Diffusion and Concentration of Growth in Italy:

An Analysis by Sector and Functional Region

Giovanni Barbieri, Guido Pellegrini, Francesca Paradisi

Abstract

Patterns of local development are affected by the technological structure of the sector, by the presence of mobile or non-mobile production factors and by the dimension of the market. The objective of the analysis is to identify and test the presence of two basic spatial location models: the core periphery and the contagion models. Both the auto-correlation and concentration indexes are used for discriminating among them. In order to have more precise results and to capture the local nature of development in Italy, a territorial grid both very disaggregated and based on socio-economic patterns (*vis-à-vis* administrative boundaries) is used.

The principal result is that – while industrial clustering processes are clearly at work – they cannot be reduced to a single spatial growth model: in many cases a core-periphery pattern seems to be operating, but in more instances an "infection" model is apparently at play. These behaviours coexist, not only among different sectors within the Italian economy, but also within the same industry at different times (i.e., likely, in different development phases).

Giovanni Barbieri

Istat (Statistics Italy)
Via Torino, 6 – I-00187 – Roma, ITALY
e-mail: barbieri@istat.it

Guido Pellegrini

University of Bologna (Dept. of Statistics)
Via Belle Arti, 41 – I-40026 – Bologna, ITALY
e-mail: pellegri@stat.unibo.it

Francesca Paradisi

Istat (Statistics Italy)
Via Gaeta, 4 – I-00184 – Roma, ITALY
e-mail: paradisi@istat.it

Diffusion and Concentration of Growth in Italy

"Within two generations Italy has grown from a largely agricultural, migrant-pool country into a large and prosperous economy. […] A peculiar industrial structure, made up mostly of small firms, has proved unexpectedly competitive and dynamic over the decades" (Signorini, 2000). The rapid catching up with the more developed countries has deeply affected the industry's composition and the spatial configuration of the Italian economy. In this article we analyse changes in the spatial structure of manufacturing and service sectors, tracing the patterns of diffusion, concentration and agglomeration. The scope is to asses the empirical relevance of the core-periphery model, that conjectures the concentration of economic activity in the core of the market, with respect to other models of spatial diffusion of growth. The main improvement introduced with respect to the rest of the existing literature is the level of territorial analysis. We use a very narrow territorial grid, based on local labour market areas (LLMAs), the result of the spatial aggregation of neighbouring municipalities, joined together on the base of daily commuting flows of local population owing to work reasons. The territorial grid based on LLMAs covers the whole country: the Italian territory is partitioned in 784 LLMAs.

Diffusion and concentration in the growth models

Even if the neo-classical model of growth well explains the process of catching up across Italian regions, especially during the Fifties and the Sixties, it largely ignores the possibility that growth patterns across economically contiguous areas might be inter-related, because of factor flows and long-run demand and supply effects. Transmission mechanisms can be either positive, in the form of inter-regional spill-overs (thick market externalities, reductions in the cost of human capital and technology transfers), or negative, related to the reduction of profit opportunities (especially in sectors dominated by scale economies) (Fabiani and Pellegrini, 1998).

The above considerations are at the base of the "core-periphery" model, that focuses on the localisation of firms. This is clearly related to growth, in the sense that the areas that attract more firms and workers have a potential for intense growth. Krugman (1991) suggests that the three fundamental factors for the concentration of production are: (i) high economies of scale; (ii) low transport costs; (iii) a relevant share of production which is highly mobile on the territory. If such conditions hold, then producers, in order to minimise transport costs, tend to concentrate production in the location with the highest demand. At the same time, because of the need for intermediate goods and services and the high concentration of workers, the location with the highest demand tends to be the one where firms decide to concentrate production. The mechanism is hence self-reinforcing: the increase in concentration sets in motion forces that push firms to localise production close to other firms.

Even if the primary cause of concentration is not explained by these models, but rather attributed to some historical event or to expectations, the outcome of the model is that firms, jobs, workers and therefore growth tend to concentrate in the core of the economy.

In Italy, the geographical concentration of firms belonging to a specific sector of production has been related to the concept of "industrial district", which has been vastly discussed by a stream of literature, less formal with respect to Krugman's model, but more related to the social environment of the firm, attempting to explain growth differentials across areas. However, the specific analysis of such theories is beyond the scope of this work.

