Journal of the Korean Geographical Society, Vol. 34, No. 5, 1999 (561~573)

Industrial Districts : Measuring Degree of Spatial Linkage within the Cincinnati Metropolitan Area*

Boyoung Lee**

산업지구 : 씬시내티 대도시지역내의 공간적 연계도의 측정에 관한 연구*

이 보 영**

Abstract : The concept of "industrial district" has emerged as a critical component of industrial location theory and regional economic development policy. Conceptually the region has an unusually well developed network of related industries, linked vertically, up and down the supply chain, and also horizontally, across support attributes which may include specialized labor and service firms. Although the concept is clear, there are empirical difficulties. Against what standard can "above average" inter-firm exchanges of ideas or labor, or reliance on local producer services be measured? There are no rules or empirical information on the necessary degrees of interactions within an area, which would qualify it as an industrial district. This research does not use pre-defined industrial districts. Rather, it examines actual spatial linkages in efforts to measure degrees of interactions as they really exist. An index of local-ness is established for inputs, outputs, subcontracting, producers services and information sources, collaborations and labor-shed dimensions for the Cincinnati, Ohio, U.S.A. The results suggest that simple singly bounded industrial districts do not exist. The metropolitan region is too small to exhibit strong vertical linkages, and horizontal linkages are also mainly with destinations outside of the metropolitan region. The local-ness index methodology shows promise; more empirical investigation is necessary to establish realistic baseline value.

Key Words : Industrial District, Linkages, Networks, Local-ness, Cincinnati

요약 : 산업지구론은 산업입지론과 지역경제개발 정책의 중요한 요소로 등장했다. 개념적으로 산업지구는 관련산업의 노동력 연계를 포함하는 수직적, 수평적 연줄망이 잘 발달된 지역이다. 기존의 연구들이 경험적 연구의 계량적 기준은 없으므로, 본 연구는 미리 정의되지 않은 전통적 공업지대인 씬시내티 대도시지역을 대상으로 투입, 산출, 하청, 생산자 서비스, 정보, 협동 및 노동력 연계에 대한 국지도를 계산하였다. 비록 노동력과 생산자 서비스의 국지적 연계가 강하나 약한 물자의 수직적 연계를 보여, 대도시지역 규모에서의 산업지구 확인은 불가능하였으며 이는 다른 지역을 대상으로 하는 보다 많은 경험적 연구가 필요함을 제안한다.

주요어 : 산업지구, 연계, 연줄망, 국지도, 씬시내티

1. Introduction

1) Agglomeration and industrial districts

Important developments have occurred in industrial location theory and in regional economic development policy. A cumulative causation with regional advantage model has gained ascendancy over the classical least-cost equilibrium development model, and regional or local economic environments are accorded great significance. A fundamental theoretical notion is that agglomeration economies (external economies of scale) and competitive advantages accrue to firms through co-location. Agglomeration is thought to be more important than ever before in determining an areas economic fortunes. There is

---

* Paper presented at the 99 annual meeting of AAG, March 18-24, 1999 and partially based on the author's dissertation.

** Part-time Instructor, Department of Geography Education, Kyungpook National University

no consensus on an operational definition of industrial district, but the concept clearly involves nearby transactions between economic actors.

In addition to the lower costs via transportation or transactions costs and shared public goods, competitive advantage adds economic dynamics as a result of continual innovation and transfers of new knowledge within clusters of firms (Doeringer and Terkla, 1995). Competitive advantage is argued to be based on collaboration among specialized firms (Piore and Sable, 1984), and the interaction of competition with innovation (Porter, 1990), and the agglomeration economies of clusters of large firms with local suppliers (Krugman, 1991). These are not new ideas in industrial location. Wheat, for example, discusses agglomeration,

> Agglomeration is the term for the tendency of industry to attract industry. The term has been applied to the clustering of industry in the Manufacturing belt. However, it can be applied to any state with a large metropolitan area where industry is clustered. Such clustering could result from intermediate markets and external economies. Firms are said to congregate in order to buy from, and sell to, each other. At the same time this clustering leads to skilled labor pools, business services, transport facilities, and other economies external to the firm. These external economies attract still more industry(Wheat, 1973, 207).

This direct and compact paragraph is very useful. It highlights what in this chapter are referred to as vertical, or supply chain, linkages (firms···congregate in order to buy from, and sell to, each other) and horizontal linkages (skilled labor pools, business services, transport facilities···). It also indicates that the concept must operate within a specified spatial context (e.g., state with a large metropolitan area where industry is clustered). These are the basic elements of the industrial district conception. The mention of metropolitan area seems to suggest that not only is manufacturing primarily an urban activity, but also that the metropolitan geographic scale may be somehow important (among other things, this chapter examines horizontal and vertical linkages at the metropolitan scale). There is another significant issue connected with Wheats discussion of agglomeration. In his Synthesis and Conclusions chapter, he discusses locational influences, in order: markets, climate, labor, thresholds, and other influences. Agglomeration is in the other influences section. Wheat wrote almost thirty years ago; a similar article today might move agglomeration up to center stage, perhaps as an industrial district topic.

