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G. Andrew Bernat Jr.
U.S. Department of Commerce

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G. Andrew Bernat, Jr.
Regional Economic Analysis Division
Bureau of Economic Analysis
U.S. Department of Commerce

Abstract Along with the recent resurgence of interest in the agglomeration and clustering of economic activity, there has been increasing interest in industry clusters as a potential economic development strategy. Ultimately, the question of whether or not clusters are an appropriate focus of economic development strategies for rural areas depends on the relationship between clusters and local economic growth. The primary purpose of this paper is to discuss some of the issues involved in measuring the relationship between clusters and rural economic growth. Preliminary evidence of a positive association between industry clusters and rural earnings growth are presented, supporting the notion that a cluster-focused development strategy may be effective in some rural areas.

Along with the recent resurgence of interest in the agglomeration and clustering of economic activity, there has been increasing interest in industry clusters as a potential economic development strategy. This interest is motivated by two general trends. First, recent research suggests that the rapid pace of technological change has altered the economic environment in ways that give establishments located in clusters a competitive advantage over establishments located in relative isolation (Malecki 1991:252; Stöhr 1986:29; and Porter 1995:58). To the extent that this is true, rural establishments, which are by definition in relatively isolated locations, will increasingly be at a competitive disadvantage vis-à-vis establishments in urban areas.

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Second, there is increasing dissatisfaction with what might be called the traditional economic development strategy of industrial recruitment or "smokestack-chasing" -- the use of tax rebates, infrastructure development, special training programs, and other inducements to attract firms to an area -- as an economic development strategy. This strategy is now viewed by many economic development specialists as a strategy with not only a relatively high probability of failure but also one with a relatively low net return even when successful because competition with other localities tends to raise the cost of incentives that must be offered to successfully attract a new plant or business (Sears and Bernat 1998:12 and Isserman 1994). In addition, plants that are susceptible to locational incentives may well relocate to yet lower-cost places in the future.

A strategy of encouraging clusters, in contrast, is perceived to be both more likely to produce positive results and to be more cost-effective than smokestack chasing because the external economies associated with clusters provide built-in incentives for the firms and establishments that are part of the cluster to remain in the area. In addition, these same external economies will help attract additional firms and establishments. The reasoning (or hope) goes, once a cluster is established, it will maintain itself rather than depend on government assistance to retain its viability.[1]

Ultimately, the question of whether or not clusters are an appropriate focus of economic development strategies for rural areas depends on the relationship between clusters and local economic growth. The purpose of this paper is to discuss some of the issues involved in measuring the relationship between clusters and local economic growth. No attempt is made to provide definitive answers to any of these questions. Instead, the goal is the more modest one of identifying the key issues involving clusters and rural growth and to present some preliminary findings on the association between industry clusters and earnings growth.

[1]As pointed out by one reviewer, clustering can also be part of an industrial recruitment strategy, where firms are recruited based on an assessment of how well they fit with existing clusters. However, the extent to which clusters contribute to the success of this type of industrial recruitment will be a function of the issues discussed in this paper.

The next section is a brief review of the literature on clusters and their role in regional economic growth. The following section discusses how clustering might benefit rural labor markets and summarizes some of the available empirical evidence. The final section concludes the paper with some thoughts on further work.

What are Clusters and Why do They Exist?

The terms cluster and clustering appear in a wide range of contexts in the regional economics and geography literature. Sometimes, especially in the urban growth literature, the terms are used synonymously with the more general term agglomeration and refer to large, diverse concentrations of economic activity. In other contexts, clusters are defined narrowly to refer to groups of firms and establishments located in close proximity that are closely connected in networks, where networks are defined as "cooperation among firms to take advantage of complementarities, exploit new markets, integrate activities, or pool resources" (Rosenfeld 1995).

For this paper, I take an intermediate view and define an industry cluster as a group of establishments in the same or closely related industry, located in close proximity to each other, whether or not they are connected in the sense of forming a network. Networks and clusters often go together but they are conceptually distinct. Networks involve formal or informal interactions among the establishments in the network (Harrison 1992). Clearly proximity is likely to facilitate networking but distance does not rule out the effective operation of a network (Malecki and Tootle 1996). Industry clusters, in contrast, are based only on proximity. As I hope will be clear from the following discussion, no direct interaction among establishments within a cluster is necessary for the existence of cluster-related externalities because many such externalities operate through the market.

