterogeneous urban economies the models apply differentially to particular sets of activities. In the London case, City financial

services stand out from other groups of respondents to the LES in terms both of their strong positive evaluation of proximity to related activities and the specific emphasis on local intelligence as the crucial externality. This is consistent with the Amin and Thrift (1992) view that a primary reason for the City's competitive survival is its central role internationally in the construction of discourses about financial operations, supported by its roles as a centre of interaction and as a proving-ground for new products. Although historically the City was deeply 'embedded' as much in the British class structure as through local networks, trust now appears to be something which has to be continually nurtured through interactions with potential clients, partners and informants (Thrift and Leyshon, 1994). Since the LES provides no evidence that City firms are particularly likely to have strategically significant links with customers or suppliers or to be involved in local joint-ventures, their main difference from other London businesses appears to be in the value attached to (sector-specific) localisation economies, rather than to more general urbanisation economies—i.e. a difference in the form of agglomeration, rather than approximation to the complex or social-network models. Localisation also appears important for high-order consumer services, but for the rest of the London economy more diffuse forms of agglomeration seem to underpin the clusters of strong sectors, with very little evidence of more specific forms of attachment.

The Coe and Townsend (1998) study of producer-service concentrations in the 'western arc' of the OMA comes to rather similar conclusions, emphasising the importance of common locational logics rather than any localised (or even sub-regional) linkages in generating clusters of financial, business and computer services. In this metropolitan ring, the relevant agglomeration seems to be the Greater South East (some 150 miles across), though these authors also found that formal business links were quite likely to involve partners outside this region. At metropolitan-region scale, the picture approximates even

more closely to the pure agglomeration model, with little evidence for the significance of either industrial complexes or strong social networks. In this respect, the London region is likely to be a rather extreme case, but one that is of substantial importance in showing the social-network model to be by no means a pre-condition for the achievement of either flexibility or the capacity to innovate.

## 6. Conclusions

Strong recent interest in the phenomenon of spatial industrial clustering from a variety of disciplines with diverse analytical approaches has led to a certain level of confusion in the literature, as authors adopt various concepts in a more or less interchangeable manner. This confusion has been catalysed by the perceived policy salience of 'clusters', which is reinforced by a range of plausible arguments and made applicable to a wide range of situations. The argument of this paper is that there are actually three analytically distinct forms (or ideal types) of spatial industrial clustering, each having a different logic, and that it is important for these not to be confused, even though actual clusters may contain elements of more than one type.

The significance of the distinction between these three interpretations lies partly in the implied scope for policy action to stimulate growth and competitiveness in backward areas or to create counter-magnets to congested metropolitan areas. In different periods and economic contexts, the complex and network models both held out the prospect that substantial spatial externalities could be generated through appropriately planned development in areas lacking a strong existing concentration of advanced industrial or service activity. In the first case, co-ordinating the locational decisions of large-scale, interlinked businesses in (high-transport-cost) sectors, such as petrochemicals (Isard and Vietorisz, 1955), steel or auto-engineering, was seen as a means of triggering viable economic development and

potential growth poles in areas such as Puerto Rico or the Mezzogiorno, which lacked established industrial concentrations. Subsequently, in a post-industrial or post-Fordist era, the *milieux* concept held out the prospect that qualitatively crucial interrelations could be developed among clusters of (small or medium-sized) businesses, securing both growth and innovation in lagging regions and/or smaller centres in developed regions. This relies heavily on elements of the social-network model, though the GREMI group's analyses of innovative *milieux* (Camagni, 1995) also embraced many sorts of agglomeration economy, and the 'rare' examples which they found of such developments in backward regions included one case of a rather pure (tourist) industrial complex, located in the Costa Smeralda. However, apart from specialisation (which can reduce the absolute scale of agglomeration required for competitiveness) and discrimination in favour of selected centres, the prospect of stimulating such development in such areas is seen as resting on investment in networks of co-operation and information transfer to stimulate synergistic development. Significantly, in both cases, the basic insights were originally developed in terms of the economic space of relations among key firms (Perroux, 1950; Schumpeter, 1934) and only later attached to geographical space (Boudeville, 1966; Camagni, 1995; Maillat, 1995).

Contrasts in the policy implications of these three ideal types of cluster make it particularly important to avoid confusing features of one with those of another, even though elements of each may co-exist in particular situations. In cases approximating to the industrial-complex model, where production links are central to the clustering process, relevant indicators of spatial externalities involve the level, pattern and temporal stability of the input-output linkages for local tradeable *and* factor inputs. Although it is common practice to focus just on the first of these—see, for example, Turok, 1993; Phelps, 1997—this can be quite misleading as an indicator of the degree of integration of

key sectors in the local economy, since it is contingent on the degree of vertical (dis)integration of the production process. Taking factor inputs into account as well provides an indicator of something which might be (and has been) referred to as local 'embeddness', but which has nothing to do with Granovetter's use of the term, or its significance in relation to the social-network model. In cases approximating to 'pure agglomeration', where linkages are diffuse, unstable and not necessarily recognised even by the parties involved, the only feasible approach to the measurement of spatial externalities is via the estimation of aggregate production functions, although the definition of urban capital as a composite commodity can lead to the identity problems inherent in both aspatial and spatial growth models (Fingleton and McCombie, 1998). Finally, in cases approximating to the social-network model, a more qualitative approach is required, in order to measure the incidence of co-operative behaviour among firms and organisations pursuing mutually beneficial ventures. In this context, direct economic links or even levels of information flow are less relevant indicators of embeddedness than involvement in joint-ventures, lobbying activity, mutual-support networks or common patterns of socialisation, along with means of controlling membership of the network. As the London example indicates, it cannot simply be assumed in the absence of such conditions that other measures of local integration are a reasonable predictor of the applicability of this model, since availability of agglomeration economies might, for example, actually discourage investment in deepening social networks.

In such empirical analyses there is a need for great care (in particular, recognising the distinctions between different types of spatial externality and seeking appropriate kinds of evidence to test the significance of each), especially in view of the policy significance currently being invested in the promotion of clusters, innovative milieux and associational economies (Cooke, 1998). Even for liberal economists, the existence of substantial

forms of spatial externalities admits the possibility of 'intellectually respectable cases' being made for selective interventions in order to promote growth paths leading to higher local real incomes—although there is a reasonable suspicion that most such instances will prove to be unwarranted cases of special pleading on behalf of more specific interests (Krugman, 1995). More sophisticated arguments, drawing on elements of the social-network model, evolutionary economics and 'lock-in' effects (David, 1985), substantially enlarge the scope for effective intervention, but also for resource misallocation, if their empirical and analytical bases are not examined critically (Lovering, 1998). One case in point is the impression created by research on 'innovative milieux' (Aydalot 1986; Aydalot and Keeble, 1988) that there exists an ideal modern form of spatial industrial organisation (based on a combination of small-firm structures and local labour flexibility) in which innovation and growth are maximised. More critical recent investigations indicate that there is no well-defined relationship between the location of innovative activities and regional spatial structure, which is applicable to any wide range of sectors (Simmie, 1998).

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