MODELS OF THE GEOGRAPHICAL DIFFUSION OF MANUFACTURING IN ITALY

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1. Introduction: reasons for the study

In Italy, economic activity is very unevenly distributed over the national territory. There is a considerable variety of local development models, reflected in significant differentiation of economic performance by region. There are also a large number of territorially concentrated clusters of specialized small and medium-sized firms, grouped together in industrial districts. The districts have shown good and in some respects surprising capacity to penetrate foreign markets and to create jobs and economic growth.

Geographical disparities between macroregions have remained largely unchanged since the 1970s, although economic growth was buoyant indeed in some parts of the country.[1] The areas that achieved the fastest growth, such as the North-East of Italy, were also those with the strongest concentration of industrial districts. This fact suggests the possibility that Italian economic development is marked by sharp territorial polarization of growth, located especially in the industrial districts, which on this view represent the core of growth.

The recent literature has devoted considerable attention to the possibility of growth polarization. A number of theoretical models of convergence and territorial development suggest explanations of geographical disparities that refer to differences in clustering and specialization of firms between areas. The essence of these models consists in the mechanism whereby development spreads, which may either produce convergence, i.e. a reduction in economic disparities between different areas, or heighten differences.

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[1] See Fabiani and Pellegrini (1999).

This essay examines the diffusion of growth poles in Italy. This means inquiring not only into the mechanisms of the forces of convergence and divergence but also, indeed primarily, into its geographical dimension, i.e. the spatial course of development. This aspect receives little emphasis in the models developed to date. For example, core-periphery models entail a geographical polarization of growth, measurable by an index of concentration (Krugman, 1991). However, the ambit of these effects (local, regional, national) is not analyzed. In neoclassical models, moreover, the geographical aspects of growth tend to be ignored or at most treated marginally (Pellegrini, 2000). This approach does include a theory of territorial development, although often not in explicit form. On sufficiently general assumptions, in these models the free play of market forces produces an asymptotic distribution of locations of production that is homogeneous, i.e. not polarized, in space. The presence of poles of growth is thus not compatible with these models, at least in their baseline version.

The existence of growth polarization between areas, hence the ability to discriminate between theories and models, cannot be checked solely by overall indices of spatial inequality, such as the concentration indices. For the same level of overall geographical homogeneity of development is compatible with widely differing spatial configurations of firms and local development. One good example of this critique[2] is brought by Brugnoli and Fachin (2001). They note that, unless it is linked to a study of spatial correlation, the analysis of the process of concentration of development across areas will not be very informative about the type and mode of territorial development. In fact, the index of concentration does not consider the proximity or spatial clustering of areas of high concentration. The example given compares the rubber and paper manufacturing industries in Italy in 1991. Although their levels of concentration by province were very similar, the former was located mainly in the region of Lombardy while the latter was spread throughout the country. In order to discriminate between models of spatial diffusion, then, it is not enough to see how development is concentrated territorially; one must also see how it is propagated between relatively near if not contiguous areas.

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[2] For others, see Arbia (2000) and Barbieri *et al.* (2001).

Another important but often neglected question is how to determine the scale of closeness or contiguity. The forces that sustain clustering – factors such as transport costs, economies of scale and territorial spillovers – may differ in spatial intensity depending on sector and territorial configuration. This implies that indices of concentration and of spatial correlation calculated on a wide geographical grid (say, at the level of provinces or regions) and for the entire country will not capture phenomena of geographical diffusion that may create poles but that take place at local level. On the other hand, the use of too fine a grid increases the probability that the data will show spatial concentration. The lack of concentration at national level, therefore, is not in and of itself an indication that there is no spatial polarization along the lines of the core-periphery model. For example, whereas in the areas where clusters have already been formed firms may concentrate further, at the expense of adjacent areas, in the areas where such clusters have not been formed location processes may take alternative paths.

The question of whether or not the districts are at the origins of the polarization of growth in Italy thus requires us to identify the areas where there are clusters, and among them those with 'district' characteristics, and also to analyze the dynamics of the spread of development at local level around these growth poles, diversifying by sector.

This essay analyzes the territorial diffusion of growth in Italy in the second half of the 1990s, taking global and local effects into account. The objective is to discriminate, on the basis of empirical tests, between various theoretical models that can explain the way in which growth spreads. Further, the essay intends to determine whether certain types of clusters of manufacturing industry, identified by the use of statistical indices, can be poles attracting development at global or at local level.

There are three main innovations in this work with respect to the previous empirical literature. First, the analysis of the processes of diffusion is conducted on the basis of three different theoretical paradigms, not only the neoclassical and the core-periphery models, but also that of diffusion via contiguity. Second, in applying analyses of concentration and spatial correlation we explicitly consider the links of contiguity and closeness between areas at the local level, in order to capture the presence of poles of attraction also within relatively narrow geographical areas. This necessarily required the use of a fine territorial grid, which is the third new element in the present essay. We have elected to use the grid of 784 Local Labour Systems (LLSs) defined by Istat in 1991.[3]

The analysis focuses on manufacturing, for three main reasons: *i)* manufacturing is relatively footloose, not bound to a specific location of productive factors like farming or mining, and non-geographical location factors are important; *ii)* there is a vast literature, especially in Italy, on district and non-district manufacturing clusters, to serve as a basis of comparison; *iii)* it is possible to construct a sufficiently comparable and temporally extensive dataset on number of workers by industry and local labour system. The study, based on the censuses of industry, covers the period from 1951 to 1996.

The work is organized as follows. Section 2 briefly recapitulates the main characteristics of the three models of growth and location, in particular setting out their implications for empirical analysis of the diffusion of growth: the neoclassical model, the polarization model and the model of diffusion by contiguity. Section 3 notes the methodological problems with the data and the spatial grid used. Section 4 defines the different types of cluster used in the analysis. Section 5 studies the diffusion of manufacturing, by type of cluster, from 1951 to 1996, noting the points of contact and the differences with respect to the work on industrial districts of Brusco and Paba (1997). Section 6 carries the analysis further, disaggregating manufacturing into 15 industries. The last section presents conclusions concerning the models of diffusion by sector and the role of clusters in economic development.

2. Models of the territorial diffusion of growth

Growth economists' interest in location effects was revived principally by the introduction of core-periphery models originating with the pioneering work of Krugman (e.g. Krugman, 1991). Spatial considerations are naturally not a novelty in work on the development of

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3 The problems that may arise in the use of this grid are discussed below.

economic activity. Following the analysis of British industrial districts (Marshall, 1890), theories of firm location developed in the first part of the twentieth century, although they did not often intersect theories of growth, and the core-periphery models are in part their debtors.

The extension of the neoclassical theory to the spread of development in space was mainly the work of the German school, with the contributions of Christaller (1933) and Lösch (1954). This school took up the concepts of neoclassical theory and applied them to the geographical distribution of economic activity. The conclusion was that markets are identified with central locations which, if the population is distributed evenly over the territory, will also be spread evenly in the economy. These results have been extended to the case of spatial heterogeneity of agents and capital stock (Brito, 2003). Spatial homogeneity is also implicit in the results of the neoclassical model of growth across nations and regions, which posits that the less developed economies will grow faster than the developed ones. The 'pure' neoclassical model for a closed economy, in fact, assuming decreasing marginal returns to capital, shows that it will be more profitable to save and invest in the backward areas, bringing the level of the capital stock per capita up to that of the advanced ones. If a single capital market exists that covers both areas, then these mechanisms of convergence are strengthened, because it is profitable to invest in the more backward areas, where the use of capital is relatively less intense. In the absence of friction, then, the concept of convergence between countries and regions translates into spatial convergence, which implies the reduction of geographical disparities. This carries two implications that can be measured and tested: first, the spatial concentration of activities should diminish; and second, spatial auto-correlation could diminish in absolute terms, even if only slightly.[4] Such developments depend on the initial configuration of the activities. Restricting ourselves to cases in which the spatial grid of centres of activity is not too dense, a random increase in the presence of new centres of activity will correspond to a decrease in spatial correlation. To illustrate: suppose that at a given point in time all