The notion that similar industries cluster together is hardly new, having been described in the general economic literature at least as far back as Marshall's *Principles* (Mulligan 1984). Following Marshall, industries cluster for three basic reasons, all related to minimizing costs. First, industries cluster in order to reduce transportation costs. Because transportation costs for some goods and services are very high, the location of establishments in

some industries is largely dictated by the location of either their primary inputs or the markets for their outputs. For example, the location of extractive industries such as mining and logging will be determined largely by the location of mineral deposits and forests. Similarly, service-producing industries that require face-to-face communication between service producer and customer will tend to locate close to their customers.

The location of establishments for which the lowest-cost location is not dictated by the location of inputs or markets for outputs, often called footloose establishments, involves a more complicated balancing of transportation costs and other costs. Recent work has shown that establishments in an industry will tend to cluster for a wide range of transportation costs as long as there are increasing returns to scale in production (Krugman 1991; Puga 1999; Venables 1996).

Second, industries cluster to reduce labor costs. Clustering may reduce labor costs by increasing the local labor supply or by increasing labor productivity. The local labor supply may increase as a result of Marshallian risk pooling. If workers are risk averse, they will tend to be attracted to areas with many potential employers because a large number of employers in a labor market shields workers, at least to some degree, from fluctuations in employment levels of individual employers. By increasing labor supply, Marshallian risk pooling tends to reduce wages, everything else being equal (David and Rosenbloom 1990).

Clustering will also result in lower labor costs because it raises labor productivity. This effect is particularly important because with higher labor productivity, wages can be higher at the same time that labor costs per unit of output are lower. Clustering may raise labor productivity in two different ways. Labor markets for industry clusters will tend to have a relatively larger pool of labor with specialized skills appropriate for the particular industry composing the clusters. Establishments will thus find it easier to obtain workers with skills that closely match their job requirements than would otherwise be the case. Because labor productivity is likely to be positively related to how closely worker skills match job requirements, average labor productivity will be higher in clusters than outside clusters, even if workers have very similar skills and abilities.

Clusters also appear to enhance worker skills. Among the more important ways in which workers improve their knowledge and skills are on the job training and learning from other workers. An individual's skills will improve faster the more often the individual works with high-skilled workers. In other words, human capital, and the rate of increase in human capital, are both hypothesized to be functions of the density of economic activity (Gibbs and Bernat 1997b; Glaeser and Mare 1994; Jovanovic and Rob 1989; Rauch 1993). Rural industry clusters, being locations where economic activity is relatively dense, may therefore contribute to greater levels of human capital, and therefore to higher labor productivity and wages, than would otherwise be the case.

Third, industries will cluster in order to take advantage of what are called "knowledge spillovers" from nearby establishments. The term knowledge spillover refers to the spread of information about technology or markets from one firm or establishment to another. For example, suppose a firm develops an improved method of producing a particular product. A knowledge spillover occurs when other firms find out about the new method and use it to improve their production process. Because many knowledge spillovers occur informally, for example when workers employed by the innovating firm take jobs at other firms or managers of firms meet outside of work-related meetings, they are more likely to occur among establishments located in clusters than among isolated establishments.

When knowledge spillovers occur, innovations spread among establishments, raising the productivity of both capital and labor throughout the cluster. By nature, knowledge spillovers are not readily observable and are therefore difficult to measure and quantify. Nevertheless, their existence is widely accepted. For instance, commonly cited examples of clustering based on knowledge spillovers are the computer and related establishments in the Silicon Valley of California and the Route 128 corridor in Massachusetts, the financial district in New York City, and carpet manufacturers in Dalton, Georgia.

Clustering generates both positive and negative externalities. The three broad reasons for clustering just discussed produce positive externalities that are increasing functions of the size of the cluster. In other words, the greater the number of establishments

in a cluster, the greater the cost and productivity advantages for an individual establishment. Negative externalities, however, are also produced. As the number of establishments in a cluster grows, costs are also likely to increase due to increased competition among the establishments in the cluster for land and labor, and increased costs associated with congestion. The existence of such negative externalities ensures that clusters do not grow without bound, although the exact limits are likely to differ among industries.

How do Clusters Benefit Rural Labor Markets?

