



**SPECIALIZATION AND CONCENTRATION OF THE  
MANUFACTURING INDUSTRY IN THE  
ITALIAN LOCAL LABOR SYSTEMS**

**Sergio Lodde**

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# Specialization and Concentration of the Manufacturing Industry in the Italian Local Labor Systems

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## Abstract

The paper examines the main trends of sectoral specialization and geographic concentration of the manufacturing industry in the Italian Local Labor Systems from 1981 to 2001. The main results are the following: both specialization and concentration show a tendency, although very weak, to decrease during the period under examination. Specialization decreases steadily in the Southern areas while in the Northern regions the trend slows down significantly during the nineties, presumably because Northern Local Labor Systems have been more affected by the European integration process.

No such difference has been detected for concentration.

Innovative industries shares are quite stable in the aggregate, however a technological convergence process can be detected among the territorial units. High tech industries tend to locate into territorial clusters and to diffuse into contiguous areas.

High tech and increasing returns to scale industries are more geographically concentrated. A stable concentration degree over time is compatible with industries locational mobility across SLLs.

Keywords: industrial specialization, technological specialization, geographic concentration, Italy.

JEL codes: R12, L60

## 1. Introduction

Recently specialization and concentration in the European economies have attracted the attention of economists due to the accomplishment of the economic integration process in the European Union in 1992. In his seminal paper which launched the New Economic Geography research program Krugman (1991) pointed out that the degree of geographical concentration in the U.S.A. is much higher than in Europe, suggesting that the latter integration process should reduce the gap, making the European industry more localized. In general integration brings with it efficiency gains stemming from better opportunities to exploit economies of scale and location advantages given by differences in factor endowments, skilled labor force and market access. Although with different arguments traditional and new trade theories as well as the new economic geography predict relevant changes of the productive structure. Nonetheless the empirical studies at the European level draw a picture of relative stability more than one of radical changes so far. This is probably due to the fact that the specialization and concentration changes proceed at a very slow pace and can be detected only in the very long run. From this standpoint trade liberalization in the European Union is a too recent phenomenon to generate relevant effects on the dynamics of such processes.

On the other hand empirical results are heavily influenced by the sectoral and geographical breakdown level adopted in the analysis. What appears as a concentration or specialization trend at a certain level might be completely reversed at a different one. Thus results obtained more or less disaggregated data are often hardly comparable and do not allow to reconstruct a coherent picture of the trends at work at the European level.

In particular, problems arise from the lack of reliable data at the regional and sub regional level, namely the most relevant units of analysis according to recent theories.

This paper aims at examining sectoral specialization and geographical concentration in the Italian manufacturing industry at a very detailed breakdown level both sectoral and geographical, taking into account sector characteristics in terms of propensity to innovate and returns to scale. The chosen territorial units are the Local Labor Systems (SLL) which allow a more detailed territorial approach and are better suited to economic analysis, since have been constructed according to economic criteria instead of administrative ones. From the sectoral standpoint the

three digit NACE classification has been adopted since sectors can be better characterized in terms of innovativeness and returns to scale.

The paper is organized as follows. The first section is dedicated to a brief review of the relevant literature both theoretical and empirical. In the second data and methodology are described. The third examines general specialization trends, while the fourth focuses on technological specialization. The fifth deals with the evolution of concentration. The paper ends with some concluding remarks.

## **2. Review of the literature**

On the theoretical side important hints on specialization and concentration phenomena come from three research programs: the traditional factor endowments trade theory, the new trade theory and the new economic geography.

According to the neoclassical trade theory, economic integration should increase regional specialization as industries relocate to exploit comparative advantages arising from different factor endowments (Heckscher 1919, Ohlin 1933). Industries tend to locate where there is abundance of the most utilized factors of production. If regions with a higher relative endowment of physical capital specialize in industries which make intensive use of this factor and vice versa, we should expect an increase in regional specialization and in the geographic concentration of industries.

The new trade theories (Krugman 1980, Ethier 1982) stress the role of returns to scale, imperfect competition and transport costs. The abatement of trade barriers forces industries to concentrate in few regions in order to fully exploit scale economies. Moreover transport costs favour locations which allow better access to wide markets. To maintain their market power firms must differentiate their products from competitors. This, in turn, increases product varieties and intra-industry trade. The implications of these models with reference to geographic concentration and specialization are not easy to check empirically if the breakdown level of the analysis is not adequate. The integration process might cause changes in product varieties in which regions specialize without an discernible change in the productive structure as defined by the most frequently used sectoral classifications (Krugman 1980).

The new economic geography (Fujita, Krugman e Venables 1999, Ottaviano e Puga 1998) goes further and hypothesizes factor mobility,

thus endogenizing regional factor endowments. Labor mobility endogenously modifies local market size in immigration regions, fostering an increasing agglomeration of productive activities. The result of the interaction of centripetal and centrifugal forces is the emergence of strongly specialized central and peripheral areas. Changing conditions modify the effects of such interaction. The reduction in transport costs causes first a strong concentration of industries with high scale economies in central regions, while peripheral ones specialize in low returns to scale industries. A further reduction of transport costs allows the exploitation of scale economies even in peripheral areas, this, together with increasing congestion problems, makes centrifugal forces prevail on centripetal ones.