The concept of spatial concentration in the core-periphery model has no clear empirical counterpart. Actually, the measures of concentration, related to the relative share of employment and value added of a single industry in one or few areas, are strongly affected by the territorial grid used for the concentration analysis: the narrower the grid, the higher the probability that the concentration process develops by spill-over towards adjacent areas. This is the case of spatial agglomeration: production is concentrated in few, close, very often adjacent areas. The location of industrial districts is a clear example.

The use of a territorial grid where the dimension of each unit reflects the dimension of one market (the labour market, in our case) does not rule out this problem. Even if each territorial unit tends to include the main geographical core of local economic activity and the adjacent spill-overs in the same area, agglomeration effects can economically join two or more LLMAs that are separated for geographical or communicational reasons.

These considerations lead to the conclusion that concentration and spatial agglomeration must be considered jointly if the core-periphery model has to be tested. The spatial concentration depicted in the model can be exhibited by both concentration within one or more areas and agglomeration around one or more leading development regions.

If the core-periphery model forecasts both concentration and agglomeration, this may not be true for other models of local development. Another important model, even if less formalised than the core-periphery one, is the model of growth poles proposed by Perroux, where development takes place by diffusion. The "contagion" model forecasts that growth springs from some growth pole and tends to spread out to the contiguous ones. In this case agglomeration is not necessarily linked to concentration. A clear example is the case of activities linked to urban expansion.

Another interesting case is the presence of concentration of some economic activities due to the existence of non-mobile production factors (e.g., ores). In these locations concentration can increase, but diffusion cannot.

Therefore, the analysis of concentration and spatial agglomeration can be used to select and evaluate different local development models. Basically, from a dynamic point of view the empirical implications of the models depicted above are the following:

In industries depending on non-mobile resources, no increase in spatial agglomeration is expected, even if concentration may vary (e.g. depending on the exploitation of new resources or shutting down of existing locations).

In "foot-loose" industries, in sectors were a core-periphery type growth pattern is at work, one should observe an increase both in concentration and spatial agglomeration.

Alternatively, in industries where a pattern of diffusion by growth poles is operating, one should detect a decrease in concentration, with an increase in spatial agglomeration if the sector is growing.

Another dynamic pattern occurs when a reduction in concentration is accompanied by a halt or decrease of spatial agglomeration, indicating a spatial diffusion of production in space and the loss of importance of industrial clustering.

Lastly, one should consider industries where location follows the distribution of population and economic activity in space; the spatial distribution therefore depends only in an indirect way on the local growth models discussed above (this is largely the case of construction, food production, non-business services, retail trade, …).

Agglomeration is not easy to measure. An indirect way to evaluate it is to consider the presence of spatial auto-correlation. If the agglomeration tends to concentrate from many to only one region, spatial auto-correlation tends to increase, because the areas without locations are perfectly correlated.

In the present paper, concentration is measured with the usual index:

$$(1) \qquad R = 1 - \sum_{1=0}^{n-1} (P_{i+1} - P_i)(Q_{i+1} + Q_i) .$$

Spatial auto-correlation is measured with Moran's *I* index,

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

where w_{ij} is the generic element of the contiguity matrix (nxn) obtained by applying to the Euclidean distances $d(r,s)$ between r and s (the centroids of two generic LLMAs) a spatial dampening factor in the exponential form $e^{-\alpha d(r,s)}$. For α the value of 0,03 has been selected for comparability with Brugnoli and Fachin (1998). Being the range of *I*:

$$(3) \qquad |I| \leq \sqrt{\frac{Var(LX)}{Var(X)}} ,$$

where *L* is the spatial lag operator (Cliff and Ord 1981), Moran's *I* has been then expressed in relative terms, by dividing it by its maximum value.