The potential benefits of clustering to rural labor markets mirror the benefits to establishments in the industry cluster (Barkley and Henry 1997). The most obvious way in which clustering is likely to benefit rural labor markets is to contribute to a more stable economic base. To the extent that clustering makes local establishments more competitive, firms and establishments in the cluster are more likely to share in any industry-wide growth and less likely to be affected by industry-wide downturns. For some industries, innovation is likely to be higher in clusters than outside clusters, especially if the clusters also involve networks. Such innovation is likely to provide competitive advantages beyond any Marshallian externalities to the firms and establishments in the cluster. Clusters will thus provide better job growth and retention because clustered local establishments will tend to be more competitive than establishments outside clusters.

Marshallian risk pooling also has benefits to rural labor. Because there are more firms in the local economy, an individual worker is less dependent on an individual firm for employment. Consequently, workers are at least partially protected from idiosyncratic fluctuations in employment opportunities associated with individual firms. Finally, while workers may be willing to work for lower wages because of the risk-pooling aspects of clusters, they may actually receive higher wages than they would outside of clusters. Because both labor and capital are more productive in clusters, firms may pay higher wages. Recent research provides support for this hypothesis by finding that rural

and urban workers both acquire human capital at higher rates in clusters than outside of clusters (Gibbs and Bernat 1997a).

Measuring the Relationship Between Economic Growth and Rural Industry Clusters

I now turn to the question of whether any of these purported advantages are observable. If the theoretical literature on clusters is correct, the externalities associated with clustering will confer competitive advantages on the firms and establishments located in the cluster. These competitive advantages should result in better growth during upturns and more moderate declines in downturns, a result that is particularly important for rural areas because rural areas do not have well-diversified economies.

Before one can begin to look for a relationship between clusters and economic performance, a procedure for identifying clusters has to be developed. The first step is to decide what industries will be considered. From the above discussion of the reasons firms cluster, any group of industries that have similar labor requirements, that use similar production technology, or that are linked in an input-output sense can be part of an industry cluster. Because of the difficulty of combining information on input-output linkages with a measure of spatial proximity, studies of clustering have limited consideration to establishments in the same Standard Industrial Commission (SIC) industries.

The second step is to decide what measure, or measures, of an industry's presence in a location to use as a basis for determining if a cluster exists. Some studies have used employment or employment density as a measure of clustering but I argue that the number of establishments is the more relevant of the two measures of an industry's presence in a local economy. While these two measures will tend to be highly correlated, the reasons why firms cluster involve externalities that are related primarily to the number of establishments rather than to the number of workers. For example, Marshallian risk pooling and knowledge spillovers would not exist with a single establishment, even if it employed a large number of workers, but could exist if there were many small establishments.

The third step is to determine how close establishments need to be to constitute a cluster. In principle, establishments are close enough to be considered in a cluster if they create local externalities that lower costs for all establishment in the cluster. The determination of how close is close enough is thus an empirical issue as theory provides little or no guidance. In this regard it is worth noting that no attempt is made to measure the activities or phenomena that create clusters, such as networking or knowledge spillovers, but rather we are attempting to measure the extent to which establishments are more clustered than would be expected if location occurred randomly. Furthermore, to the extent that there is a gradual attenuation of clustering forces with distance, the identification of discrete clusters is somewhat arbitrary.

Three different approaches have been used to identify clusters.[2] First, some studies have used total employment or employment density as a measure of clustering in regression analyses. This approach is simple to implement but will tend to miss clusters if the spatial units are small because it ignores the effects of neighboring spatial units. It will also tend to over-estimate the number of clusters if the spatial units are large because there is no way to determine if establishments within a particular unit are close to each other. A more serious shortcoming from the current perspective is that this approach doesn't really measure clusters at all. The notion that clusters have a positive impact on economic growth is based on the idea that clusters are a discrete phenomena that either exist or do not exist. Hence, continuous variables are inappropriate proxies for clusters.[3]

[2]A few studies have tried to measure the degree to which an industry is geographically concentrated (what can be called a global indicator of spatial association) without identifying individual clusters. The indexes employed in these studies are not directly relevant to the issue at hand and so are not considered here. See for example Barkley and Henry's (1997) use of the locational Gini and Ellison and Glaeser's (1997) index based on employment shares and a Herfindhal index of industry concentration.

[3]To be fair, many studies use employment in this way as a proxy for more general agglomeration effects rather than for industry clusters, as defined here. But, because agglomeration and clustering are frequently used synonymously, it seems appropriate to mention this method.