Therefore as integration goes on increasing returns industries location patterns assume a U shaped form with initial dispersion followed by concentration and dispersion again in a later phase. This is accompanied by first increasing and then decreasing regional specialization. New economic geography models do not offer unique predictions about the evolution of regional specialization due to the possibility of multiple equilibria and to the fact that results vary according to the starting hypotheses. To make an example, under the hypothesis of reduced mobility of labor and higher mobility of firms, the reduction in transport costs lets emerge decentralized clusters of industries with increasing returns to scale in several regions, as a consequence the degree of specialization might increase (Ottaviano e Puga 1998).

On the empirical side most of the studies find an increase in specialization at the national level in European Union member countries during the seventies and the eighties of the last century (Hufbauer e Chilas 1974, Molle e Boeckhout 1995, Amiti 1999, Walz 1999). This increase proceeds at a very slow pace and is the result of divergent processes of concentration in some countries and dispersion in others. From the temporal point of view no well defined trend can be detected either. Middelfart-Knarvik et al. (2004) find that specialization has actually decreased in European countries in the seventies end increased later on during the eighties showing a U shaped trend.

As regards concentration Aiginger and Davies (2004) find a decreasing trend between 1985 and 1998, while an opposite result comes from Brühlhart and Torstensson (1996), Amiti (1998) and Brühlhart (1998) studies. In particular Brühlhart (1998) remarks that industries characterized by high economies of scale, in accordance with the NEG models predictions, form clusters even at low levels of integration, while

those with lower returns to scale tend to agglomerate in a later phase of the integration process. Labor intensive industries are more dispersed. Finally, also with reference to concentration, Middelfart-Knarvik et al. (2004) find divergent trends between the seventies (reduction) and the eighties (increase).

At the regional level Molle (1996) finds a general tendency to convergence of productive structures and to despecialization between 1950 and 1990. The study shows that in 1990 peripheral regions were more specialized. Hallet (2002) looks into the distribution of economic activities in 119 regions between 1980 and 1995 making use of value added data instead of employment. According to his findings, specialization slightly decreased in the period under examination starting from the eighties (although this result, by admission of the author himself, might depend on the low level of sectoral disaggregation of the data) while geographic concentration does not show significant changes.

As regards Italy, Pagnini (2002) analyses the agglomeration of 100 manufacturing sectors showing that centripetal forces tend to prevail against centrifugal ones, and that the most innovative sectors as well as those with higher human capital endowment are more agglomerated compared to the others.

The study of de Dominicis, Arbia and de Groot (2007) focuses mainly on spatial aspects. The authors examine simultaneously geographic concentration and spatial dependence in manufacturing industry and services. They find that concentration has diminished in manufacturing industry and that traditional and high tech industries are the most concentrated.

### **3. Data and methodology**

Figures used in this study come from industry and services censuses done in 1981, 1991 and 2001 and refer to employment in manufacturing industry by labor local system at three digits breakdown level according to the NACE classification. Five sectors (23.3: processing of nuclear fuel; 28.3: manufacture of steam generators; 31.2: manufacture of electricity distribution; 37.1: recycling of metal waste and scrap; 37.2: recycling of non metal waste) have been excluded due to the impossibility of reconstructing reliable figures for 1981.

The territorial units of analysis are local labor systems (from now on SLLs) which are particularly suitable for analysing the territorial

distribution of economic activities since, contrary to regions and provinces, they are defined according to economic criteria instead of administrative ones. More precisely they can be regarded as territorial units characterized by a high degree of self containment in terms of labor force commuting patterns. Thus they are clusters of economic activities around which most of the resident population in the included municipalities gravitates.

On one side this is a very sound methodological definition for our purposes, however it raises some problems not easy to solve when long run dynamics are the target of the analysis. Actually their territorial extension changes over time according to the changing values of the variables used to define them. For this reason the number of the SLLs has diminished from 955 down to 686 between 1981 and 2001. The growth in size reflects a wider and more complex articulation of the labor market and an increase in the attractive capacity of their major urban centres compared to the hinterland. This changes give rise to serious problems of comparability across the three censuses. To maintain comparability the SLLs defined for the intermediate year (1991) have been kept unchanged throughout the period under analysis, assuming that this solution minimizes the bias caused by the improper definition of the territorial units. Therefore the adopted territorial grid is composed of 784 SLL.

For robustness reasons the analysis of productive specialization and geographic concentration has been done using three different indicators. More precisely Krugman, Gini and Theil indices have been constructed. These indices can be defined both as relative and absolute measures. The difference being that, in the former case, the reference distribution is a uniform one. This is equivalent to assuming that each sector shares in the whole sample of geographical units as regards specialization (or those of geographical units for each sector in the case of concentration) are all equal. In the latter case the reference distribution is the effective one of the aggregate sample of sectors or territorial units.

The two types of indices might be more or less suitable according to the goal of the analysis. Relative indices are to be preferred when the goal is checking the degree of dissimilarity of the productive structure of one area (or of one sector) compared to the whole sample or emphasizing the behaviour of small units. However they have the disadvantage of weighting outliers too much. The problem of extreme values dominance is less acute in absolute indices. Therefore we chose to use the latter both because the size variability of the local labor systems

is very high<sup>1</sup>, and because the goal here is not as much to analyze the behaviour of specialization within the Italian context, as to look into the effects of the European integration process. Taking the Italian aggregate distribution as the reference one could bring to erroneous conclusions if it evolves in an opposite direction compared to the European Union as a whole<sup>2</sup>.