An industrial district is an area with a group of economic activities connected by functional linkages and spatial proximity. The "industrial cluster" model focuses on supply chain (input-output) linkages, producer services linkages, informational linkages and labor force linkages between producers. The "industrial district" model adds spatial proximity to the industrial clusters conception. Factories located in an industrial district presumably are able to enjoy the localization and urbanization advantages of co-location. Thus, an industrial district is (a) a relatively small region, (b) with above average horizontal and vertical links with other economic activities in the region. However, the industrial district concept has no significance if the spatial clustering is not greater than normal (more than expected, or above average). In other words, to be designated an industrial district the area should have significant groupings of activities that have especially strong ties with the local area. The concept is clear, but how are especially strong real-world industrial linkages to be recognized, at what spatial scales, and what are their characteristics?

This paper demonstrates the development of indices that can be used to measure the degree of these spatial linkages. Thus, any area can be ranked by the relative local-ness of its economic activities.

2) Linkages, networks, and localness

Regional production linkages are those where firms buy and sell to each other within the area. The more a region can be both a supply and a market area, the stronger and more attractive it is. These supply chain linkages are central to regional development theory. They still are the most important linkage elements in regional development models. As important as production linkages are, expertise and information sharing also are important to economic success. Social and institutional and labor force linkages are critical in the rapid communication of industrial expertise, and in enriching the contents. The importance of informational agglomeration has long been recognized (e.g., Chinitz, 1960), but it now has a much more important role in economic growth models (Rees and Stafford, 1986). For example, Saxenian (1994) persuasively argues that the current differences in economic health between Silicon Valley and its once more mighty rival area, Route 128 in Boston, are in large part a consequence of differences in regional industrial cultures in the previous decade. Silicon Valley' s competitive edge seemed to be in a network of firms that constantly interacted, both formally and informally, economically and socially, with much trading of employees, in an information rich environment which encouraged experimentation. In contrast, the Route 128 electronics firms were much more self-sufficient and did not produce the same levels of creative tension in their region. Informational agglomeration was superior in the modern Silicon Valley industrial district.

Modern information and communication technologies permit the development of flexible production systems. Flexible production is an important adjunct to the logic of industrial districts (e.g., Scott, 1988). To the extent that producers are able to move from mass production to more customized operations-to temper economies of scale with economies of scope-they are better able

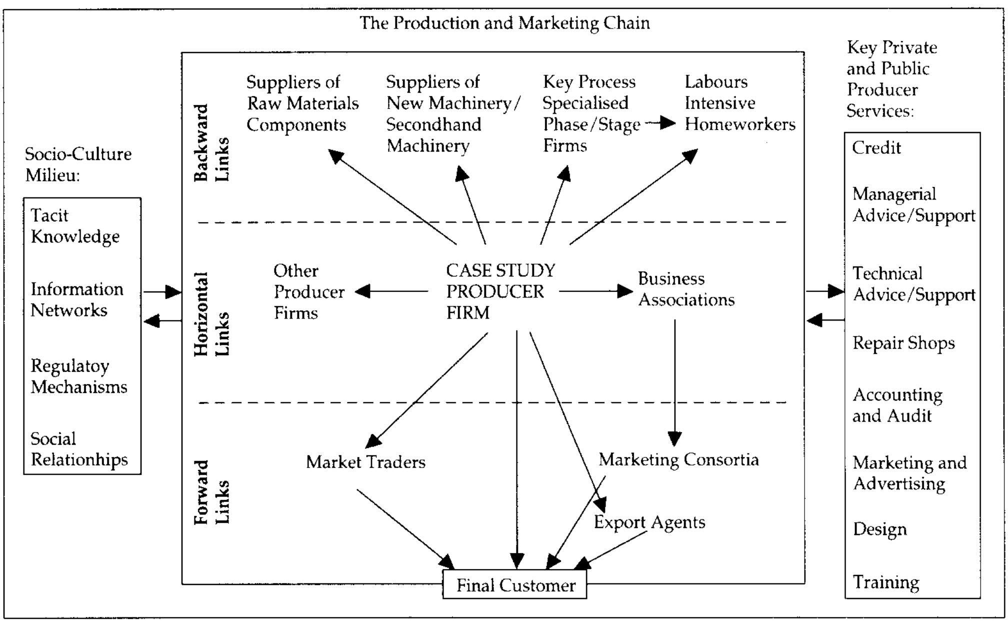

Figure 1. Relational/network case studies of industrial clusters in LDCs

Source: Nadvi and Schmidz, 1994

to cope with market volatility. Another aspect is increasing outsourcing of functions from companies to suppliers, and closer ties between producers and suppliers. Superior communication and transportation capabilities also allow the development of Just-in-Time production systems. All these developments enhance the advantages of spatial proximity. It is now contended that regional economic development favors areas with strong large firms, long-standing industrial cultures, and service-rich environments, which together create a positive spatial symbiosis effect (Capello, and Nijkamp, 1997). In other words, in spite of the potentials of advances in communications to help overcome the friction of distance and enable rapid and almost cost-less transmission of data, modern technologies seem to be favoring spatial agglomeration, at least at the regional scale. Production systems in the information age increasingly rely on knowledgeable individuals, who in turn maintain their competitive edge via intense, and often informal professional and social contacts. Face-to-face contact is important, and it happens at the local level (Malecki, Tootle and Young, 1995).