Barkley, Henry, and Kim take a second approach, using standard cluster analysis to identify clusters in the Component Economic Areas (CEAs) defined by the Bureau of Economic Analysis (BEA) (Barkley, Henry, and Kim 1999; Johnson 1995). Their procedure is substantially superior to the simple use of employment for two reasons. First, it explicitly identifies clusters so economic performance of a local economy can be associated with the presence or absence of a cluster. Second, their procedure takes into account the number of establishments as well as employment (they also include location quotients in their cluster analysis). As I argued above, the number of establishments is, if not the primary attribute of a cluster, certainly a key attribute.

A third approach is to use what are called local indicators of spatial association (LISA) such as the local Moran (Anselin 1995). These statistics indicate whether significant spatial clustering of similar values occurs around each observation. The use of a LISA has two advantages compared to other measures found in the literature. First, a LISA explicitly measures the degree to which observations of similar values are located near each other, which is the essence of a cluster. Second, the statistical properties for a number of LISAs have been analyzed and documented so it is possible to determine if the observed clustering is statistically significant.

While there have been numerous studies over the years that have tried to estimate productivity advantages of industry clusters at a point in time (static externalities), only recently have researchers begun to focus their attention on how industry concentrations affect industry growth over time (dynamic externalities)(Beardsel and Henderson 1999; Glaeser, Kallal, Scheinkman, and Schleifer 1992; Henderson 1999; Moomaw 1998). These studies focused almost exclusively on either states or metropolitan areas and so provide little direct evidence pertinent to rural clusters. However, three studies that have attempted to explicitly measure the relationship between economic performance in rural areas and the presence or absence of clusters have found significant, though sometimes small, effects on local growth. Barkley, Henry, and Kim (1999) looked at the effect of clusters on job growth in nonmetropolitan portions of CEAs. One of their principal findings was that job growth and job losses were greater when a cluster was present than

when there were no clusters. This suggests that rural clusters may not have the stabilizing effects that would be expected if clusters improve the competitiveness of the establishments in the cluster. Second, in a study that looked at the effect of manufacturing on county growth, I used the local Moran to identify clusters and found that the presence of clusters was positively related to both job and population growth. The effect was statistically significant although not large, and was more pronounced for metropolitan counties than nonmetropolitan counties (Bernat 1996). Third, the presence of clusters has been shown to be associated with higher wages in local labor markets, even after accounting for characteristics of individual workers (Gibbs and Bernat 1997a).

Before closing, I would like to present some preliminary results from a study that uses the local Moran, one of the most widely used LISAs (discussed above), together with a finer spatial resolution for identifying clusters than has been used in the past. As discussed above, one of the key issues involved in identifying clusters is deciding how close establishments must be to be considered part of a cluster. Because the distance chosen for any analysis is constrained by the size of the smallest spatial unit used, all previous studies have been limited by the use of county data. In other words, using counties as the basic spatial unit means that it is not possible to distinguish between a situation in which the number of establishments are uniformly distributed across a county and one in which all the establishments are located in one location within the county. Using zip code data permits the identification of clusters within counties. An additional advantage of zip code data is that unlike counties, zip codes are not political boundaries and may more closely reflect the relative density of economic activity than do counties.

For this analysis I used data from the 1987 Census of Manufactures for electronic and other electrical equipment (SIC 36) and instruments (SIC 38) in the twelve states composing BEA's southeast region (U.S. Bureau of the Census 1997). I calculated local Moran statistics for two digit manufacturing industries using the following formula (Anselin 1995):

$$LM_i = \frac{(X_i - \bar{X})}{\sum_j (X_j - \bar{X})^2} \sum_j w_{i,j}(X_j - \bar{X})$$

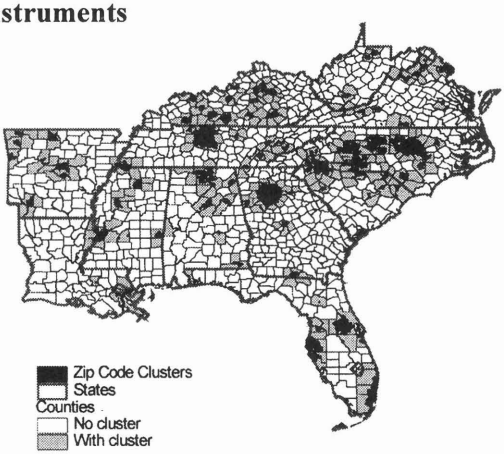
where LM_i is the local Moran for zip code i, x_i and x_j are the number of establishments in zip codes i and j, respectively, $\bar{x}$ is the mean number of establishments for all zip codes, and w is the spatial weights matrix. The spatial weights matrix has a row and a column for each zip code. If two zip codes are "neighbors," defined as having centroids 25 miles apart or less, the corresponding element of w is equal to one. If the zip codes are not neighbors, the element of w is zero. The spatial weights matrix used in calculating the local Moran is normalized so that the sum of each row is equal to one.