Data

The data used refer to the level of employment in local units from the industrial censuses 1961 to 1991 (Istat 1998), updated to 1996 to take into account the most recent census (Istat 2000). Municipality level data have been aggregated by LLMA. Industries are broken down in 47 sectors. The classification adopted (Istat 1998) takes care of the problem of changes over time and can be mapped on the ISIC Rev. 3 classification; nevertheless, caution is recommended for a few industries, that were partially covered up to 1981 (e.g. services) or underwent a substantive classification change (footwear, furniture, recorded media). For 5 sectors data are available only from 1971 (activities related to photography, cinema and video, reproduction of recorded media, manufacture of basic and structured metals).

In order to standardise with respect to the dimension of LLMAs, the variable here adopted is sectoral employment per km^2.

The territorial grid is represented by LLMAs as resulting from the 1991 population census. The identification of LLMAs is based on individual census data referring to the daily movements of persons to/from work to domicile (Istat 1997). The multi-step regionalisation algorithm at the basis of the definition of LLMAs refers to the existing geography of domicile-work daily travels and to the self-containment of territories so defined.

This grid is kept constant over time, because we are interested mainly in observing the dynamics of growth from the viewpoint of the existing spatial pattern of Italian economic geography. Nevertheless, the territorial grid itself is affected by growth processes, so that successful LLMAs tend to expand by incorporating nearby municipalities and unsuccessful ones tend to decay. This way, the analysis implies an underestimation of agglomeration, because part of it is already included in the territorial pattern resulting from the different success rate of LLMAs as represented by the 1991 boundaries. In other words, agglomeration is not completely captured by spatial auto-correlation.

Main results

Over the 35 years between the 1961 and 1996 industrial censuses, 14 industries exhibited an increase both in concentration and in spatial auto-correlation, while in 24 auto-correlation grew but concentration declined (for the total of economic activities, Moran's standardised *I* shows an increase of 6.3 percentage points, while the concentration index shows a very slight decrease of 0.5). In the remaining 9 sectors spatial auto-correlation dwindled (in 6 cases along with an increase in concentration and in 3 with a reduction). Thus, both growth patterns (i. e. the diffusion by growth poles and a core-periphery mechanism) are at work (Table 1).

Table 1. Concentration and auto-correlation by industry. Percentage change 1961-1996

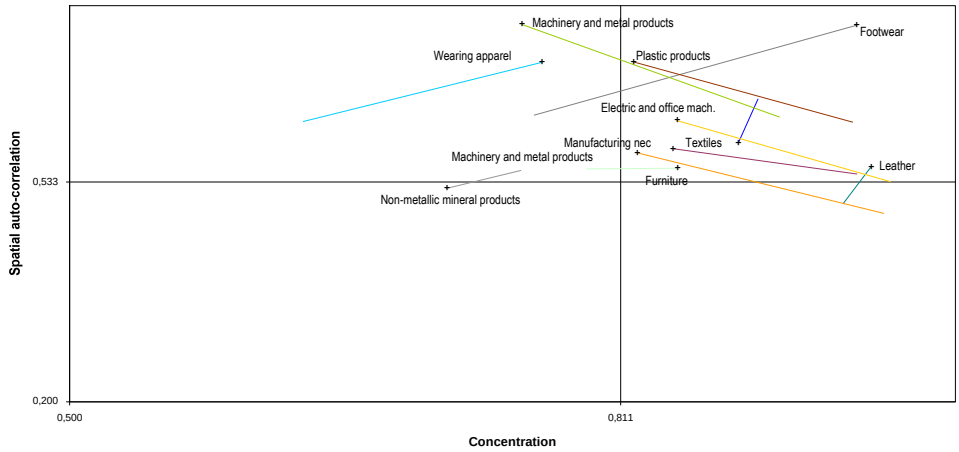
Industries	Concentration	Auto-correlation
Extraction of crude oil	0,7	1,2
Tanning and dressing of leather	1,6	5,6
Manufacture of wearing apparel	13,5	9,0
Manufacture of footwear	18,2	13,6
Manufacture of furniture	5,2	0,1
Activities related to photography (*)	0,9	11,4
Mechanical shops	0,3	11,7
Retail trade	3,0	3,7
Hotels and restaurants	0,7	2,0
Land transport	1,0	11,0
Post and telecommunications	3,9	5,2
Business service activities	3,9	14,1
Recreational activities	8,0	0,9
Other service activities	1,7	2,6
Manufacture of food products	-4,2	5,7
Manufacture of paper	-6,0	0,8
Publishing and printing	-7,3	7,3
Activities related to cinema and video (*)	-7,0	8,8
Reproduction of recorded media (*)	-3,5	1,2
Manufacture of basic metals (*)	-3,5	9,0
Manufacture of structured metals (*)	-7,3	11,3
Machinery and metal products	-14,5	14,0
Electric and office machinery	-12,0	9,3
Precision and optic machinery	-13,9	9,2
Manufacture of motor vehicles	-7,2	5,6
Manufacture of chemicals	-4,0	6,8
Manufacture of fuels	-8,4	7,8
Manufacture of man-made fibers	-0,7	5,0
Manufacture of rubber products	-1,1	5,2
Manufacture of plastic products	-12,4	9,1
Manufacturing n.e.c.	-10,4	3,8
Construction	-4,7	13,5
Wholesale trade	-2,1	10,8
Water transport	-1,2	15,2
Air transport	-0,7	1,1
Auxiliary transport activities	-2,9	5,5
Financial intermediation	-3,8	6,3
Insurance and pension funding	-14,6	2,7
Mining of metal ores	1,4	-9,1
Mining of coal	0,2	-2,7
Manufacture of tobacco products	1,8	-6,2
Manufacture of wood	3,0	-1,6
Electricity and gas supply	0,4	-1,8
Collection and distribution of water	17,8	-6,4
Other mining and quarrying	-7,9	-3,8
Manufacture of textiles	-1,1	-6,6
Man. of non-metallic mineral products	-4,2	-2,8
Total industries	-0,5	6,3