The absolute indices have been calculated in the following way:

Krugman index<sup>3</sup>

$$\text{specialization: } K^r = \frac{1}{2} \sum_{s=1}^S \left| \mu_r^s - \frac{1}{S} \right|$$

$$\text{concentration: } K^s = \frac{1}{2} \sum_{r=1}^R \left| \lambda_r^s - \frac{1}{R} \right|$$

Gini index

$$\text{specialization: } G^r = 1 - \sum_{n=1}^S \frac{1}{S} (\mu_r^n + \mu_r^{n+1})$$

$$\text{concentration: } G^s = 1 - \sum_{n=1}^R \frac{1}{R} (\lambda_n^s + \lambda_{n+1}^s)$$

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<sup>1</sup> In 2001 census the average size of SLLs in terms of employment was 6186, and the standard deviation 16731.

<sup>2</sup> For example an increase in relative specialization of the SLLs compared to the national manufacturing industry might be compatible with despecialization with respect to Europe if Italy, in turn, despecializes.

<sup>3</sup> In the specification adopted here the Krugman index has been halved. In this way the index varies between 0 and 1 (in the original formulation the range is from 0 to 2) and can be more easily interpreted. Moreover it measures the percentage of industrial activities which should change sector to obtain a uniform distribution.

Theil index

$$\text{specialization: } T^r = \sum_{s=1}^S \mu_r^s \log(S\mu_r^s)$$

$$\text{concentration: } T^s = \sum_{r=1}^R \lambda_r^s \log(R\lambda_r^s)$$

where:

$\lambda_r^s$  = share of region  $r$  in total employment of sector  $s$

$\lambda_n^s = \sum_{r=1}^n \lambda_r^s$  = cumulative share of the first  $n$  regions in total

employment of sector  $s$

$\mu_r^s$  = share of sector  $s$  in total manufacturing employment of region  $r$

$\mu_r^n = \sum_{s=1}^n \mu_r^s$  = cumulative share of the first  $n$  sectors in total  
manufacturing employment of region  $r$

S = number of sectors

R = number of regions

Two tests have been run to check specialization and concentration trends: the sign test and a cross section test. The former is a non parametric test which compares positive and negative variations of the chosen indicator and checks whether the given shares of increases and decreases are likely to be generated by chance. If the goal is to test the existence of a tendency to specialize or to despecialize (concentrate/deconcentrate) within a defined time span the null hypothesis can be formulated as follows:

$$1) H_0: p(I_{it} - I_{it-1} > 0) = 0.5 \quad i=1 \dots n$$

where  $p$  is the probability and  $I$  is the specialization or concentration index.

If we are interested in the significance of the differences between two sub periods the null hypothesis becomes:

$$2) H_0: p(I_{it+1} - I_{it} > 0) - p(I_{it} - I_{it-1} > 0) = 0 \quad i=1 \dots n$$

The sign test has been preferred to the t-test due to non normality problems in the distributions of the examined variables.

The cross section test involves regressing the log of the specialization (concentration) index at time  $t$  on itself at time  $t-1$ <sup>4</sup>.

$$3) \log(I_{it}) = a + b \log(I_{i,t-1})$$

A coefficient  $b$  lower than 1 indicates that during the examined period a tendency to despecialize (deconcentrate) has been at work, a value higher than 1 denotes an increase in specialization (concentration). Finally  $b=1$  means stability over time.

A  $b$  value lower than one is a necessary but not sufficient condition for despecialization (deconcentration). The next condition requires the initial value of the index to be higher than the long run one, measured by the expression:  $a/(1-b)$ .

Problems of spatial dependence have also been addressed in the analysis. For this purpose the Moran index both global and local has been calculated, using a binary distance matrix where contiguous SLLs take the value of 1 or 0 otherwise<sup>5</sup>.

#### 4. Specialization

In general the degree of specialization slightly decreased during the period between 1981 and 2001. Figure 1 shows the distribution of Krugman specialization index values among the 784 SLLs in 1981 and in 2001<sup>6</sup>. We can observe a small shift of the whole distribution toward the left and the appearance of a further local maximum in the left-hand tail which suggests the emergence of a bimodal distribution with a second group of relatively less specialized SLLs. The degree of specialization seems rather stable over the period nonetheless the shift of the distribution indicates a slight tendency toward despecialization.

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<sup>4</sup> This methodology has been applied in several studies on productive and technological specialization (Pavitt 1989; Cantwell 1989; Dalum, Lursen, Villumsen 1998; Aiginger, Pfaffermayr 2004)

<sup>5</sup> Two SLL are defined as contiguous if the distance between their centroids is less than the maximum distance. The latter, in turn, is a distance such that every SLL has a contiguity relationship with at least another one.

<sup>6</sup> The distributions obtained using Gini and Theil indices are omitted for the sake of brevity since they are not significantly different.

This stability over long periods is a general characteristic of specialization behaviour, confirmed in several empirical analyses, both at the national level (Hufbauer e Chilas 1974, Molle e Boeckhout 1995, Amiti 1999, Walz 1999, Middelfart-Knarvik et al. 2004) and at the regional one (Molle 1996, Hallet 2002).