A particular zip code was considered to be part of a cluster for a given industry if the local Moran was significant at the 5-percent level or better, where the significance level was determined using a normal approximation. Because of the large number of observations (over 7,400) the normal approximation was deemed appropriate. If the local Moran statistic for a given zip code and industry was statistically significant, counties that include or are contiguous to the zip code were considered to be part of the cluster.

As discussed above, theory provides no clear guidance regarding the appropriate distance to use in defining w so the use of 25 miles as the cutoff distance is admittedly arbitrary. At first glance, 25 miles might seem too close, especially for rural areas. However, this is the straight-line distance and this will often be substantially shorter than the highway distance, which is a more relevant measure of distance in terms of interactions.

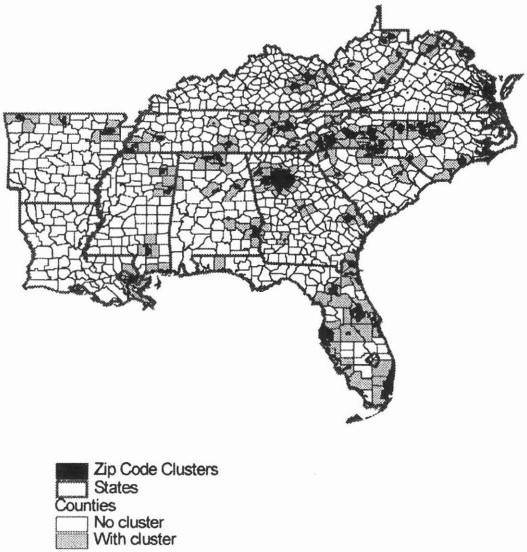
Figures 1 and 2 show the zip codes that were identified as clusters for instruments and electronic and other electrical equipment, respectively. The relatively fine resolution of the clusters is evident by the fact that many clusters encompass only portions of counties. The urban nature of many of the clusters is also evident by the instrument clusters in Atlanta, Tampa, and Miami, and the electronic and other electric equipment clusters in Atlanta, Nashville, Orlando, and Raleigh-Durham. The maps also show the counties that either include or that are contiguous to these zip codes. It is necessary to identify these counties because the data

Figure 1. Instruments



Source: U.S. Bureau of the Census. 1997. 1992 Economic Census CD-ROM ZIP Code Statistics, Data User Services Division. August. Washington, D.C.: U.S. Department of Commerce.

Figure 2. Electronic and Other Electrical Equipment



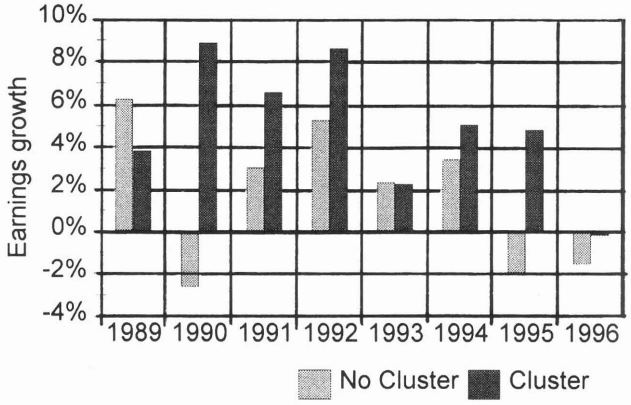
Source: U.S. Bureau of the Census. 1997. 1992 Economic Census CD-ROM ZIP Code Statistics, Data User Services Division. August. Washington, D.C.: U.S. Department of Commerce.

needed for calculating the growth in earnings is available only at the county level.

Using unpublished data from the Regional Economic Information System, or REIS (U.S. Bureau of Economic Analysis 1997), I calculated annual growth rates for earnings in industries SIC 36 and 38 for counties with a cluster and counties without a cluster. Figure 3 shows that for the instruments industry, the growth rate for the instruments industry earnings was higher in counties with a cluster in seven of the eight years, clearly suggesting that the presence of a cluster may enhance industry growth prospects for these counties. In contrast, no such relationship is evident for electronic and other electrical equipment (figure 4). Industry earnings growth in counties with clusters was higher than in counties without clusters in only the first two years of the period.