[4] This is not necessarily true, in the presence of repeated shocks that shift the geographical location of economic activities in such a way as to reduce rather than increase spatial dispersion. Actually, the problem is more general; it concerns the possibility of identifying spatially dynamic processes in the presence of external shocks that have a causal impact on location. In this work we assume that the variance of these external shocks is sufficiently low to allow empirical identification of the models of spatial diffusion.

production is concentrated in one region. If at a subsequent point in time there is some production also in another region, then the spatial autocorrelation index diminishes between the first and the second point in time.[5]

Models of location and growth different from the neoclassical arose in the 1950s, as the principle of cumulative causation began to win acceptance. Firms locate where there are other firms, in order to reduce costs thanks to the nearness of input and output markets. Also, increasing returns to scale contribute to the clustering of firms and workers in a territory and thus induce spatial polarization (Harris, 1954; Pred, 1966). This model of growth in its equilibrium configuration does not result in spatially homogeneous growth. In particular, the theoretical school of 'underdevelopment' notes that regional disparities are a permanent feature of the economy and seeks to address policy to the formation of economies of scale from clustering, because through a process of cumulative causation they can generate self-sustaining growth. This school of thought, which involved not only theory but also many efforts at policy application, included Myrdal (1957) and Pred (1966), who theorized and empirically demonstrated the cumulative processes; Perroux (1964), who proposed poles of development as engines of local growth, because of their innovative capacities or relations between suppliers, firms and consumers or simply because of their size; Hirschman (1958), who stressed the linkages formed upstream and downstream of the production process as sources of development.

Some of these models essentially supplement the neoclassical model by postulating externalities based on clustering that cause firms to tend to locate in areas near to where other firms are already located. For example, the models suggested by Perroux and Hirschman hypothesize 'contagious' development, growth through contiguity. They predict that growth will spring from development poles (mainly industrial, sometimes characterized by the presence of large firms) and spread, through upstream and downstream linkages (Hirschman, 1958), to adjacent areas. As Hirschman (1958, p. 184) says: "*Thus investors spend a long time mopping up all the opportunities around some 'growth pole' and neglect those that may have*

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5 Where the spatial grid of development is already very dense, however, making it still more dense could increase rather than diminish spatial correlation.

arisen or could be made to arise elsewhere". This happens because of overestimation by entrepreneurs of the external economies generated around a pole or perhaps because they want to enjoy the benefits without the spatial constraints that often arise within such poles. Core-periphery theories, which frequently took up these same themes, posited that congestion costs can reduce concentration and trigger processes of outward diffusion, but not necessarily in adjacent areas. As in the neoclassical model, diffusion to contiguous areas does not have significant effects on concentration, which may either increase or decrease but presumably only to a small extent. However, such diffusion is expected to create clusters and thus result in an increase in spatial correlation.[6]

Locational advantages also underlie the theories of the New economic geography, which put the aspects of location together with those of the development of economic activities. The aim is to explain the concentration or the migration of economic activities and productive factors to or from given geographical locations. It is these models of cumulative causation that have as an explicit consequence the spatial polarization of activity. An example is Krugman's core-periphery model (1991), where the forces for clustering consist mainly in increasing economies of scale combined with sufficiently low transportation costs. Other factors for concentration have been added in the literature, often in the form of externalities, such as technological spillover, access to a deeper labour market, or access to a richer market for production inputs.

From the empirical standpoint it is not possible to define the territorial concentration predicted by polarization models independently of the choice of the spatial reference grid: the finer the grid, the greater the probability that concentration will be associated with an aggregation of adjacent areas having similar structures of production. This is the case with spatial clustering of production, which in dynamic terms translates into development of adjacent areas by contiguity. It follows that the polarization model, with fine territorial grids, entails both concentration and spatial clustering: not only do firms and workers tend to be

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6 Again, we find the identification problem mentioned earlier. In particular, spatial auto-correlation, or the presence of processes of stochastic clustering in space, may not be distinguishable, empirically, from spatial heteroskedasticity, i.e. the presence of clusters of firms that are structured unequally, for random reasons, in space. On this see Anselin (2001).

concentrated in the same location, but nearby locations also tend to have the same level of development, forming clusters of firms. A broad spatial grid, by contrast, amplifies the general effects of absorption of firms in core areas and impoverishment of peripheral ones, accentuating the effects of polarization. The 'optimal' spatial dimension for analysis of the spread of development depends mainly on the intensity of the forces for aggregation and concentration. If they are local in scope (this depends in part on the technological structure and on geographical configuration), then the centripetal effects too will have a limited area of action. This implies that low concentration is not necessarily associated with the lack of centripetal forces but may be related to the limited spatial range of action of the polarizing forces. The problem in this case is spatial heterogeneity by groups: areas with clusters that tend to polarize development can coexist, if these forces of polarization operate in a local sphere, with areas lacking clusters in which the location of firms depends on a different logic and different models. Consequently a complete analysis of models of diffusion requires one to distinguish the two groups and evaluate the development model that prevails within each. Obviously this model can only be applied in sectors, such as manufacturing, that are not bound to a specific location of some unmovable productive factors (as in farming or mining).

An example of the kind of effects of diffusion around a core that we want to detect, and that differ according to type of model, is given in Graph 1. Within a regular grid, the figure gives examples of the implicit dynamics of diffusion in the three models considered, measuring the spatial auto-correlation produced by Moran's *I* index (whose complete formulation is given in Section 5).

The examples show that the spatial dispersion of the neoclassical model is sharply opposed to the spatial concentration of the polarization model. The diffusion model, as expected, shows higher spatial auto-correlation.

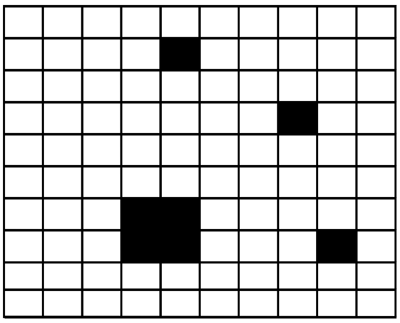
Figure 1, which places the models within the concentration-spatial auto-correlation space, summarizes the conclusions drawn above.

The three models set out above can therefore be empirically tested on the basis of these assumptions, albeit at the cost of a substantial simplification with respect to their richer formulations. The polarization model leads to an increase in concentration, while self-correlation may increase or decrease, although always to a limited degree. The invariance or the reduction in concentration towards spatial homogenization is the distinctive trait, in this work, of the neoclassical model with its two characteristics: in the ‘pure’ version it implies a reduction over time in spatial auto-correlation; in the version with clustering externalities (the model of diffusion by contiguity), it corresponds to a definite rise in auto-correlation. Let us specify that the test presented here concerns a stylized and necessarily simplified version of the various models, which in many cases display a variety of approaches and specifications that cannot be held within the narrow empirical confines set out. However, this schematic approach helps us to grasp the main characteristics of the territorial evolution of development.