(*) Change 1971-1996

Focusing the analysis on manufacturing and selecting the industries more representative of Italian industrial clusters (Figure 1), the picture is more intelligible. Note that in Figure 1: (a) the longer the line in the graph, the more dynamic the industry; and (b) the steeper the slope towards spatial auto-correlation, the stronger the territorial effects at work both in the "diffusion" and the "core-periphery" cases.

Most sectors (5 out of 11) exhibit a pattern of diffusion from growth poles: namely manufacture of fabricated metal products, machinery and equipment; electric and office machinery; precision and optical instruments; plastics products and other manufactures (including jewellery, musical instruments, sport goods, toys, brooms and brushes). On the other hand, three industries (leather, footwear and wearing apparel) reveal a behaviour consistent with the core-periphery model.

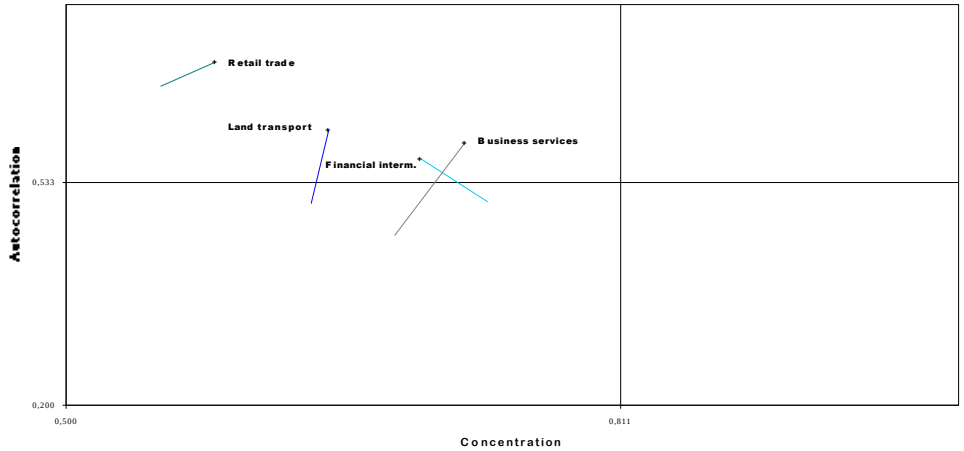
Figure 1. Concentration and auto-correlation in Italian LLMAs by selected manufacturing industries. Dynamics 1961-1996.