Figures one and two illustrate the arguments. No firm (or manufacturing plant) operates in isolation. All have interchanges up and down the production and marketing (supply) chain, and horizontally with producer services and with their socio-cultural milieu (Figure 1). In addition, there must be a spatial context; the agglomeration arguments require spatial boundaries. Figure 2 puts the concept in terms of local and nonlocal space. This research examines interchanges in terms of their degree of local-ness. Local-ness should be a measure of the consequences of the efficiency of agglomeration, or of the supply or opportunity for local acquisition of the commodity or service or information. For example, the use of printing services would be expected to have a higher local-ness index than a highly specialized and infrequently used manufacturing input. Labor would be expected to have a high local-ness index when the region is defined as the metropolitan area, but a lower index if the spatial context is intra-urban neighborhoods.

Of course, each company, industry, and region may be expected to exhibit some uniqueness. For example, not all firms can benefit equally from Just-in-Time production systems; while they work well in the automobile industry, they do not serve oil refiners at all (Laulajainen and Stafford, 1995). Each manufacturing industry depends on a different mix

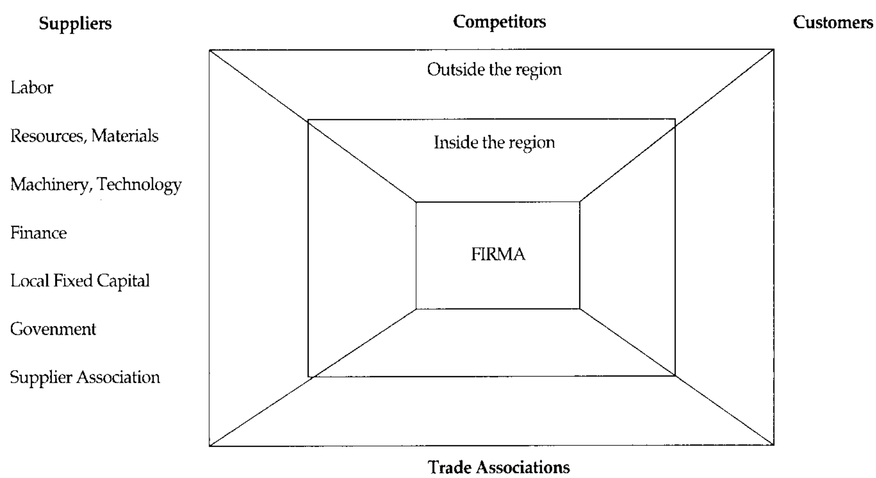

Figure 2. Firm mapping onto local and nonlocal space

Source: Markusen, 1994

of economic resources and costs for its success. What makes a community an ideal place for chicken processing is different from the resources required for the production of plastic feedstocks, plastic end-use products, automobiles, or computer chips (Hill, 1998). Different regions with different industrial specializations presumably benefit differently from local linkages and networking. This research uses empirical data from a long-established and reputedly well-rounded region.

3) The identification problem: degree of local-ness?

For some observers clusters are simply plants of similar type or size that have some relatively close spatial arrangement. For example, Sweeney and Feser note that they are not interested in whether businesses cluster, per se; this can be verified by viewing any map of economic activity (1998, 50). They are defining clustering only in terms of spatial proximity. Not captured are the horizontal or vertical linkage aspects; these cannot be verified just by map viewing. Another frequent use of the term cluster focuses on industries of the same and/or closely related types;here the operational definition is by prior classification rather than either functional interactions or spatial proximity. Even when the industrial district concept includes space, there is no consensus on how large the space should be; it in different studies it ranges from city sub-areas to multiple countries. Finally, in the majority of studies there is emphasis on the supply chain linkages but too little attention is given to the vertical linkages (Held, 1996). In regional development practice there is little consistency among states or other regional governments regarding definitions or operational criteria or implementation of procedures to enhance clustering (Doeringer and Terkla, 1995).