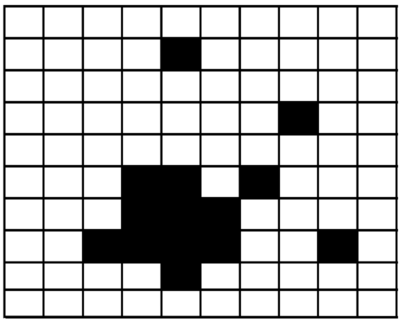
Graph 1

A stylized case

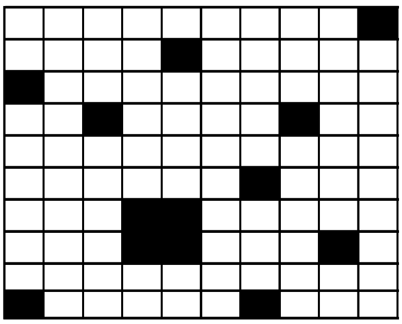
A. Base grid:
Moran *I* Index = 0.25



B. Contiguity model: *I* = 0.36



C. Neoclassical model: *I* = 0.05



D. Polarization model : *I* = 0.32

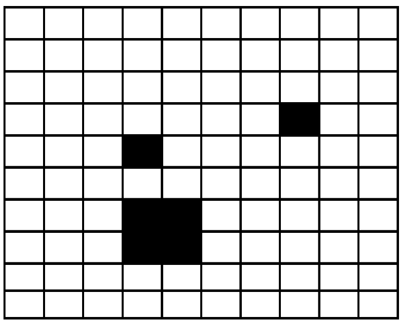
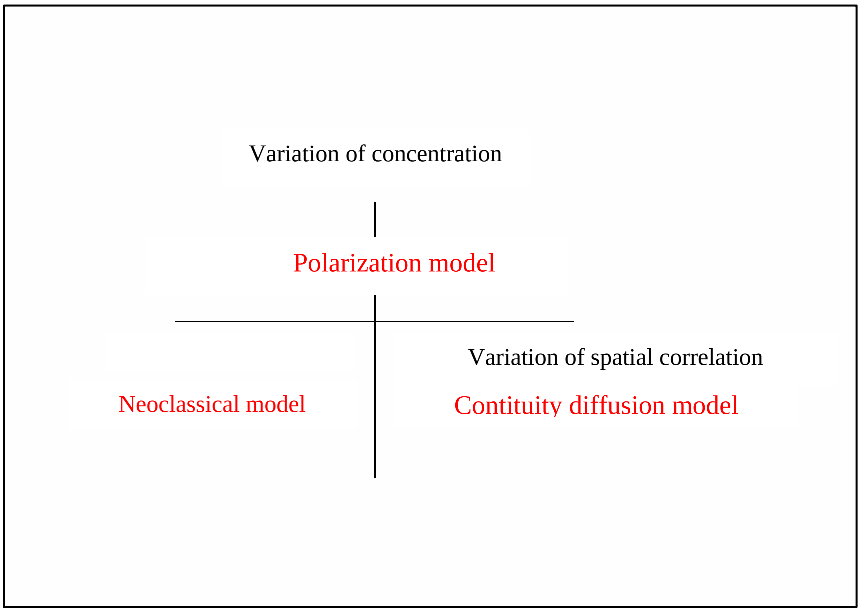


Figure 1



3. The data and the spatial grid

Like all statistical analyses concerning space, this study organizes the data according to two modalities: the territorial reference grid and the economic variables available given that grid.

As noted, the results of a spatial analysis depend crucially on the choice of the territorial grid to which the data are to refer. It is essential to find a level of territorial disaggregation that is consistent with the phenomenon under analysis, like focusing a telescope on the object you want to examine. In this case, the choice of the right territorial level can be decisive in analyzing concentration and spatial auto-correlation. Unsuitable grids can conceal or over-represent phenomena of polarization at local or general level. Available data also set constraints on the fineness of the level of analysis (hence of the grid). The possibilities are not numerous. Many studies have made it clear by now that the functional grid of Local Labour Systems (LLSs), which is intermediate between the lowest two administrative grids in Italy (municipalities and provinces), is generally capable of capturing the complexities and the fineness of territorial phenomena without losing the unity of those phenomena.[7] The regional or provincial grids pose not only the problem of non-correspondence of administrative borders (often the result of past political, economic and social developments in the areas) with the present extension of markets for factors and products. Rather, the most important question is the dimension of growth, which in Italy is often significant at a fine territorial level. For this reason, for our purposes a definition of functional zones like those of the LLSs seems most useful. Not only does this enable us to aggregate areas that are economically similar, at least in labour market structure; it also enables us to capture phenomena of polarization or diffusion of activities at local level.

A local labour system is defined as an aggregation of two or more contiguous municipalities with a relatively self-contained daily commuting flow pattern (Barbieri and Pellegrini, 2004). Taken all together, the Local Labour Systems form a grid that completely covers the national territory. The LLS concept is thus strictly linked to that of self-containment, denoting a territory's capacity to include the greatest possible quantity of human relations taking place between the places where production is carried on (work localities) and those connected with social reproduction activities (residence localities) (Sforzi *et al.*, 1997). In Italy, the practical application of the concept resulted in the definition of 784 LLSs for 1991 (140 in the North-West, 143 in the North-East, 136 in the Centre, and 365 in the South and Islands). Each of the country's about 100 provinces thus had an average of about 8 LLSs.

The LLS units can be used thanks to the fact that Istat has produced statistical series linked with this type of territorial grid. The census data have been unified and arranged in time series for a set of 15 manufacturing industries. However, the adoption of LLSs has also been subjected to criticism. First Iuzzolino (in this volume) rightly pointed out that commuting flows concern residents employed in all economic sectors and

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[7] Among many, see the numerous works based on LLSs in Signorini (2000).

thus do not take account of the individual LLS's specialization. This requires greater care in interpreting sectoral data. A second criticism concerns the use of a static concept like LLS for what is essentially a dynamic analysis. The problem stems from the fact that in the analysis carried out here the LLS grid is kept constant over time, so that it is possible to isolate variations due to the valuables to their different territorial aggregation. In order not to complicate the analysis by introducing variability of the borders over time, it has in fact been decided to apply the LLS grid for 1991 to the entire period analyzed, even at the cost of aggregating, for earlier years, areas that were not yet functionally integrated. Unfortunately, the dimensions of the LLSs in 1991 also depend on aggregation and concentration that occurred in previous periods. Thus the use of this grid will underestimate the effects of local aggregations and polarization.

The data used here are for workers in local production units in each municipality, aggregated into LLSs, in the censuses for 1951, 1961, 1971, 1981, 1991 and 1996. The 1996 census had special features as regards the data collection process that affected the field of observation. The other censuses, already unified by Istat, were accordingly adjusted to adapt them to the field of observation in 1996. Public services and government institutions have been excluded from total employment. No changes were made to manufacturing employment.

4. The different types of cluster

Empirical analysis of the forces for polarization and for diffusion that are present in different models of local development requires preliminary identification of the LLSs that are spatial 'engines' of growth, i.e. the 'poles' (as they are called in theories of growth by contiguity) or 'core' areas (as they are called in the core-periphery models). The theoretical literature, which is not particularly helpful in this regard, notes that these areas generally display a spatial aggregation of workers, which depends on a cluster of firms or, in a few cases, on the presence of a large firm. The literature offers many theoretical and empirical definitions of what constitutes a cluster of firms and of workers in a territory. These definitions are based mainly on the concepts of density, specialization and agglomeration.

Faced with this multitude of definitions, in the present work I have elected to identify clusters of manufacturing workers, given the sufficiently fine territorial grid, on the basis of three empirical specifications. As one naturally expects, identification is based first of all on a high density of workers, i.e. number of workers in a territory in relation to land area. Second, it is based on the presence of a sectoral specialization of workers, whether in manufacturing generally or in sub-segments of manufacturing. This definition is analogous to one of the four criteria for the identification of LLSs that are "areas of light industrialization" proposed by Sforzi (1990) and by Istat (1997).[8] These are the empirical counterpart to the concept of industrial district. Third, the identification is based on especially pronounced specialization, on the assumption that this could identify the existence of broad sectoral advantages and external economies, with effects that therefore differ from those of simple specialization. The threshold used is that set by the Ministry for Industry in the decree of 21 April 1993 implementing Law 317/1991.

None of these definitions consider firm size, on the assumption that the concept of territorial cluster of workers, in general, may comprise small, medium and large firms, which may establish both horizontal and vertical relations with one another. The present work thus takes a different approach in identifying areas of light industrialization – industrial districts as defined by Sforzi (1990) and Istat (1997) or by Brusco and Paba (1997) – that is less restrictive in some respects and closer to the definitions used in the international literature. The 'district' local labour systems identified by these authors in part on the basis of a high share of SMEs will nevertheless be used as a point of reference in our analysis.