A first hint about the strength of such trend can be obtained by looking at the average values of the specialization indices. During the two decades the variation of the three indices is very small as shown in table 1. However this is not a random change, rather it is statistically significant. In table 2 the results of the sign and of the cross section tests for the three indices are reported. In all cases negative variations of the indices prevail on positive ones at 1% significance level. The tendency to despecialize is confirmed by the results of the second test shown in table 3. They confirm the findings of other papers on the specialization trends in the European regions (Molle 1996, Hallet 2002, Ezcurra et al. 2006). Ezcurra et al. find a reversal of the despecialization trend of the eighties with an increase in specialization in the following decade. This U shaped behaviour might be due to the acceleration of the European integration process after the complete liberalization of capital and goods movements in 1992.

It is interesting to check whether this reversal occurred in the Italian economy as well. For this purpose let us examine the specialization trend during the two decades by means of the same tests done previously. As regards the sign test the null hypothesis is now 2), in other words what we want to check is whether specialization indices variations are significantly different in the two periods.

The analysis of the sub periods trends discloses some differences in the evolution of specialization (table 4). The shares of the increases are significantly higher in the second decade using Krugman and Gini indices, while no significant difference can be detected when the Theil index is applied. In general the results suggest that the despecialization trend has slowed down somewhat in the second decade.

This general trend disguises significant territorial differences in specialization behaviour which can be clearly observed by means of a simple visual examination. Figure 2 shows the SLLs with increasing, decreasing or stable Krugman index<sup>7</sup>. In the second decade the

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<sup>7</sup> Stability is defined as an increase or a decrease of the index lower than 2 percentage points. Variation ranges from -28 to +33 points.

specializing SLLs appear to increase in the Northern regions while in the centre and in the South the picture is rather less clear.

Dividing the sample into three areas, North, Centre and South and running the sign test we get the results reported in table 5. We can see that in the Northern area the shares of increases of the three indices are significantly higher in the second decade, while in the Centre and in the South no appreciable difference can be detected between the two periods. The different behaviour of the North on one side and the two remaining areas on the other is confirmed by the cross section test (the results are shown in table 6).

The  $b$  coefficient is always lower than one in both periods, however, as we already know, this is not enough to conclude that there has been despecialization. One more condition must be fulfilled: the initial value of the index must be higher than the long run one (measured by  $a/(1-b)$ ). Taking a look at the results for the North we can see that the percentage share of SLLs which satisfy this condition decreases considerably between the first and the second decade and this change involves all the indices (see “init.val.>1/(1-b)” in table 6). On the contrary it is almost unchanged in the Centre and increases in the South, where nearly all SLLs fulfil the second condition in the period 1991-2001.

In our view these results show that in the Centre and the South the tendency to despecialize of the first decade persists in the second, while in the North the trend is reversed in the nineties, although the change is far from dramatic given that the increase in the Krugman index for the whole area amounts to just two points.

A likely explanation for this different behaviour is that Northern SLLs are more integrated in the European market and, as such, have been affected to a greater extent by the accomplishment of trade liberalization in the European Union than their Southern counterparts.

## **5. Technological specialization**

Italian manufacturing industry specialization pattern is characterized by the dominance of traditional sectors (textiles, clothing, shoes), the instrumental machines branch being the only technology intensive sector in which Italy shows a clear comparative advantage (Onida 1978, De Nardis 1997). This pattern did not change very much in the recent years and this is one of the most important reasons for the present competitiveness problems of the Italian economy in the globalized

international context. This fact can be easily checked taking a look at table 7 which shows the distribution of employment among technology intensive and traditional sectors according to the O.E.C.D. classification<sup>8</sup>. The share of the high tech sectors moderately increased between 1981 and 2001 but this change is offset by a simultaneous reduction in the share of the medium-high technology industries. On the whole the weight of traditional sectors has remained substantially unchanged in the last two decades. Nonetheless at a more disaggregated territorial level the geography of technology intensive industries displays some change.

In figure 3 we can observe some territorial clusters of high tech manufacturing industries in 1981 and twenty years later. The clusters are mapped using the Moran local index of spatial association (LISA)<sup>9</sup>. Three main clusters can be distinguished: two in the North and one in the Centre. The first was located around Turin in 1981 and included four SLLs specializing in office, accounting and computing machinery (Ivrea is among them). In twenty years the cluster shrank somewhat reducing from four to two SLLs (Turin is no longer included). Optical instruments is the dominant industry in the North-Eastern cluster around Belluno.

This cluster grew in size capturing some contiguous SLLs, probably thanks technology diffusion mechanisms typical of the small firms networks which characterize Italian industrial districts. The biggest one gravitates around the capital Rome and includes a variety of industries: office, accounting and computing machinery; TV/radio transmitters, line communication apparatus; electronic components; pharmaceuticals; medical equipment.

To the mentioned clusters two more minor agglomerations of high tech industries can be added: one near Naples (TV/radio transmitters) and the second in the Catania SLL (telecommunications).

Despite the described changes, on the whole, the geography of high tech sectors seems fairly stable along this period. Perhaps some sign of

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<sup>8</sup> The O.E.C.D. classification grounds on R&D expenditure and is composed of four classes: 1) high technology industries; 2) medium-high technology industries; 3) medium-low technology industries; 4) low technology industries.

<sup>9</sup> To calculate the index the employment shares have been preferred to the location quotients, often used to analyse technological specialization, because the latter are affected by serious problems of comparability over time (see De Benedictis e Tamberi 2004). Moran statistic and its significance are reported in table 8.

change can be detected in the South where the association low-low was widespread at the beginning of the period but nearly disappears twenty years later.