There are two exceptions (non-metallic mineral products and textiles) that register a decrease in both concentration and auto-correlation. Historically these industries played an important role in the industrialisation of Italy, especially in the birth of industrial clusters. The first sector – which includes the production of bricks, sanitary fixtures, tableware, tiles, worked stone, glass, cement, lime, plaster and other construction materials – has been affected over time by the increase in transport costs (at least in relative terms) and is obviously influenced by the location of construction activities and by localisation constraints. The evolution of textiles – with an even sharper decline in spatial auto-correlation – should be read in connection with the positive dynamics of apparel: in fact, there is evidence that many LLMAs once specialised in the textile sector moved downstream to reap the opportunities offered by the wearing apparel industry (Istat 2000).

Among non manufacturing industries (Figure 2), the evolution of sectors that complement the consolidation and development of industrial clusters is noteworthy: these are the cases of retail trade (where the movement towards greater concentration and auto-correlation is a hint to the modernisation of commercial distribution), land transport (which in Italy is characterised by small, mainly local firms), financial intermediation (the pattern here is one of diffusion) and especially business services (where the dynamics is of the core-periphery type).

Figure 2. Concentration and auto-correlation in Italian LLMAs by selected services. Dynamics 1961-1996.



Conclusions

We observed several sectoral patterns of local development that are affected by the technological structure of the sector, by the presence of mobile or non-mobile production factors and by the dimension of the market. The objective of the analysis was to identify and test the presence of two basic spatial location models: the core periphery and the contagion models. We use both the auto-correlation and concentration indexes for discriminating among them. In order to have more precise results and to capture the local nature of development in Italy we use a territorial grid – that of LLMAs – that is both very, very disaggregated and based on socio-economic patterns (*vis-à-vis* administrative boundaries).

In the 35 years under observation, with respect to the sum total of economic activities, spatial auto-correlation is rather dynamic, while spatial concentration is fairly stable. The results confirm our hypothesis, that the observation of this variable alone would have missed a great part of the phenomena to analyse. At the sectoral level, this is even more visible: with the exception of a few industries (mostly non-mobile), most sectors show a clear dynamics with respect to both concentration and auto-correlation.

The principal result is that – while industrial clustering processes are clearly at work – they cannot be reduced to a single spatial growth model: in many cases a core-periphery pattern seems to be operating, but in more instances an “infection” model is apparently at play. These behaviours coexist, not only among different sectors within the Italian economy, but also within the same industry at different times (i.e., likely, in different development phases).

These patterns, which are symptoms of spatial clustering of industrial activity, are not limited to the industries traditionally associated to the phenomenon of Italian industrial districts (so-called “light” manufacturing sectors; manufacture of metal products and machinery), but involve also some sectors considered unaffected by this factors, such as “heavy” manufacturing sectors (e.g. basic metal products, chemicals,

paper and publishing, …) and part of the services (retail trade, financial intermediation and business services).

On the contrary, no decisive evidence emerges in favour of "pure" diffusion (horizontal movements on the concentration axis with no spatial auto-correlation components). The cases where the dynamics of spatial auto-correlation is negative are limited (mining and quarrying; electricity, gas and water supply; manufacture of wood, textiles and non-metallic mineral products) and, generally speaking, the specific explanation can be traced in the features and the "history" of the industries involved.

Sources

Istat (1997*). I sistemi locali del lavoro.* Argomenti n. 10. Roma.

Istat (1998). *I censimenti delle attività produttive dal 1951 al 1991*. Informazioni n. 92. Roma.

References

Brugnoli, A. & Fachin S. (1998). *Concentrazione e diffusione: l'economia industriale italiana*. Quaderni del Dipartimento di scienze economiche n. 6. Università di Bergamo. Bergamo.

Cliff, A. D. & Ord J. K. (1981). *Spatial Processes – Models and Applications*. Pion. London.

Fabiani, S. & Pellegrini, G. (1998). *Education, Infrastructure, Geography and Growth: An Empirical Analysis of the Development of Italian Provinces.* Temi di discussione n. 323. Banca d'Italia.

Istat (2000). *Rapporto annuale. La situazione del Paese nel 1999*. Roma.

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

Signorini F. (ed.) (2000). *Lo sviluppo locale. Un'indagine della Banca d'Italia sui distretti industriali.* Donzelli. Roma.