The first definition used, which is based on the concept of the cluster as a concentration of firms and workers in the territory, is that which identifies 'dense systems', i.e. systems where the average density of manufacturing workers (the number of manufacturing workers per unit of land area within the LLS) is greater than the national average. This is the

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8 The criteria are: a share of manufacturing workers in total non-agricultural employment higher than the national average; a share of employment in manufacturing industry in firms with fewer than 250 workers higher than the national average; at least one sub-sector having a share of total manufacturing employment that is higher than the national average for that sub-sector (a condition that is obviously always fulfilled); and, finally, in that sub-sector the share of employment in firms with fewer than 250 workers must be higher in the LLS than nationwide.

most natural definition, but also the most problematic. It tends to capture all large agglomerations, which mainly consist of urban LLSs. It does not consider sector of production but only manufacturing activity in general.

The second and the third definitions are tied to the concept of product specialization, which translates empirically into the share of workers in a given sector within the LLS's overall economy as compared with that same share nationwide. As Iuzzolino recalls (in this volume), the existence of comparative advantages for a territory in the production of a given good must translate, sooner or later, into statistical evidence of the territory's specialization in that industry. For the general analysis, therefore, an index of specialization (of workers) within manufacturing has been calculated; it is independent of the number of firms and of the territorial area to which it is applied. Identification of the systems depends directly on the threshold used to distinguish clusters from other local systems. In the present work two thresholds have been adopted. That is, a system is defined as specialized above the threshold of 1.0, i.e. when its share of manufacturing employment is higher than the national average (as noted, this is one of the criteria used in the Sforzi-Istat procedure). And it is defined as highly specialized above the threshold of 1.3 (that set in the ministerial decree). As this index is very important in the Sforzi-Istat procedure, there is a very strong resemblance between the core LLSs identified here and industrial districts (the correlation between binary specialization indices and districts is greater than 70 per cent).

The index of specialization was chosen instead of a simple index of concentration because the latter is not independent of the size of the LLS, for two main reasons: first, for equal density of workers, larger systems are also more concentrated; and second, larger systems have a larger population and are thus those with larger demand, so that they have Jacobian comparative advantages, i.e. advantages that affect all sectors.[9] In order to identify systems where there are specific centripetal forces, the literature has adjusted the concentration index (a simple Herfindahl index based on shares of workers per LLS) with the same LLS's population share (Ellison and Glaeser, 1997). The approach taken in the present work is similar, if population is proxied by total non-agricultural workers: an LLS is defined as specialized in a sector also if its share of workers compared

9 See Ellison and Glaeser (1997).

with the national total in that sector is larger than the share of total workers in that LLS compared with the national total.

This adjustment does not fully take account of the suggestion of Ellison and Glaeser, who note that concentration may also depend on the size distribution of plants and accordingly suggest a new adjustment based on a Herfindahl index for the concentration of plants. There are a number of reasons why this adjustment was not adopted here. First, size data for 1951 and 1961 at sector and LLS level are lacking, so such an indicator would have significantly constricted the breadth of the analysis. Second, as the analysis is dynamic, our interest is not in the level of the H-index but in its variation over time. A calculation for manufacturing shows that it fell from 0.00012 in 1971 to 0.00009 in 1981 and 0.00007 in 1991. Such differences do not appear decisive for the analysis, in view of the variability of the concentration indicator.[10] Finally, the effect of plant concentration is large where the sectors studied have few firms and few plants, which is not the case with our sample.

Table A1 shows the main characteristics of the types selected for 1996. The number of systems identified for each type is generally lower than the number found by Sforzi and Istat for their district systems, save – as expected – for specialized systems, for which the identification mechanism was similar but without the constraint of the small and medium enterprises share, so that they necessarily had to turn out to be more numerous.

The dense systems are those grouping the largest share of total and of manufacturing employment. This depends mainly on the fact that they include many large cities (e.g., Rome, Milan, Naples, Bari), with an average share of manufacturing employment per LLS about twice as large as the average of other classifications. For all types, the Centre and North of Italy shows a greater presence than the South, especially marked in the case of industrial districts and highly specialized systems.

The analysis of the geographical distribution displays similarities and differences between types. As expected, there is a relatively high correlation between specialized systems and districts (0.72 for specialized

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[10] And above all considering, as we shall see more clearly below, that manufacturing concentration diminishes over time. The use of the H-index would thus strengthen our conclusions.

and 0.64 for highly specialized systems). Curiously, dense systems appear to be an intermediate category, in that they have about the same correlation coefficient (around 0.4) as the other types considered.

Overall, then, we can subdivide the four types (dense systems, specialized systems, highly specialized systems and Sforzi-Istat districts) into two groups. The first is based on indices of specialization; districts turn out to be an intermediate class between specialized and highly specialized systems, which are found mainly in the regions of the Centre and North, especially the North-East and the Centre. The second, that of dense systems, is more strongly present in large cities, including in the South.

5. Concentration and spatial correlation in the aggregate manufacturing sector

This analysis is based on an index of spatial auto-correlation and an index of concentration.

1. Spatial auto-correlation is measured by Moran's *I* index defined as:

$$(1) \qquad I = \frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}} \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2},$$

where x is the indicator used and w_{ij} the generic (binary) element of the (nxn) contiguity matrix obtained by applying the Euclidean distance $d(r,s)$ between r and s (the centroids of two generic LLSs). The significance of the index is based on asymptotic approximation. Contiguity is defined by average distance between LLSs (12.8 km), if not otherwise indicated.

2. Concentration is measured using a Herfindahl index defined as the sum of the squares of the shares of workers per LLS.

The results of the analysis of concentration and spatial correlation for manufacturing are given in Table 1. The dynamic of the indices clearly shows that between 1951 and 1996 the concentration of manufacturing diminished while its spatial auto-correlation increased. This result is confirmed also using two different measures of spatial distance to gauge contiguity (average distance between LLSs and maximum distance between contiguous LLSs). Further, asymptotic tests reveal that the values of the Moran index are all highly significant for the calculation using maximum distance.

With the testing procedure described above, the results indicate that in manufacturing the polarization model is hardly consistent with the data, whereas the dynamics are consistent with a model of diffusion via contiguity. The overall result confirms the findings of Brugnoli and Fachin (2001) on the role of the core-periphery model and those of Pellegrini (2002) on growth via contiguity.

Table 1

Concentration (Herfindahl index) and spatial auto-correlation (Moran's *I* index) in manufacturing, 1951-1996

	Index of concentration	Moran Index	
		average distance (*)	maximum distance (**)
1951	0.0255	0.0486	0.1196
1961	0.0291	0.0406	0.0937
1971	0.0253	0.0419	0.1014
1981	0.0175	0.0563	0.1197
1991	0.0136	0.0702	0.1418
1996	0.0124	0.0775	0.1601

(*) = Contiguity if the distance between LLSs is less than average (12.8 km).

(**) = Contiguity if the distance between LLSs is less than the maximum (i.e. the distance at which all LLSs have at least one contiguous neighbour: 46.5 km).

However, while these conclusions are underpinned by global indices, they need additional support from analysis on a more limited spatial dimension, to make sure that polarization mechanisms are not important at local level. This means comparing employment growth in core LLSs, adjacent LLSs – adjacency being defined, in this case, as sharing a border – and other systems. Diffusion models presume that growth in adjacent LLSs is greater than in the core LLS. For polarization models, the reverse holds.

The first step in the analysis was to identify, based on an adjacency matrix, the LLSs adjacent to the core systems, i.e. those qualifying, by our definitions, as dense systems, specialized systems and highly specialized systems. Adjacency is measured ‘net’, i.e. excluding any core systems that are adjacent to other core systems. The results of this univariate analysis for the period 1951-1996 are given in Table 2. In every case, adjacent systems grew more than core systems.[11] Many studies – including Brusco and Paba (1997) and Fabiani and Pellegrini (1999) – report a discontinuity between the growth processes of the 1950s and 1960s and those of subsequent decades. To take these effects into account, we performed the same analysis also for the period 1971-1996 (Table 3), constructing core systems for 1971 by applying the same parameters described above to 1971. The results are basically similar.