However, as Maggioni (2002) noticed, in the Italian case territorial clusters are mostly composed of small and medium firms characterized by a lower technology intensiveness. To get a picture closer to the Italian technological specialization a map of the clusters of medium-high technology industries is shown in figure 4. Here we can see two big clusters in Piemonte-Lombardia on one side, and in Emilia-Romagna regions on the other, which merge into a very extended one during the period under examination. Some smaller ones can be found in Veneto, Tuscany, Umbria and Abruzzo regions.

This spatial picture suggests that high and medium-high technology industries are localized in well defined areas but it does not necessarily entail that technological specialization is becoming more and more polarized among the Italian SLLs. On the contrary a process of technological convergence has been at work between the beginning and the end of the period. We check this by regressing the variation of the high tech and medium-high tech industries shares between 1981 and 2001 on the log of the initial value of the same variable. Two control variables have been also included in the regression. The first is a North-South dummy which is meant to control for structural differences between the two macro regions. The second is a general measure of the degree of specialization (Krugman specialization index) at the beginning of the period. The purpose in this case is to check whether Marshall-Romer versus Jacobs type externalities have been at work (Jacobs 1969, Audretsch and Feldman 2004). If the former prevailed the expected sign of the coefficient is positive.

Given the presence of spatial autocorrelation Moran and LM tests have been run to evaluate the appropriateness of a model which takes it into account. The test LM for the spatial error model turned out to be significant (6%). Thus two estimates have been done: one is a standard OLS, the other is a spatial error model. However the results do not differ very much as can be seen looking at table 9.

The coefficient of the initial value is negative and significant at 1% level, suggesting that beta convergence has occurred during the period<sup>10</sup>. On the other side there is no discernible difference between the SLLs

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<sup>10</sup> Sigma convergence has occurred as well since standard deviation decreased from 1.92 to 1.30.

belonging to the Northern and the Southern regions. As regards initial specialization, the regression results show that innovative industries shares grew less in the initially more specialized SLLs compared to the others. This evidence can be interpreted as an indication that the Marshallian-Romer externalities had a minor role compared to those stemming from diversification of the productive structure (Jacobs type externalities).

## 6. Concentration

In the present context concentration must be interpreted as spatial agglomeration rather than firm or plant concentration as is usually defined in the industrial organization literature. Thus a concentrated sector is defined as an industry located in few local labor systems, while less concentrated ones are more geographically dispersed.

The results of both the sign (table 10) and the cross section (table 11) tests show that concentration decreased slightly during the eighties and the nineties. According to the sign test the Krugman index of concentration decreased in 65.3% of the manufacturing sectors. For the other two indices the value is even higher and the difference between the shares of positive and negative variations is always highly significant. In the cross section test the b coefficient is always less than one and for 90% of the industries the initial value lies above the long run level. As in the specialization case the trend proceeds at a very slow pace, given that the average value of the Krugman index varies from 0.80 down to 0.78<sup>11</sup>. Sectors mobility in the concentration ranking as measured by 1-R is also rather limited.

Contrary to what happens in the specialization case no significant differences come out between the two decades<sup>12</sup>. The trend toward deconcentration goes ahead very slowly without substantial changes in the nineties as well. This result is at odds with the increasing spatial concentration in Europe during the eighties found in other studies (Brühlhart 1995; Amiti 1998, 1999; Haaland et al. 1999). These trends and the fact that, as Krugman (1991) remarks the concentration degree is much higher in the United States compared to Europe, foster the

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<sup>11</sup> The weighted average decreases from 0.76 to 0.72.

<sup>12</sup> The sign test for the two periods differences is not significant for all the indices.

expectation that the accomplishment of trade liberalization in the European Union should accelerate the trend toward concentration.

Nevertheless the decreasing concentration in the nineties is confirmed for the Italian manufacturing industry in other studies (Pellegrini, 2004; de Dominicis, Arbia e de Groot, 2007) and is also a European phenomenon as Midelfart-Knarvik et al. (2004) and Aiginger and Pfaffermayr (2004) show in their analyses.

From the spatial point of view the values of the Moran index of global spatial autocorrelation for each sector show that between 1981 and 2001 a small increase of spatial association has occurred. The average value of the index increases by a small amount (from 0.07 to 0.10), while the number of sectors for which the index is significant changes from 74 to 90 (over 98). Although figures must be read with caution because we are dealing with very weak trends, nevertheless a possible interpretation is that, though concentration in each SLL decreased, sectors tend to locate in spatially contiguous SLLs<sup>13</sup>.

Let us now look with more detail into the more or less concentrated sectors and their characteristics as regards technology and scale economies. To simplify the analysis industries have been classified according to their degree of concentration and to their higher/lower mobility across classes. The first two classes group stable industries, namely those which kept their degree of concentration substantially unchanged along the examined period. In the other two concentrating and deconcentrating sectors are included, that is to say those which showed the biggest increase or decrease in the concentration index.

Let us start by considering, within the twenty most concentrated industries in 1981 (the first quintile), those which remained within this group twenty years later (table 12). Most of them (12 over 15) are concentrated in Northern SLLs. In this class we can find several sectors with high scale economies, such as chemical products for agriculture, synthetic fibres, motor vehicles, aircraft, iron and steel basic industries. All less concentrated sectors (see table 13), except for plastic products,

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<sup>13</sup> The concentration indices used here measure geographic concentration in the sense that they capture the dissimilarity of sectors distribution among the SLLs, but do not take into account their spatial location. This means that, if the industry is completely concentrated in, say, two SLLs, the value of the index remains the same both if they are contiguous or very far from each other.

belong to the low scale economies group according to Pratten's classification (Pratten 1988)<sup>14</sup>.