Research rarely focuses on the *identification* of industrial districts; rather, almost all studies examine *assumed* clusters and *assumed* industrial districts. Research on the medical devices industry cluster in the Minneapolis - St. Paul region illustrates the normal approach; both the cluster and the region were *predefined* (Maki and Maki, 1994). The abundant research literature on industrial districts consistently uses the concept to explain the outstanding or unusual economic performance of such predefined regions. Sforzi's (1989) Italian study is a rarity. He does *not* assume a pre-determined industrial district. He attempts to *find* industrial districts (while everyone else works the other way around). We follow his lead by not assuming an industrial district (but we do not use his methodology). Also, most of the literature has no empirical content. In those studies which look at real places, almost always a fast growth and specialized place is selected for examination before the industrial district concept is applied. The place is then named some sort of industrial district, which presumably explains the already documented unusual performance of the place. The implication is that the growth is explained by the specialized industrial district characteristics of the place, but this is analytically unacceptable. The definition must be separated from the explanation. Gertler neatly expresses the difficulty:

> How do we recognize a true industrial district when we see one? How big or small, in terms of area extent, can these be? What proportion of transactions involving producers within such districts need be wholly contained within the same area? And what kinds of social relations between producers in the area in question qualify as being representative of the unique behaviour believed to take place in such districts? Here there is no real consensus (1992, 263).

This research develops methodologies to answer these questions. The application of the procedures can provide empirical benchmarks to judge unique or above average. The common procedures are partially reversed. The industrial districts are not pre-defined. Nor is the metropolitan area examined especially noted for recent unusual economic performance. Measuring the magnitudes of vertical and horizontal linkages in a seemingly normal regional economy begins to develop benchmarks that may be used in any area. The empirical application is in accord with Harrisons observation that there is not much already available data available so there is little alternative to scholars rolling up their sleeves and going out and conducting original surveys.[on] how firms located a different sites within a metropolitan region interact(1998, 25).

2. Methodology

As noted, there is no consensus on an operational definition of "industrial district", but the concept clearly involves "nearby" transactions between economic actors. Malmberg notes that proximity matters but asks the basic empirical question to what degree are linkages local? (Malmberg, 1996, 194).

This research suggest that an industrial region must meet the following criteria to be considered as an industrial district:

- There exist high degrees of spatial proximity
- There exist strong local vertical linkages, represented as input-output linkages.
- There exist strong horizontal linkages, represented as producer service linkages, informational linkages and collaboration linkages.
- There exist strong local force linkages.

A Composite Industrial District index(IDI) can then defined as a function of spatial proximity(SP), vertical linkages(VL), horizontal linkages(HL), and labor force linkages(LL).

$$IDI = f\,(SP, VL, HL, LL) \qquad (1)$$

Following the above criteria, if an industrial region can be regarded as an industrial district, its IDI must be larger than a certain threshold value.

The simplest form of the above function is a logical conjunction

$$IDI = (SP < TSP)\ \&\ (VL > TVL)\ \&\ (HL > THL)\ \&\ (LL > TLL) \qquad (2)$$

where T_{SP}, T_{VL}, T_{HL} *and* T_{LL} are the threshold values of the four corresponding factors. For every factor, "less than" or "greater than" is used assuming that small SP means high degree of proximity while large VL, HL and LL means strong local-ness. In this case, the value of IDI is either TRUE or FALSE. If TRUE, the region is an industrial district, otherwise it is not.

The following sections describe the calculation of each of the four factors.

1) Spatial proximity

A standardized nearest neighbor index R is to used determine the difference in the degree of clustering among industry groups. The R index can be calculated by dividing the average nearest neighbor distance by the corresponding value for a random distribution with the same point density. With the standardized index, a perfectly clustered pattern produces an R value of 0.0, a random distribution 1.0, and a perfectly dispersed arrangement (a lattice) generates the maximum R value of 2.149.

This index has been calculated for all manufacturing plants of 15 or more employees in the Cincinnati Metropolitan Area (N = 1,500). The type (by SIC code) and location (by latitude and longitude) of each plant (Fig. 3) is known (Industrial Map Company, 1993). For the nearest neighbor calculations straight-line distances between plants were used.