The univariate analysis highlights two facts. The first is that if the core systems are accurately identified, the prevailing model of diffusion of growth is still by contiguity. The second is a consideration bearing on the explanation why so often, especially in the second period, non-core and non-adjacent systems grew more than others. Still assuming correct identification of core systems, this signals large-scale geographical congestion, resulting in the prevalence of centrifugal over centripetal forces. Such a development apparently shows that there are geographical and probably also economic limits to further growth in the core areas. An alternative possibility, though, is that the methods used are not especially suitable for identifying core systems. This may depend on two different factors: the univariate analysis may not take proper account of the other factors that interact with employment growth; or there may be sectoral specificities that are implicitly captured in the identification of the districts and that have significant effects on growth. To take account of the first consideration we test a one-equation econometric model allowing multivariate analysis; to respond to the second, we have conducted a further sectoral analysis. The results of the latter are given in Section 6.

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11 For purposes of comparison, the analysis was also conducted on the set of district systems as defined by Sforzi-Istat. The results show that these grow more than neighbouring systems. This result depends essentially on the method of selecting the LLSs. Whereas for dense, specialized and non-specialized systems the methodology was applied to the data for 1951, the districts were selected on the basis of the data for 1991. In a sense, therefore, this method picks districts that are ‘winners’, and this is reflected in the growth record.

Table 2

Percentage increase in employment in local labour systems by type: 1951-1996

Type of LLS	Dense	Specialized	Highly specialized
Core	83.5	30.2	14.9
Adjacent	149.4	76.9	29.6
Other	50.6	75.8	83.7

Table 3

Percentage increase in employment in local labour systems by type: 1971-1996

Type of LLS	Dense	Specialized	Highly specialized
Core	-9.0	-7.0	-7.7
Adjacent	27.1	0.2	-5.6
Other	27.2	29.8	9.2

The evaluation of the multivariate relation between core and adjacent systems was performed by estimating a cross-section econometric model, relating the rate of growth of employment to a series of structural and geographical variables (size in terms of employment, location in the South, urban system, typical Italian export product district[12]). This basic structure was supplemented with exogenous dummy variables identifying

[12] The latter two categories are determined according to Istat (2000).

core and adjacent systems for the four types of system considered. The estimation residuals for these equations show strong spatial auto-correlation. This result is subject to two interpretations: on the one hand, it is a symptom, per se, that territorial diffusion is significant and extensive; and on the other, that there are spatial characteristics, not necessarily linked to the subject of our inquiry, that cause its spatial dispersion with particular modes. In both cases, it appears to be necessary to bring into the equation either a spatial lag or a spatial component of the error term. This specification was tested (LM test and robust LM test, specified in Anselin *et al.,* 1996), and proved strongly positive in all cases (see Table 4).

We therefore modified the model to introduce a spatial lag variable. The model was thus estimated in this form:

$$Y = \rho WY + X\beta + \mu \qquad (2)$$

in which Y is an n×1 vector of observations of the dependent variable Y, X is an n×k matrix of observations of the exogenous variables (which include the dummies for core and adjacent systems), β is the k×1 vector of regression parameters and μ is a vector of non-correlated and normally distributed homoskedastic errors. $W\,Y$ is the variable Y lagged in space (W is always the adjacency matrix, binary for simplicity, calculated in this case with respect to the maximum distance of 46.5 km) and ρ is the auto-regressive spatial parameter. The OLS estimator of equation 2 is notoriously biased and inconsistent, because of simultaneity between the spatially lagged term and the error term.[13] Accordingly we estimated model 2 by an ML method that takes account of such simultaneity (Anselin, 1988). We show non-standard diagnostics concerning the variance ratio (a pseudo-R-square statistic based on the ratio between the estimated and the observed variance of the dependent variable) and an LM test of the significance of the self-regressive parameter.

13 See for instance Anselin (2001).

The results of these estimates are given in Table 4. In all the equations estimated the test shows strong spatial auto-correlation that requires the introduction of the spatial lag, which is always highly significant. This result is common in the literature, and as noted it is subject to various explanations.[14] From a static point of view, it may signal the presence of geographical factors favouring some locations over others. From a dynamic point of view, it may reflect the prevalence of the model of diffusion via contiguity, produced perhaps by technological spillover. Finally, as noted by Pagnini (in this volume), it may be produced by shocks common to adjacent areas. In any case, this interferes with the measurement of models of proximity around a core. For in the three models considered, the coefficient for the adjacent systems diminishes (in absolute terms) when the spatial lag is included. This may explain why the coefficients for the adjacent systems are generally positive (as expected in diffusion models) but not significant, except in the case of those adjacent to dense systems.

The core systems, and in particular those identified by manufacturing specialization, always have a significantly negative effect on growth (i.e., a lower rate of growth than the other systems). This finding is consistent with the literature, which registers the lack of positive effects from clusters' specialization (see for instance Pagnini, in this volume, as well as Cainelli and Leoncini, 1999, and Paci and Usai, 2001, for Italy; Combes, 2000, for France; Glaeser *et al.*, 1992, for the US).

The results of the multivariate analysis are thus less clear-cut than those of the univariate analysis. Again, there is no evidence for the polarization model, which the data exclude for all of manufacturing industry. There is some evidence in support of diffusion via contiguity, which appears to be statistically significant only in the case of dense systems.

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[14] See Attfield *et al.* (2000), who show the existence of spatial auto-correlation between countries, between regions of Europe and between states in the US; Fingleton (2001), for European regions; Pagnini (in this volume) for provinces and regions in Italy; Pellegrini (2202) for Italian LLSs.

Table 4

Core systems and employment growth

Endogenous variable: rate of growth of manufacturing employment, 1951-1996

	Simple equation		**Eq. with dense LLSs**		**Eq. with spec. LLSs**		**Eq. with highly specialized LLSs**	
	no lag	*lag*	*no lag*	*lag*	*no lag*	*lag*	*no lag*	*lag*
	OLS	*ML*	*OLS*	*ML*	*OLS*	*ML*	*OLS*	*ML*
Employment 1951	*signif.*	*signif.*	*signif.*		*signif.*			
Urban systems	*signif.*	*signif.*	*signif.*	*signif.*		*signif.*		
Typical export district	*signif.*	*signif.*	*signif.*	*signif.*	*signif.*	*signif.*	*signif.*	*signif.*
South	*signif.*	*signif.*	*Signif.*		*signif.*	*signif.*	*signif.*	*signif.*
Dense LLSs			*-0.3725*	*-0.403121*				
Adjacent dense LLSs			*0.404897*	*0.315107*				
Specialized LLSs					*-0.63432*	*-0.48688*		
Adjacent specialized LLSs					0.0716628	0.0106287		
Highly specialized LLSs							*-1.21787*	*-0.74415*
Adjacent highly spec. LLSs							-0.3028523	-0.1605374
Spatial lag		*0.038687*		*0.03807*		*0.036839*		*0.036653*
R-square	0.178		0.2043		0.2087		0.2058	
Lagrange multiplier spatial test	signif.		signif.		signif.		signif.	
Robust LM spatial test	signif.		signif.		signif.		signif.	
Variance ratio		0.311		0.332		0.327		0.321
LM test for spatial lag		signif.		signif.		signif.		signif.

Level of significance: 5 per cent. Significant coefficients are in italics.

6. Analysis by manufacturing industry

The results to this point are affected by the fact that manufacturing as a whole consists of a number of industries that differ greatly in technology, factor shares, diffusion and geographical concentration. A disaggregated analysis highlighting models of territorial development by individual industry is thus desirable.