As regards innovativeness nine of the fifteen sectors in the first class belong also to the groups of high and medium-high technology industries. On the contrary none of the less concentrated ones is a member of these groups.

To test more thoroughly the relationship between concentration on one side and innovativeness and economies of scale on the other, the concentration indices have been regressed on dummy variables constructed according to the OECD and Pratten classifications. The expected signs are positive in both cases for high and medium-high technologies and for high scale economies dummies.

As regards technology the positive expected correlation is grounded on the importance for innovative industries of agglomeration economies arising from knowledge spillovers. In the scale economies case, increasing concentration is predicted by the new economic geography models and is a frequent result in the empirical literature (Brülhart e Torstensson 1996, Amiti 1998). The results reported in table 14 are obtained using the Krugman index as dependent variable<sup>15</sup>.

The dummy for high tech sectors is significant only in the 1981 regression, while medium-high technology industries show up a tendency to higher spatial concentration which seems quite stable over time. This result reflects the characteristics of Italian local productive systems, in particular the industrial districts, which often specialize in few medium or medium-high technology industries.

The scale economies dummies are always positively and significantly correlated with the dependent variable, both for high and intermediate scale economies industries<sup>16</sup>.

What the previous analysis shows about concentration is a picture of substantial stability over time. This evidence is confirmed if we look at the behaviour of the groups of ten sectors which concentrated or deconcentrated most during the period under exam. Even in these two

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<sup>14</sup> Pratten's classification is divided into three groups: high scale economies industries; medium scale economies industries; low scale economies industries.

<sup>15</sup> The regression run with the other two indices as dependent variables are not reported for brevity since no significant differences came out.

<sup>16</sup> Another regression has been run substituting a scale economies indicator built on plants average size for the dummy. The positive correlation between concentration and scale economies is confirmed.

groups deviations from the whole sample average are relatively small. The first group of ten most concentrating sectors is shown in the upper part of table 15. The biggest change (sector 15.6) amounts to no more than 15 percentage points in terms of the Krugman index, and the group average is 8.3 points.

A similar story applies to the deconcentrating industries. Here variations are a little wider (the maximum value is -0.2 and the average equals -0.13) but far from dramatic.

However we are dealing with geographic concentration, therefore it is interesting to look more deeply behind the stability of the concentration indices, to check whether it implies a spatial stability of the industries or not. The two phenomena need not move together since, if an industry relocates from a SLL to another one and its share decreases in the former as much as increases in the latter, the concentration index does not change but industry location is no longer the same. Thus the stability of the concentration index is compatible with some spatial mobility of the industry.

Mobility can be measured by the correlation coefficient between the industry shares by SLL in the initial and the final year. A high correlation coefficient implies low mobility and vice versa. Table 16 displays the ten industries with the lower and higher correlation coefficients. Therefore on the left we can see the spatially most mobile industries and on the right the most static ones. Five industries of the mobile group (23.1, 31.4, 32.3, 33.5, 35.5) belong also to the class of the most concentrated industries both in 1981 and 2001, namely of those industries which show the most stable behaviour according to the concentration index.

A more general measure of the association between concentration index and spatial stability can be obtained by correlating the mobility coefficient with the absolute deviations from the mean of the index variations between 1981 and 2001. The correlation coefficient is just 0.11 and is not significant.

The conclusion which can be drawn from this exercise is that, at least for the Italian case, the stability of the geographic concentration index does not necessarily entail locational stability. On the contrary some industries with a very stable concentration level have relocated to other SLLs.

## 7. Concluding remarks

The main results of the previous analysis can be summarized as follows.

- Italian local labor systems show a tendency to despecialize during the examined period. This trend proceeds at a very slow pace but is statistically significant according to the tests done.
- A significant difference in the specialization trends can be detected between the Northern areas and the Southern ones in the two decades. In particular, in the South the despecialization trend carries on without any change from the first to the second decade, while in the North there are significant signs of a reversal of the trend, although weak, during the nineties. This difference in the behaviour of the two areas is likely to depend on Northern SLLs being more integrated in the European market and, for this reason, having been more affected by the accomplishment of the trade liberalization process.
- The technological specialization did not change very much in the aggregate. Some high and medium-high technology territorial clusters have been identified but this does not mean that a polarization trend is going on. On the contrary a process of technological convergence has occurred among the SLLs. Within that process no difference has been found between Northern and Southern local labor systems.
- The share of innovative industries grew less in the initially more specialized SLLs. This suggests that externalities of the Marshall-Romer type did not play a major role.
- Concentration shows a decreasing trend which proceeds very slowly but steadily along the two decades. Simultaneously an increase in spatial association for most industries has occurred. This suggests that locational dispersion tends to be confined within contiguous areas.
- The degree of concentration is influenced by technology and economies of scale. Innovative and increasing returns to scale industries show a higher degree of concentration *ceteris paribus*.
- No difference can be detected between the two decades as regards the concentration trend. This is at odds with the findings of some

studies on European countries (but not those on Italy) however that evidence comes from analyses conducted at a much lower breakdown level both sectoral and spatial. It would be interesting to check whether those results are confirmed at a more disaggregate level.