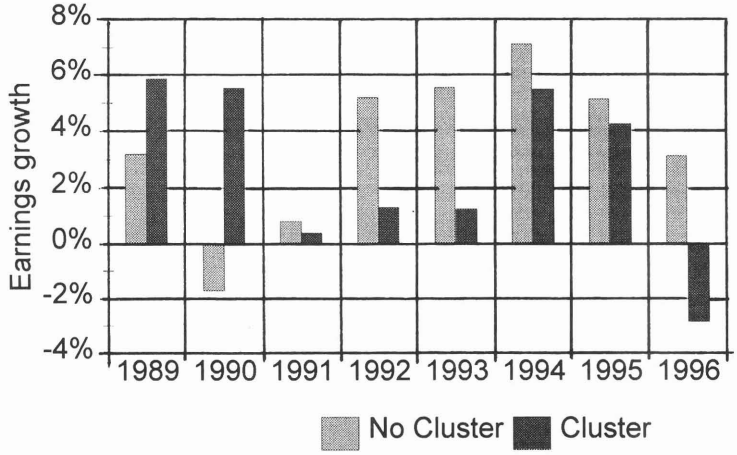
These results are consistent with previous work and indicate that economic growth might be enhanced by the presence of clusters but that such a relationship differs by industry. That clustering effects might be different for different industries is not particularly surprising. For instance, clustering is likely to be more important for industries that require skilled and specialized labor

Figure 3. Rural Earnings Growth in Instruments Higher in Clusters



Source: U.S. Bureau of Economic Analysis. 1998. Unpublished data from *The Regional Economic Information System* (REIS).

Figure 4. Rural Earnings Growth in Electronics Lower in Clusters



Source: U.S. Bureau of Economic Analysis. 1998. Unpublished data from *The Regional Economic Information System* (REIS).

labor or for industries with rapidly changing technologies and less important for industries that use relatively unskilled labor or that are producing products for which technology is relatively stable.

Obviously, the results presented here are only suggestive. A thorough analysis requires that a host of other factors that affect local economic growth be considered before reaching any conclusions regarding the relationship between economic growth and the presence of industry clusters.

Conclusion

Although there is still relatively little solid evidence regarding the role of agglomeration and industry clustering in local economic growth, the generally positive findings represent both bad news and good news for rural areas. That agglomeration and clustering appear to be important in industry growth is bad news in the sense that it means rural areas will always be at a significant disadvantage compared to urban areas. The good news is that the most important effects seem to be due to industry clustering and not

general agglomeration. This is good news because industry clusters can and do occur outside urban areas. In terms of rural development policy, the mixed results indicate that, at least for some rural areas, policies directed at creating and fostering industry clusters may provide a significant boost to local economies. However, these policies would have to be carefully crafted and targeted because they will not be successful for every industry or for every community. A better understanding of industry clustering is needed in order to more accurately predict which industries and which areas are most amenable to cluster-based development initiatives.

While there is as yet no definitive answer to the question of whether or not industry clusters can provide a boost to rural job and wage growth, there is sufficient empirical support for continued research. This paper has focused largely on the measurement of clusters using what might be called secondary source data. A number of directions for further research have been indicated. For example, more research is needed into measures of clustering that take into account linkages among industries. More work also is needed in determining the appropriate spatial scale. In terms of investigating the relationship between clusters and growth, a more thorough analysis that takes into account the multitude of factors that affect local growth needs to be undertaken in order to identify the contribution of clusters to local economic growth.

The use of secondary-source data, as in the type of analysis described above, is useful in comparing a large number of local economies and in analyzing broad trends, but there are limits to how much it can tell us about clusters and their effects on rural labor markets. Consequently, a combination of secondary-source analysis and case studies, which are better able to tell us more about the formation and functioning of industry clusters, are needed if we are to improve our understanding of industry clusters and their effects on local economies.

References

Anselin, L. 1995. "Local Indicators of Spatial Association - LISA." *Geographical Analysis* 2:93-115.

Barkley, D., M. Henry, and Y. Kim. 1999. "Industry Agglomerations and Employment Change in Nonmetro Areas." *Review of Urban and Regional Development Studies* 11(3):168-186.