Table 5

Concentration of workers by LLS in manufacturing industry in Italy, 1951-1996

Herfindahl index (by industry)	1951	1961	1971	1981	1991	1996
Food and beverages	0.008	0.029	0.013	0.009	0.008	0.008
Tobacco	0.033	0.010	0.037	0.038	0.033	0.044
Leather goods	0.052	0.032	0.044	0.046	0.049	0.074
Textiles	0.027	0.050	0.024	0.026	0.024	0.029
Clothing and footwear	0.014	0.028	0.012	0.010	0.008	0.009
of which: clothing	-	0.016	0.014	0.010	0.008	0.008
of which: footwear	-	0.020	0.018	0.021	0.021	0.024
Wood and furniture	0.010	0.019	0.012	0.012	0.012	0.012
of which: wood	-	0.011	0.007	0.007	0.006	0.006
of which furniture	-	0.008	0.030	0.028	0.022	0.021
Paper products	0.035	0.030	0.028	0.022	0.018	0.016
Printing and publishing	0.105	0.038	0.110	0.094	0.070	0.060
Audiovisual equipment	0.058	0.110	0.081	0.069	0.047	0.062
Basic metals	0.062	0.097	0.041	0.037	0.028	0.023
Mechanical engineering	0.065	0.060	0.047	0.028	0.020	0.017
of which: Transport equipment	-	0.059	0.192	0.107	0.091	0.070
Non-metallic minerals	0.013	0.161	0.012	0.011	0.009	0.011
Petrochemicals	0.058	0.011	0.071	0.055	0.063	0.063
Rubber	0.290	0.079	0.106	0.054	0.043	0.040
Plastics and other manufactures	0.075	0.206	0.047	0.027	0.020	0.017

The heterogeneity of manufacturing industries is clear from the sectoral concentration indices (Table 5). Between 1951 and 1996 the degree of concentration increased in about half the industries considered; this is true both of low-capital-intensity industries, often located in industrial districts, such as leather goods, textiles, and wood and furniture, and of capital-intensive industries like petrochemicals and transport equipment. The index declined in mechanical engineering and remained essentially constant after 1971 in clothing and non-metallic minerals.

As for spatial auto-correlation (Table 6), the index rose in nearly all industries (except textiles and clothing). The index is positive and statistically significant (to 1996) in 'district' type industries such as textiles, clothing and footwear, wood and furniture, and non-metallic minerals. When the analysis is conducted at sub-sector level, the observation is strengthened. Table 7 shows strong spatial auto-correlation of such industries as clothing, footwear, furniture, and mechanical engineering.

Table 6

Spatial correlation by industry

	Moran index (boldface= significant at 5%)			LLS with LSAI (*) significant al 5%		
	1951	1971	1996	1951	1971	1996
Food and beverages	0.0572	0.6578	0.0750	18	13	28
Tobacco	**0.1319**	**0.1169**	0.0020	17	10	9
Leather goods	0.0131	0.0155	0.0267	12	15	14
Textiles	**0.2996**	**0.2518**	**0.1625**	35	34	36
Clothing and footwear	0.0435	**0.1385**	**0.4043**	11	39	69
Wood and furniture	0.0543	0.0738	**0.1119**	12	18	27
Paper products	0.0351	0.0451	0.0599	21	19	27
Printing and publishing	0.0089	0.0082	0.0124	2	2	3
Audiovisual equipment	0.0108	0.0090	0.0118	0	0	2
Basic metals	0.0203	0.0522	0.0929	9	13	21
Mechanical engineering	0.0192	0.0258	0.0664	6	10	25
Non-metallic minerals	0.0670	**0.1107**	**0.2711**	28	19	28
Petrochemicals	0.0146	0.0131	0.0154	7	3	4
Rubber	0.0044	0.0113	0.0197	4	6	14
Plastics and other manufactures	0.0480	0.0395	0.0832	9	13	34

(*) = Moran-type local spatial auto-correlation.

Table 7

Spatial correlation for some sub-sectors

	Moran index (boldface= significant at 5%)			LLS with LSAI (*) significant al 5%		
	1961	1971	1996	1961	1971	1996
Clothing	0.0368	0.0732	**0.2009**	8	30	58
Footwear	**0.1343**	**0.4806**	**1.0700**	20	32	32
Furniture	0.0296	0.0587	**0.1077**	8	13	22
Non-electrical machinery, metallic carpentry	0.0554	0.0726	**0.1321**	12	19	45

(*) = Moran-type local spatial auto-correlation.

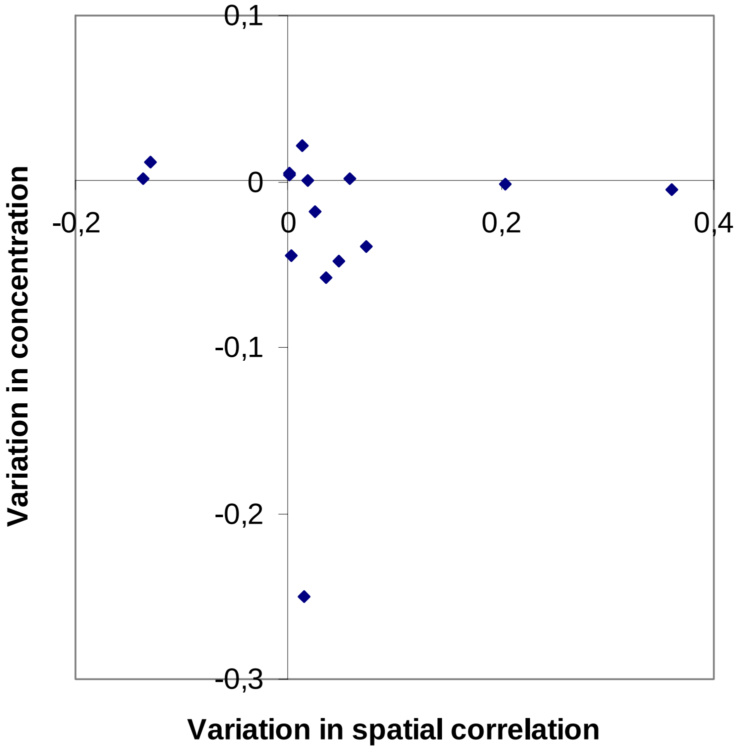
The results can be plotted in the spatial concentration-correlation space (Figure 2).

Generally, between 1951 and 1996 most of the industries (10 out of 15) show an evolution that is consistent with the contiguity model. Only a few are consistent with the polarization or the neoclassical model. Typical Italian export industries, too, display the marked presence of the contiguity-diffusion model (clothing and footwear, wood products, mechanical engineering and non-metallic minerals). The polarization model seems to fit leather goods and (less well) textiles. Note that it is precisely this type of industries that have the largest number of LLSs with a local Moran index (local defined as within 50 kilometers) that is positive and significant (e.g., textiles, clothing and footwear, wood products, non-metallic minerals, plus food products and plastics). For 1971-1996 the results are similar (Figure 3), although the lesser increase in spatial correlation weakens the results for the contiguity model.

In this case too, we must check whether there are centripetal tendencies towards the core systems. These are identified using the same algorithms that were applied to manufacturing as a whole, but restricted to specialized and highly specialized systems only. We then performed a univariate analysis at local level to examine tendencies between core and adjacent systems. The results for the two periods considered, 1951-1996 and 1971-1996, differ in part from those obtained in the previous analysis (Table 8).

Figure 2

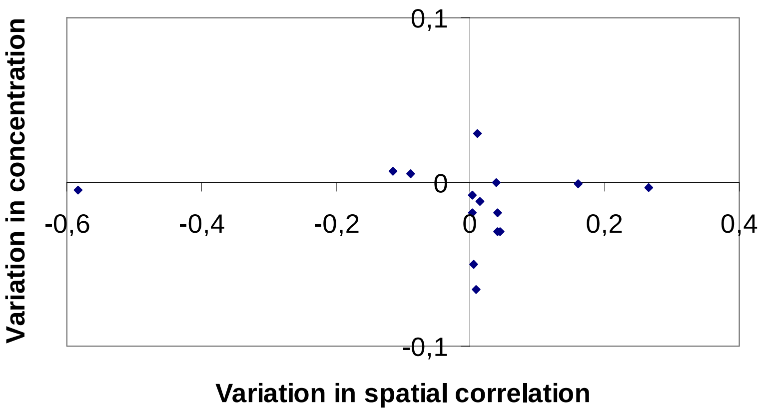
Contiguity diffusion models by industry, 1951-1996



Employment increased mainly in the non-core and non-adjacent systems (about two thirds in the specialized systems during the two periods, slightly less in the non-specialized systems). This would appear to be typical of the search for profit opportunities concentrating on the less congested markets and areas, consistent with a neoclassical model. For specialized systems, between 1951 and 1996 only one industry (wood and furniture) shows traits consistent with the polarization model. For the period 1971-1996 three industries do (in addition to wood and furniture, also clothing and footwear and leather goods). For the highly specialized systems, they number respectively 3 and 4 (adding textiles). The polarization model is thus found mainly in district-type industries. In these cases externalities are so great that firms find it profitable to ‘enter’ the district rather than stay on the fringes. The contiguity diffusion model is prevalent in such industries as tobacco, printing and publishing, and non-metallic minerals (also of low capital intensity) and to a lesser extent in audiovisual equipment. A multivariate model for the two periods has also been estimated for sub-sectors. The results of the OLS estimates, given in Table 9, show that in most cases the dummies for core areas and for adjacent areas are not significant.