- The relative stability of concentration pattern disguises some spatial mobility of industries which relocated to other areas during the period under analysis.

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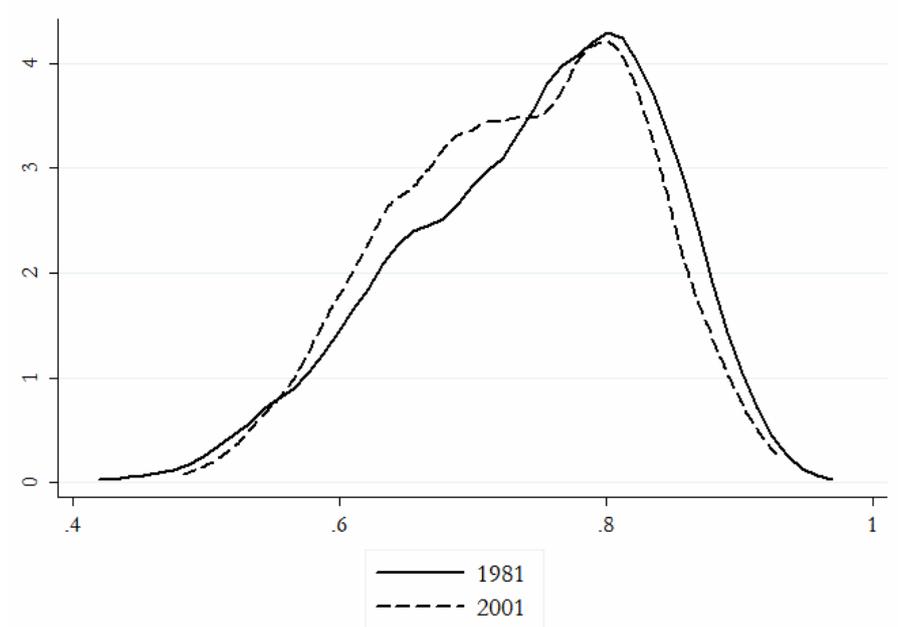
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## Figures and tables

Figure 1. Krugman specialization index distribution by SLL. 1981, 2001



Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 1. Variation of the specialization indices. 1981, 2001

	<i>Krugman</i>	<i>Gini</i>	<i>Theil</i>
1981	0.75	0.87	1.94
2001	0.73	0.86	1.88

Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 2. Sign test. Krugman, Gini and Theil specialization indices. 1981-2001.

	<i>Krugman</i>	<i>Gini</i>	<i>Theil</i>
% positive var.	38.7	42.2	41.6
% negative var.	61.3	57.8	58.4
Significance	0.00	0.00	0.00

Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 3. Cross section test. Krugman, Gini and Theil specialization indices. 1981-2001.

	<i>Krugman</i>	<i>Gini</i>	<i>Theil</i>
A	0.039***	-0.027***	0.072***
B	0.863***	0.856***	0.834***
R <sup>2</sup>	0.84	0.80	0.72
init.val. > a/(1- b)	0.78	0.77	0.75
b/R	0.94	0.96	0.98
1-R	0.08	0.11	0.15

Source: ISTAT, Industry and Services Censuses 1981, 2001

Legend:

\*\*\*= significance level  $\leq$  1%

\*\* = significance level  $\leq$  5%

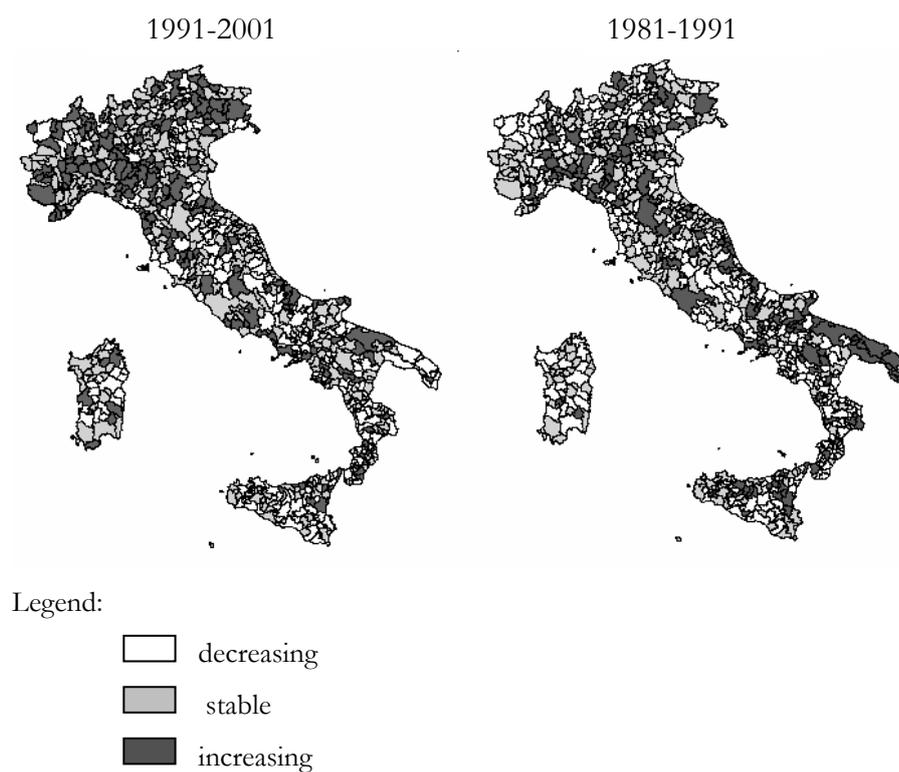
\* = significance level  $\leq$  10%

Table 4. Sign test. Krugman, Gini and Theil specialization indices. Variations between 1981-1991 and 1991-2001.