This index has been applied to manufacturing in

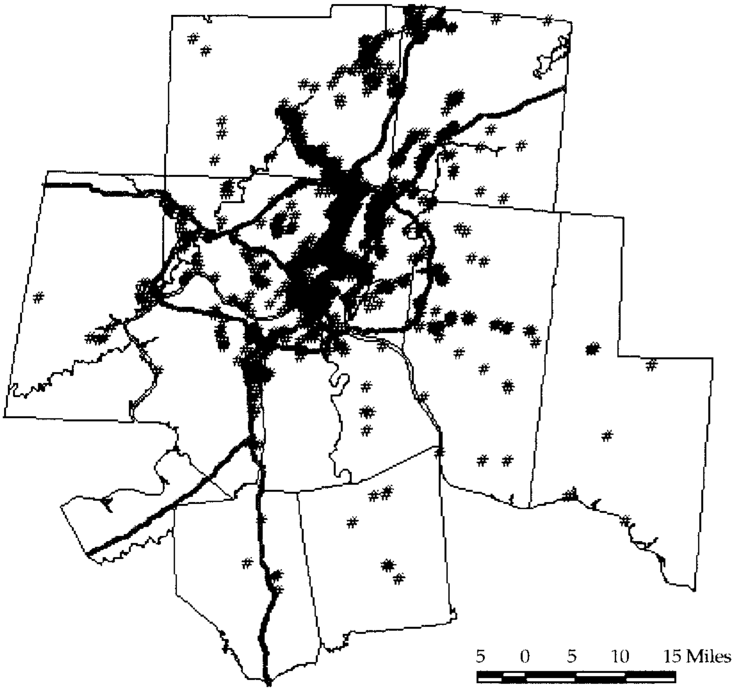

Figure 3. Manufacturing in Cincinnati metropolitan area

* index: Plants with 15+ employees

the Cincinnati Metropolitan Area. Nearest neighbor indices for each SIC 2-digit class suggest spatial clustering across the board (Figure 4).

For all manufacturing, the index is 0.22, showing strong clustering.

For this study, the R index is converted to the SP index so that larger SP values indicate higher degrees of clustering.

$$SP = (2.149\ R) / 2.149 \qquad (3)$$

The value of SP ranges from 0 to 1. For a perfect clustering pattern (all points are at the same location), SP will be 1. For a triangular lattice pattern, SP will be 0. For all manufacturing, the R index of 0.22 is converted to the SP index of 0.90.

2) Local-ness of vertical linkage and horizontal linkage

The point pattern analysis cannot reveal the important interactions (linkages) between individual plants. For these it is necessary to gather

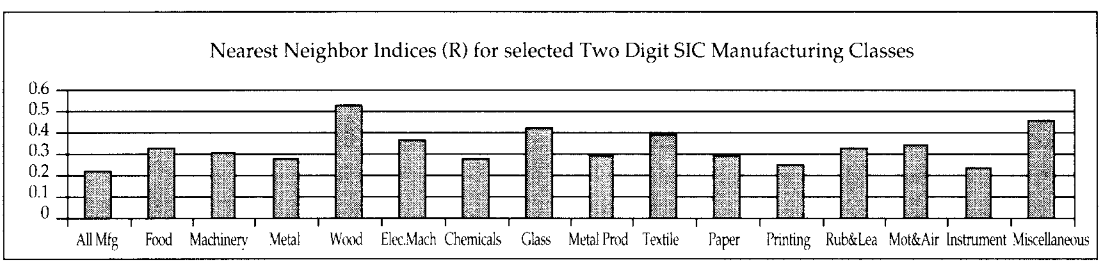

Figure 4. Spatial clustering of manufacturing in Cincinnati metropolitan area

information from manufacturers. Local-ness has been examined for inputs to plants, and outputs from plants, and the distances from which producer services are obtained, and the relative location of employees for a sample of manufacturers in the Cincinnati metropolitan area. A questionnaire was sent to managers of manufacturing plants within the 13 county metropolitan region. Five of the counties are in southwest Ohio, six are in northern Kentucky, and two are in southeast Indiana.

The managers were asked questions about their specific plant at a specific location. Of particular relevance to this research, they were asked to list the major material inputs which came into the plant, and to make informed guesses about the percentage of each which came from a source (a) less than 2 miles from the plant, (b) 2 or more miles but less than 5 miles, (c) 5 or more miles but within the Cincinnati metropolitan area, or (d) from outside the Cincinnati metropolitan area. They were asked to list the main products shipped from the plant, and again for each to indicate how far away it was shipped, using the same four distance categories as for inputs. For informational contacts there were questions regarding frequency of use and distance away from the plant to the place of work of the contact. A list of producer services was presented and respondents were asked to rank them by volume of purchases, and to indicate the distance between the plant and the source of the producer service, using the four distance categories. The managers were asked to make an informed guess about the radius (in miles) of a circle around their factory that encloses the residences of 75% of their employees. There were seventy-one usable responses. This is a small portion of the manufacturing plants in the region, and we cannot say that it is a representative sample.

However, as discussed later, the results generally accord with theoretical expectations so we are encouraged to believe that they are realistic. They are certainly sufficiently realistic for illustration of the development and interpretation of local-ness indices. Industry scale analysis cannot reveal the important interactions between individual plants. In this research, interactions among individual plants are examined in the following four different ranges:

- less than 2 miles
- between 2 miles and 5 miles
- more than 5 miles but within the Metro. Area
- outside the Metro. Area

A local-ness index is computed for each plants interaction with each other economic actor.

The index is of the form:

$$LI = 1*(\% < 2\ miles) + 0.0075*(\%2\text{-}5\ miles) + 0.0025*(\%5miles - Metro.\ Area) \quad (4)$$

This produces local-ness index values that range from 1 to zero. If, for example, a plant obtains all of its payroll services within 2 miles of the plant, it has a local-ness index of 1 for that service. If all of the service is obtained outside the metropolitan area, the index is zero. If 50% of the service is obtained within 5 miles, and the remainder from outside the metropolitan area, the index is .375. The absolute values of the indexes will provide evidence on the robustness of the local industrial district argument. The relative values will indicate if a plant or service, an input or output is especially well connected locally.