Figure 3

Contiguity diffusion models by industry, 1971-1996



The model also displays a fairly poor fit. Probably sectoral heterogeneity is such as to require a sectorally differentiated model. What we see is that in all cases the coefficient for adjacent areas is higher than for core areas. This is consistent with a contiguity diffusion model.

Overall the marked sectoral heterogeneity is also reflected in development models. In general development is compatible with a contiguity growth model, with a few exceptions, especially in district industries, where there are elements pointing to the working of polarization models.

Table 8

Average rates of employment growth by LLS in Italian manufacturing

	1951-1996			1971-1996			1951-1996			1971-1996		
	Spec.	*Adjac.*	*Other*	*Spec.*	*Adjac.*	*Other*	*Highly Spec.*	*Adjac.*	*Other*	*Highly Spec.*	*Adjac.*	*Other*
Food and beverages	11.5	35.6	136.8	13.8	11.8	72.5	7.3	37.7	58.9	13.1	12.8	35.2
Tobacco	-77.9	-17.5	-86.0	-43.6	35.7	-61.5	-80.6	2.1	-69.2	-42.6	15.9	-67.3
Leather goods	60.6	140.3	282.6	39.2	-16.3	10.5	110.2	36.3	75.4	44.9	-14.8	-13.8
Textiles	-58.8	-47.5	33.2	-37.9	-54.3	-35.8	-59.5	-52.5	28.5	-36.9	-51.8	-41.8
Clothing and footwear	38.2	17.7	57.4	-2.5	-15.1	-26.6	35.5	30.9	24.4	4.5	-19.2	-21.6
Wood and furniture	38.8	13.9	-22.2	-0.7	-9.2	-22.9	39.7	19.7	4.6	1.6	-9.7	-11.0
Paper products	-11.1	209.6	242.9	-25.3	29.5	63.7	-12.2	68.0	219.8	-21.8	-9.5	42.1
Printing and publishing	81.0	388.2	291.3	3.5	112.8	84.3	81.1	372.7	180.8	-1.5	95.8	52.2
Audiovisual equipment	184.7	324.2	358.2	46.9	98.8	82.8	173.3	289.1	339.1	43.5	86.7	79.2
Basic metals	-49.9	161.7	590.6	-57.1	1.8	66.7	-51.9	104.3	496.2	-53.8	-50.3	48.3
Mechanical engineering	58.8	331.6	353.8	-10.4	56.5	95.7	41.4	299.6	314.2	-16.7	14.8	62.0
Non-metallic minerals	11.2	47.4	40.6	-24.5	-24.2	-17.2	10.1	42.6	14.3	-23.9	-23.4	-26.8
Petrochemicals	-14.3	99.8	353.4	-41.4	18.6	87.4	-14.5	51.6	168.6	-44.2	0.7	33.0
Rubber	-60.8	308.1	728.2	-54.0	-16.8	-9.1	-61.0	398.3	548.3	-54.2	-17.6	-12.3
Plastics and other manufactures	99.3	1181.1	1439.5	-0.4	172.8	160.9	96.9	1063.9	1334.5	-8.1	135.4	81.0

Table 9

Core systems and employment growth by industry

Endogenous variable: sectoral employment growth rate, 1951-1996 and 1971-1996

	Specialized 1951-1996		*Specialized* 1971-1996		*Highly specialized* 1951-1996		*Highly specialized* 1971-1996	
	core	*adjacent*	*core*	*adjacent*	*core*	*adjacent*	*core*	*adjacent*
Food and beverages	**-3.2**	**-2.3**	**-1.6**	**-1.1**	**-2.0**	**-1.0**	**-1.1**	**-0.4**
Tobacco	0.1	1.7	-0.6	1.1	0.1	2.4	-0.5	1.2
Leather goods	-6.3	0.4	**-2.0**	-0.8	-5.2	1.2	-1.3	-0.1
Textiles	-1.9	0.1	-0.6	-0.2	-2.0	-0.1	-0.6	-0.2
Clothing and footwear	-0.8	-0.5	-0.1	0.1	-0.5	0.1	-0.1	0.1
Wood and furniture	0.6	1.2	0.2	0.4	0.2	0.7	-0.1	0.1
Paper products	-5.6	4.7	-1.4	2.7	-6.2	2.8	-3.6	-1.4
Printing and publishing	**-3.7**	1.2	**-1.5**	0.2	**-4.0**	1.0	**-1.6**	0.1
Audiovisual equipment	**-1.5**	0.5	**-1.0**	0.1	**-1.7**	-0.1	**-1.0**	0.1
Basic metals	-82.8	-46.7	**-6.0**	-3.0	-83.3	-50.6	**-5.9**	-3.3
Mechanical engineering	**-3.4**	0.6	**-0.9**	-0.3	**-3.9**	0.7	**-1.0**	-0.2
Non-metallic minerals	**-4.0**	0.4	**-1.8**	0.4	**-3.8**	-0.1	**-2.1**	-0.2
Petrochemicals	**-16.7**	-7.1	-4.0	1.4	**-14.7**	-5.5	-5.4	-2.1
Rubber	-19.1	-8.9	-1.6	-0.8	-18.4	-8.1	-1.3	-0.7
Plastics and other manuf.	**-71.5**	-10.4	**-6.7**	-0.6	**-70.0**	-12.5	**-6.3**	-0.4

7. Conclusion

We have analyzed the pattern of spatial diffusion characterizing Italian manufacturing and its component industries from 1951 to 1996. A twofold approach was taken: a general approach based on overall indicators for all 784 of the local labour systems into which Italy is divided; and a specific approach, which compared employment trends in each LLS with those in the areas adjacent to it.

The first, clear result is the substantial increase in auto-correlation and the reduction in concentration for the manufacturing sector as a whole in the course of the period. This cannot be reconciled with a model of development via polarization, such as the core-periphery model. The finding reinforces the conclusions of Brugnoli and Fachin (2001), extending them to a longer period (ending in 1996 instead of 1991) and using a finer territorial grid (LLSs rather than provinces).

The lack of evidence for the polarization model at aggregate level does not mean that there are no centripetal forces at work around clusters of firms. Accordingly, the analysis was conducted at local level, first identifying possible core systems and then comparing their employment growth with that of contiguous LLSs. For all manufacturing industries this procedure turned up no significant evidence of polarization: employment in the core systems tends to grow less than in adjacent ones. There are also signs of spatial congestion in the most highly specialized and densest areas.

These results could depend on the method used to identify core systems, and in particular on not having considered size in identifying clusters. However, the data available do not permit us to classify the LLSs by size. There could also have been some effect from sectoral heterogeneity: the aggregate results depend on the aggregation of many sub-sectors, each with its specific characteristics. The hypothesis of sectoral heterogeneity in contiguity-diffusion growth models was accordingly tested. Overall, the results show that heterogeneity prevails in industries characterized by the contiguity-diffusion model. This is consistent with the history of territorial development in Italy. From the North-West, industrialization spread out first to the North-East and then to the Centre, and finally, with some difficulty, to parts of the South. Further, this result suggests a model of development without geographical ruptures, i.e. without breaks in development. This may depend on the powerful interconnections between bordering areas and firms, owing to territorial spillover that is significant but has a high spatial decay rate and takes the form of a perceptible contiguity effect on growth (see Pellegrini, 2002).