Barkley, D. and M. Henry. 1997. "Rural Industrial Development: To Cluster or Not to Cluster?" *Review of Agricultural Economics* 19:308-325.

Beardsel, M. and V. Henderson. 1999. "Spatial Evolution of the Computer Industry in the USA." *European Economic Review* 43:431-456.

Bernat, G. A. Jr. 1996. "Manufacturing and Rural Economic Growth." Presented at the 44th North American Meeting of the Regional Science Association International, November, Crystal City, VA.

David, P. A. and J. L. Rosenbloom. 1990. "Marshallian Factor Market Externalities and the Dynamics of Industrial Localization." *Journal of Urban Economics* 28:351-2.

Ellison, G. and E. L. Glaeser. 1997. "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach." *Journal of Political Economy* 105:889-927.

Gibbs, R. and G. A. Bernat, Jr. 1997a. "Rural Industry Clusters Raise Local Earnings." *Rural Development Perspectives* 12(3):18-25.

_____. 1997b. "The Wage Effects of Local Industry Clusters: An Analysis of Multi-County Labor Market Areas." Presented at the Southern Regional Science Association meetings, April 1997, Memphis, TN.

Glaeser, E. and D.C. Maré. 1994. "Cities and Skills," NBER Working Paper No. 4728, National Bureau of Economic Research, Cambridge, MA.

Glaeser, E., H. Kallal, J. Scheinkman, and A. Schleifer. 1992. "Growth in Cities." *Journal of Political Economy* 100:1126-1152 .

Harrison, B. 1992. "Industrial Districts: Old Wine in New Bottles?" *Regional Studies* 26:469-483.

Henderson, V. 1999. "Marshall's Scale Economies." Working Paper No. 7358, September 1999. National Bureau of Economic Research, Cambridge, MA.

Isserman, A. 1994. "State Economic Development Policy and Practice in the United States: A Survey Article." *International Regional Science Review* 16:80-81.

Johnson, K. 1995. "Redefinition of the BEA Economic Areas." *Survey of Current Business* 75 (February):75-81.

Jovanovic, B. and R. Rob. 1989. "The Growth and Diffusion of Knowledge." *Review of Economic Studies* 56:569-582.

Krugman, P. 1991. "Increasing Returns and Economic Geography." *Journal of Political Geography* 49:137-150.

Malecki, E. 1991. *Technology and Economic Development: The Dynamics of Local, Regional, and National Change*. New York: Longmans Scientific and Technical.

Malecki, E. and D. Tootle. 1996. "The Role of Networks in Small Firm Competitiveness." *International Journal of Technology Management* 11:43-57.

Moomaw, R. L. 1998. "Agglomeration Economies: Are They Exaggerated by Industrial Aggregation?" *Regional Science and Urban Economics* 28:199-211.

Mulligan, G. 1984. "Agglomeration and Central Place Theory: A Review of the Literature." *International Regional Science Review* 9:1-42.

Porter, M. 1995. "The Competitive Advantage of the Inner City." *Harvard Business Review* 73(May-June):58.

Puga, D. 1999. "The Rise and Fall of Regional Inequalities." *European Economic Review* 43(2):303-334.

Rauch, J.E. 1993. "Productivity Gains from Geographic Concentration of Human Capital: Evidence from the Cities." *Journal of Urban Economics* 34:380-400.

Rosenfeld, S. 1995. *Industrial Strength Strategies: Regional Business Clusters and Public Policy.* Washington, DC: The Aspen Institute.

Sears, D. W. and G. A. Bernat, Jr. 1998. *Business Assistance and Rural Development.* Rural Economy Division, Economic Research Service Staff Paper AGES No. 9519. September 1998. Washington DC: U.S. Department of Agriculture.

Stöhr, W. B. 1986. "Regional Innovation Complexes." *Papers of the Regional Science Association* 59:29.

U. S. Bureau of the Census. 1997. *1992 Economic Census CD-ROM: ZIP Code Statistics*, Disc 2B. Data User Services Division. August. Washington DC: U.S. Department of Commerce.

U.S. Bureau of Economic Analysis. 1998. *The Regional Economic Information System [REIS],* unpublished data. Washington DC: U. S. Department of Commerce.

_____. 1997. *The Regional Economic Information System, 1996. [REIS]* CD-ROM. June. Washington DC: U.S. Department of Commerce.

Venables, A. J. 1996. "Equilibrium Location of Vertically Linked Industries." *International Economic Review* 37:341-360.