Information from 71 individual manufacturing plants in the Cincinnati Metropolitan Area allows tests of local vs. non-local interactions. Table 1 and Figure 5 reveal that material outputs have the lowest the local-ness index, and the next lowest is material inputs. This leads to low local-ness index (0.17) for vertical linkages.

Producer services have the highest local-ness index (0.46), followed by collaborations and information contacts. The local-ness of horizontal

Table 1. Linkage structures based on distance from plants: local-ness indices

(unit: %)

Regional Scale	Material Input	Material Output	Total Input/Output	Information	Collaborations	Producer Services
Within 2 miles	3.9	0.99	2.45	5.03	2.51	6.35
2-5 miles	16.13	6.93	11.53	18.21	22.67	49.22
5 mi-metro. area	19.34	18.25	18.79	18.31	18.64	14.33
Within 5 miles	20.03	7.92	13.98	23.24	25.18	55.57
Within metro area	39.37	26.17	32.77	41.55	43.82	69.9
Out of metro area	60.63	73.83	67.23	58.45	56.18	30.1
Local-ness	0.21	0.11	0.16	0.23	0.24	0.47

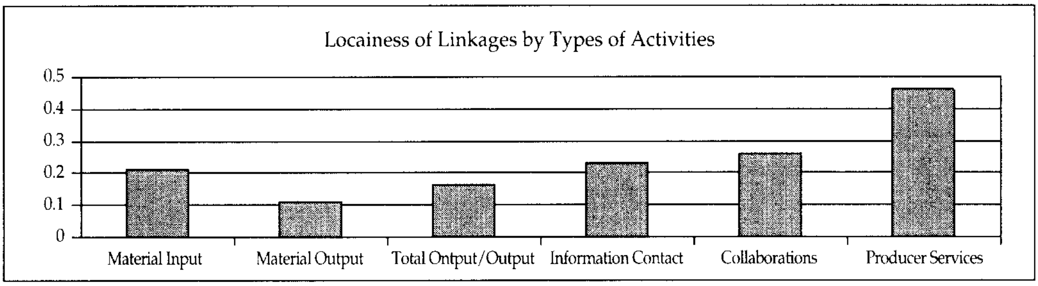

Figure 5. Local-ness of vertical linkages and horizontal linkages

linkages as a whole can be represented as the average (0.3) of the above three indices. Obviously, horizontal linkages are more locally oriented than vertical linkages.

Table 1 also shows that significant amounts of interactions occur within the metropolitan area, but do not occur at sub-regional scales within the Metro. Area.

3) Local-ness of labor force

Local-ness of labor force can be measured by the average distance between workplace and residence of employees, which in turn can be converted to a local-ness index. Information from 71 individual manufacturing plants of the Cincinnati Metropolitan Area allows a test of the degree of local-ness of labor force.

In terms of labor force, most employees commute to work between 15 to 30 miles (Table 2). It can be concluded that the "labor shed" is the metropolitan region, which is proximately a circular region centered on downtown Cincinnati with a radius of 35 miles.

The 15 - 30 miles fall into the range of "more than 5 miles" but within the metropolitan area. Using formula (3), the local-ness index of labor force is approximately 0.25.

Table 2. Labor linkages by employment size

Employment Size	Total of Plants	Subtotal(miles)	Average (miles)	Ranges (miles)
Total	70	1409	20.42	5~50
Less than 50	46	927	19.72	5~50
50~100	9	189	21.00	5~42
100~500	12	203	16.92	8~30
500~1,000	2	60	30.00	10~50
Greater than 1,000	1	30	30.00	30

4) Calculation of a composite industrial district index

A general definition of the industrial district index is given in equation (1). The function f in equation (1) is unknown. In this study, we use a weighted linear combination: Following the above, the all-manufacturing spatial proximity indicator for the Cincinnati Metropolitan Area is 0.22 (nearest neighbor index), the local-ness of vertical linkages is 0.17, the local-ness of horizontal linkages is 0.3, and the local-ness of labor force linkages is 0.25. A numeric value can be calculated for the industrial district index based on formula (1), or a TRUE and FALSE value can be derived from (2) if the threshold values are provided. However, realistic threshold values can only obtained from future comparative studies of multiple industrial regions.

$$IDI = WSP*SP + WVL*VL + WHL*HL + WLL*LL \quad (5)$$

Subject to: $WSP + WVL + WHL + WLL = 1$

where *WSP, WVL, WHL and WLL* are the weights of their corresponding factors. Since the range of SP, VL, HL and LL is 0 to 1, the value of IDI will range from 0 to 1. A larger IDI value indicates a higher degree to which an industrial region can be viewed as an industrial district.