However, in some respects the behaviour of the industries in which a substantial portion of output comes from district areas is distinctive. Univariate analysis shows the presence of polarizing forces, but this is not fully confirmed by multivariate analysis. Polarization at local level in the core systems may be explained by the kind of externalities that arise in the clusters, which favour the choice of locating within rather than adjacent to the clusters. These externalities may consist in greater ease of formal and informal contacts, shorter distance from product markets and the possibility of exploiting a local, territorial 'brand name'. In this case the spatial decay effect would be so great that even localities adjacent to the core are denied significant enjoyment of the externalities. The fact that the multivariate analysis does not find these effects may depend on the fact that the model needs refining and on identification procedures that may be over-simplified. For example, it is possible that size does in any case play a role, like other factors such as the presence of leader companies, the social climate and environment, or geographical location. These aspects will be examined in further work along these same lines.

Table A1

Types of local labour systems, 1996

Variable	Dense systems	Specialyzed systems (*)	Highly specialyzed systems (**)	Memo: ind'l districts
Number	191	294	156	199
Centre-North	156	249	145	184
South	35	45	11	15
Mfg. empl't	4,070,550	3,137,451	1,715,711	2,271,396
Centre-North	3,616,401	2,934,490	1,669,668	2,211,242
South	454,149	202,961	46,043	60,154
% mfg. empl't	78.1	60.2	32.9	43.6
Centre-North	79.5	64.5	36.7	48.6
South	68.7	30.7	7.0	9.1
Total empl't	1,024,132	6,266,172	2,993,202	4,437,327
Centre-North	8,789,741	5,825,417	2,915,179	4,310,142
South	1,451,588	440,755	78,023	127,185
% total empl't	74.3	45.4	21.7	32.2
Centre-North	76.1	50.5	25.2	37.3
South	64.6	19.6	3.5	5.7

(*) Threshold value: 1.

(**) Threshold value: 1.3.

Table A2

Number of local labour systems by type and year

Year	Dense systems	Specialyzed systems	Highly specialyzed systems	Memo: ind'l districts (*)
1951	151	202	44	149
1961	157	153	52	-
1971	175	192	69	166
1981	187	241	118	-
1991	198	284	150	238
1996	191	294	156	-

(*) Brusco and Paba (1997).

REFERENCES

Anselin, L. (1988), *Spatial Econometrics: Methods and Models*, Dordrecht, Kluwer.

Anselin, L. (2001), "Spatial Econometrics", in B. Baltagi (ed.), *Companion to Econometrics*, Oxford, Basil Blackwell.

Anselin, L., Bera, A.K., Florax, R. and Yoon, M. (1996), "Simple Diagnostic Tests for Spatial Dependence", *Regional Science and Urban Economics*, Vol. 26, No. 1, pp. 77-104.

Arbia G. (2000), "Two Critiques to the Statistical Measures of Spatial Concentration and Regional Convergence", *International Advances in Economic Research*, Vol. 6, No. 3.

Attfield, C.L.F., Cannon, E.S., Demery, D. and N.W. Duck (2000), "Economic Growth and Geographic Proximity", *Economic Letters*, Vol. 68, No. 1, pp. 109-112.

Barbieri, G., Paradisi, F. and Pellegrini, G. (2001), "Concentration and Spatial Agglomeration of Italian Economy: A Very, Very Disaggregated Analysis", *Journal of Cities and Urban Economics*, Urban Development Special issue, June.

Barbieri, G. and Pellegrini, G. (2004), "I Sistemi locali del lavoro: uno strumento per la politica economica in Italia e in Europa", forthcoming in G. Esposito (ed.) *Scritti in onore di Antonio Giannone*, ISCONA, Rome.

Brito, P. (2003), "The Dynamics of Distribution in a Spatially Heterogeneous World", UECE-ISEG, Lisbon University, 31 marzo 2003, mimeo.

Brugnoli, A. and Fachin, S. (2001), "Testing Economic Geography: Italy, 1951-1991", *Economics Bullettin*, Vol. 18, No. 1, pp. 1-7.

Brusco, S. and Paba, S. (1997), "Per una storia dei distretti industriali italiani dal secondo dopoguerra agli anni novanta", in F. Barca (ed.) *Storia del capitalismo italiano dal dopoguerra a oggi*, Rome, Donzelli.

Cainelli, G. and Leoncini, R. (1999), "Esternalità e sviluppo industriale di lungo periodo in Italia. Un'analisi a livello provinciale", *L'Industria - Rivista di economia e politica industriale*", Vol. 20, No. 1, pp. 147-165.

Christaller, W. (1933), *Central Places in South Germany*, Jena.

Combes, P.Ph. (2000), "Economic Structure and Local Growth: France, 1984-1993", *Journal of Urban Economics*", Vol. 47, No. 3, pp. 329-355.

Ellison, G. and Glaeser, E.L. (1997), "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach", *Journal of Political Economy*, Vol. 105, No. 5, pp. 889-927.

Fabiani, S. and Pellegrini, G. (1999), "Convergenza e divergenza nella crescita delle province italiane", in *Ricerche quantitative per la politica economica 1997,* Banca d'Italia, Rome.

Fingleton, B. (2001), "Theoretical Economic Geography and Spatial Econometrics: Dynamic Perspectives", *Journal of Economic Geography*, Vol. 1, No. 2, pp. 201-225.

Glaeser, E., Kallal, H., Scheinkman, J. and Shleifer, A. (1992), "Growth in Cities", *Journal of Political Economy*, Vol. 100, No. 6, pp. 1126-1152.

Harris, C.D. (1954), "The Market as a Factor in the Localization of Production", *Annals of the Association of American Geographers*, Vol. 44, No. 4, pp. 315-348.

Hirschman, A.O. (1958), *The Strategy of Economic Development*, New Haven, Yale University Press.

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

Istat (1997), *I sistemi locali del lavoro 1991*, Rome.

Istat (2000) *Rapporto annuale. La situazione del Paese nel 1999*, Istituto poligrafico dello Stato, Rome.

Lösch, A. (1954), *The Economics of Location*, New Haven, Yale University Press.

Marshall, A. (1890), *Principles of Economics*, London, Macmillan.

Myrdal, G. (1957), *Economic Theory and the Underdeveloped Regions*, London, Macmillan.

Paci, R. and Usai, S. (2001), "Externalities and Local Economic Growth in Manufacturing Industries", CRENOS, Working Paper, No. 13.

Pellegrini, G. (2000), "I fattori strutturali dello sviluppo locale nelle recenti analisi teoriche ed empiriche della crescita", in E. Ciciotti and A. Spaziante (eds.), *Economia, territorio e istituzioni. I nuovi fattori delle politiche di sviluppo locale*, Milan, Franco Angeli.

Pellegrini, G. (2002), "Proximity, Polarization and Local Labour Market Performances", *Network and Spatial Economics*, Vol. 2, No. 2. pp. 151-173.

Perroux, F. (1964), *L'économie du XXème siècle,* Presses Universitaries de France, Paris.

Pred, A.R. (1966), *The Spatial Dynamics of U.S. Urban-Industrial Growth*, Cambridge MA, MIT Press.

Sforzi, F. (1990) "The Quantitative Importance of Marshallian Industrial Districts in the Italian Economy", in F. Pyke, G. Becattini and W. Sengenberger (eds.), *Industrial Districts and Inter-firm Co-operation in Italy*, Geneva, International Institute for Labor Studies.

Sforzi, F., Wymer, C. and Gillard, A. (1997), *I sistemi locali del lavoro nel 1991,* in Istat (1997).

Signorini, L.F. (2000), "L'"effetto distretto": motivazioni e risultati di un progetto di ricerca", in L.F. Signorini (ed.), *Lo sviluppo locale. Un'indagine della Banca d'Italia sui distretti industriali*, Rome, Donzelli.