Following the calculations in the above section, the SP for all-manufacturing is 0.90, the local-ness of vertical linkages is 0.16, the local-ness of horizontal linkages is 0.31, and the local-ness of labor force linkages is 0.25. Assuming the weight is 0.25 for each of the four factors, we can calculate the IDI for the Cincinnati metropolitan area as

$$\text{IDI Cincinnati} = 0.25*0.9 + 0.25*0.16 + 0.25*0.31 + 0.25*0.25 = 0.41$$

3. Results

Simply looking at the spatial proximity of plants and inferring that such simple clustering reveals anything about the interactions between the factories is not valid. *All* manufacturing within the metropolitan area is highly spatially clustered. There is no evidence of special spatial clustering by type of manufacturing. Simple spatial clustering is not unusual and does not vary significantly by type of manufacturing.

The distances between plants and the different economic actors with whom they interact, however, are useful data. The empirical evidence from the Cincinnati metropolitan area is in accord with expectations. Industrial location theory and experience indicate that the average travel distance for inputs and outputs will decline as the elements become more widely spatially available, or the friction of distance involved in the delivery of the product or service increases. Material inputs and market locations are most likely to be specialized and spatially scattered. Producer services are spatially more widely available, and there often are personal contact components involved in vendor selection or service use involved. Personal contacts often are also important for collaborations and information transmission. Labor faces high friction of distance. Thus, the results in this research that the local-ness index for supply chain (vertical) linkages is lower than for the producer services, information and collaborations (horizontal) linkages, and for labor are expected. These reasonable results indicate that the sample data are realistic and also that the methodologies employed are useful.

1) Metropolitan scale and industrial district

The appropriateness of thinking of a metropolitan sized or smaller region as an industrial district is questionable:

- -The industrial district concept has no validity at a sub-metropolitan scale.
- -The interactions between firms and those with whom they do business often are beyond the metropolitan area, so it is difficult to make a strong argument for the metropolitan region as an industrial district.
- -The metropolitan region is too small an area to show industrial districts as traditionally measured via material inputs and product sales vertical (supply chain) linkages.
- -The within-metropolitan linkages are more apparent in the exchange of information, the utilization of local contacts, and the use of local producer services. At the metropolitan scale, the horizontal links are much more important than the vertical links between firms.
- -Of the firm-to-firm linkages, only producer services are mainly sourced (70%) within the metropolitan region.
- -An exception is labor. The metropolitan region is the appropriate spatial frame for analysis when the focus is labor supply or employment opportunities.

If the major concern is for labor, and there is evidence that labor skills and availability and technology transfer among workers are the most critical factors now determining regional economic prosperity, then the metropolitan region is an appropriate size for designation as an industrial district. This, of course, might have been expected since in the United States metropolitan regions are defined by labor force journey-to-work patterns. Others have found this scale useful in regional economic development analyses (Bartik, 1991; Hicks and Rees, 1993). The relatively high local-ness index for producer services reinforces these arguments for the metropolitan area as an industrial district in these restricted dimensions.

The metropolitan area is not a satisfactory scale for industrial district designation when the emphasis is on traditional supply chain linkages. Inputs and outputs have spatial fields far beyond the city. Somewhat surprisingly, the informational contacts and collaborations also appear to be mainly beyond the metropolitan region. This may be a data deficiency, or it may be a consequence of specialized intra-industry knowledge fields, which operate nationally or even internationally. More careful exploration of this issue is necessary.

Coe and Townsend argue that localized agglomerations are a myth, and that the service economy of Southeast England operates on a large region basis (1998). The results of this research generally support their position. There is no evidence that local has any real operational meaning at the within metropolitan scales. The smallest viable region is the metropolitan, and only for certain types of interactions. Most linkages operate beyond the metropolitan area. McLean (1996) observes that defining a region is one of the most difficult tasks planning practitioners face (1996, 189). This research confirms why it is so difficult. There is no one spatial scale that fits all circumstances. We probably cannot answer Gertlers question how do we recognize a true industrial district when we see one? because there is no such thing as a true industrial district with a single and simple geographic boundary.

This research provides something more important than identification of simple single bounded industrial districts. It provides methodologies to conduct analyses of regions regarding their varying degrees of local-ness for horizontal and vertical linkages or labor, collectively and independently. Thus, analysts can approach questions such as Do more successful regions have higher degrees of local-ness for supply chain linkages than less successful regions, or vice-versa? or Are local-ness indices for vertical linkages inversely related to horizontal indices? It also is possible to systematically address the relationships between changes in local-ness and changes in spatial scale.

2) Local-ness indices

The local-ness indices objectively identify components of industrial districts. The Industrial District Index (IDI) is a function of spatial proximity (SP), local-ness of vertical linkages (VL), horizontal linkages (HL) and labor force linkages (LL). It has paved the way for future large-scale comparative studies to establish baseline values for IDI, SP, VL, HL and LL. These can be used to indicate the degree to which any area demonstrates industrial district characteristics, and/or to determine the relative local-ness of the components.

Comparative studies are needed to establish benchmarks for baseline values of SP, VL, HL, labor LL, IDI.

In this research, IDI is represented as a weighted linear combination of SP, VL, HL and LL. Other expressions of IDI may be useful as well. Comparative studies are needed to test the stability and sensibility of the function for IDI.

Reference

Bartik, T. J., 1991, *Who Benefits from State and lLocal Economic Development Policies?*, Kalamazoo: UpJohn Institute.

Capello, R. and Nijkamp, P., 1997, Telecommunications network externalities and regional development: empirical evidence, in Bertuglia, Lombardo and Nijkamp, *Innovative Behaviour in Space and Time*, Berlin: Springer.

Chinitz, B., 1960, Contrasts in agglomeration: New York and Pittsburgh, *American Economic Review: Papers and Proceedings*, 40, 279-289.

Cincinnati Industrial Pinpointer, 1993, Alexandria, KY: Industrial Map Co.

Coe, N. M. and Townsend, A. R., 1998, Debunking the myth of localized agglomerations: the development of a regionalized service economy in South-East England, *Transactions of the Institute of British Geographers*, 23 (3), 385-404.

Doeringer, P. B. and Terkla, D. G., 1995, Business strategy and cross-industry clusters, *Economic Development Quarterly*, 9 (3), 225-237.

Gertler, M. S., 1992, Flexibility revisited: districts, nation-states, and the forces of production, *Transactions of the Institute of British Geographers*, 17, 259-278.

Harrison, B., 1998, It takes a region (or does it?): the material basis for metropolitanism and metropolitics, Paper prepared for the conference, *Urban-Suburban Interdependence: New Directions for Research and Policy*, co-sponsored by the Great cities Institute of the University of Illinois, the Lincoln Institute of Land Policy, and the Center on Urban and Metropolitan Policy at the Brookings Institution, Chicago, IL, September 24-25, 1998.

Held, J. R., 1996, Clusters as an economic development tool, *Economic Development Quarterly*, 10 (3), 249-261.

Hicks, D. A. and Rees, J., 1993, Cities and beyond: a look at the nations urban economy, in Sommer, J. and Hicks, D. A. (eds.), *Rediscovering Urban America: Perspectives on the 1980s*, Washington, D.C.: US Department of housing and Urban Development.

Hill, E. W., 1998, World-class productivity: Basis for the industry week formula, *Industry Week*, April 6, 1998.

Krugman, P., 1991, *Geography and Trade*, Cambridge, MA: MIT Press.

Laulajainen, R. and Stafford, H. A., 1995, *Corporate Geography: Business Location Principles and Cases*, Dordrecht: Kluwer Academic

Publishers.

Maki, J. and Maki, W., 1994, Economic role of university-industry collaboration in a regional medical devices industry cluster, Paper prepared for the North American Meeting of the Regional Science Association.

Malecki, E. J., Tootle, D. M. and Young, E. M., 1995, Formal and informal networking among small firms in the USA, Paper prepared for the Annual Meeting of the Association of American Geographers, Chicago.

Malmberg, A., 1996, Industrial geography: agglomeration and local milieu, *Progress in Human Geography*, 20, (3), 392-403.

Markusen, A., 1994, Studying regions by studying firms, *The Professional Geographer*, 46 (4), 477-490.

McLean, B. M., 1996, Studying regional development: The regional context of development, *Economic Development Quarterly*, 10 (2), 188-198.

Nadvi, K. and Schmidz, H., 1994, *Industrial Clusters in Less-Developed Countries: a Review of Experiences and Research Agenda*, Institute of Development Studies, Discussion Paper 339. [62].

Piore, M. and Sable, C., 1984, *The Second Industrial Divide*, New York: Basic Books.

Porter, M. E., 1990, *The Competitive Sdvantage of Nations*, New York: Free Press.

Rees, J. and Stafford, H. A., 1986, Theories of regional growth and industrial location: their relevance for understanding high-technology complexes, in Rees, J. (ed.), *Technology, Regions, and Policy*, Totowa, NJ: Rowman & Littlefield.

Saxenian, A., 1994, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Cambridge, MA: Harvard University Press.

Scott, A. J., 1988, *New Industrial Spaces: Flexible Production, Organization and Regional Development in North America and Western Europe*, London: Pion.

Sforzi, F., 1989, The geography of industrial districts in Italy, in Goodman, E. and Bamford, J. (eds.), *Small Firms and Industrial Districts in Italy*, Routledge.

Sweeney, S. H. and Feser, E. J., 1998, Plant size and clustering of manufacturing activity, *Geographical Analysis*, 30 (1), 45-64.

Taylor, P. J., 1977, *Quantitative Analysis in Geography: an Introduction to Spatial Analysis*, Boston: Houghton Mifflin Company.

Wheat, L., 1973, *Regional Growth and Industrial Location*, Lexington, MA: D. C. Heath & Co.