	<i>Krugman</i>	<i>Gini</i>	<i>Theil</i>
% positive var. 81-91	37.7	40.4	41.8
% positive var. 91-01	47.9	48.6	46.7
Significance	0.00	0.02	0.16

Source: ISTAT, Industry and Services Censuses 1981, 1991, 2001

Figure 2. Specialization and despecialization in the SLLs. 1981-91; 1991-2001



Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 5. Sign test. Krugman, Gini and Theil specialization indices. Variations between 1981-1991 and 1991-2001. North, Centre, South.

	<i>Krugman</i>	<i>Gini</i>	<i>Theil</i>
		<i>North</i>	
% positive var. 81-91	64.6	60.8	56.5
% positive var. 91-01	42.4	43.1	44.5
Significance	0.00	0.00	0.05
		<i>Centre</i>	
% positive var. 81-91	47.1	44.1	41.9
% positive var. 91-01	35.3	32.3	35.3
Significance	0.16	0.14	0.43
		<i>South</i>	
% positive var. 81-91	35.1	41.4	42.2
% positive var. 91-01	35.3	40.8	40.8
Significance	1.00	0.95	0.82

Source: ISTAT, Industry and Services Censuses 1981, 1991, 2001

Table 6. Cross section test. Krugman, Gini and Theil specialization indices. Variations between 1981-1991 and 1991-2001. North, Centre, South.

	<i>Krugman</i>	<i>Gini</i>	<i>Theil</i>
		<i>North 1981-91</i>	
A	0.008***	-0.012***	0.002
B	0.954***	0.960***	0.956***
R <sup>2</sup>	0.93	0.93	0.91
init.val. > a/(1- b)	0.84	0.89	0.90
		<i>North 1991-01</i>	
A	0.028***	0.007**	0.041***
B	0.947***	0.929***	0.942***
R <sup>2</sup>	0.94	0.93	0.91
init.val. > a/(1- b)	0.04	0.19	0.24
		<i>Centre 1981-91</i>	
A	0.016***	-0.020***	0.010***
B	0.926***	0.915***	0.935***
R <sup>2</sup>	0.90	0.90	0.89
init.val. > a/(1- b)	0.90	0.88	0.95
		<i>Centre 1991-01</i>	
A	0.015***	-0.013***	-0.002
B	0.939***	0.955***	0.945***
R <sup>2</sup>	0.90	0.87	0.86
init.val. > a/(1- b)	0.84	0.98	0.98
		<i>South 1981-91</i>	
A	0.044***	-0.025***	0.168***
B	0.875***	0.805***	0.748***
R <sup>2</sup>	0.82	0.73	0.61
init.val. > a/(1- b)	0.85	0.71	0.63
		<i>South 1991-01</i>	
A	-0.002	-0.012***	0.032
B	0.969***	0.962***	0.917***
R <sup>2</sup>	0.87	0.83	0.76
init.val. > a/(1- b)	1.00	0.98	0.90

Source: ISTAT, Industry and Services Censuses 1981, 1991, 2001

Legend:

\*\*\*= significance level <= 1%

\*\* = significance level <= 5%

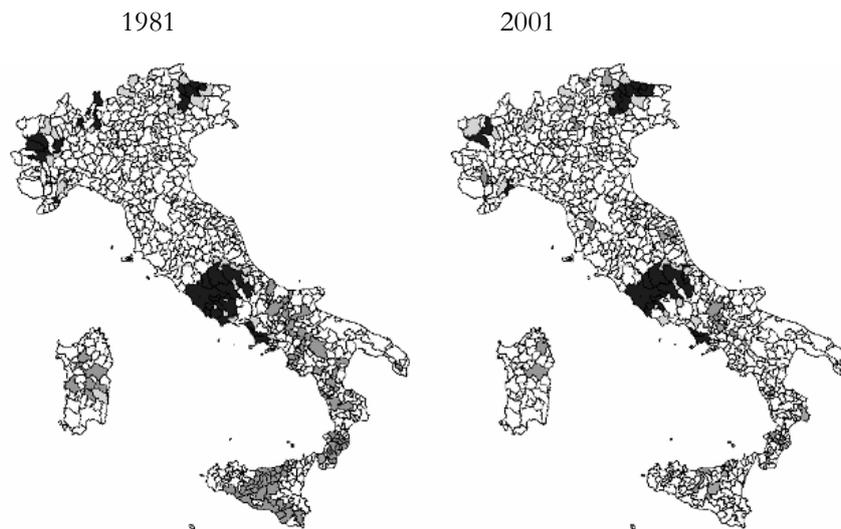
\* = significance level <= 10%

Table 7. Sectors shares by technological level. 1981, 1991, 2001.

	<i>1981</i>	<i>1991</i>	<i>2001</i>
high technology	6.0	7.7	7.2
medium-high	18.1	14.4	15.9
medium-low	31.4	31.3	32.4
low	44.5	46.6	44.5

Source: ISTAT, Industry and Services Censuses 1981, 1991, 2001

Figure 3. High tech industries clusters. 1981, 2001

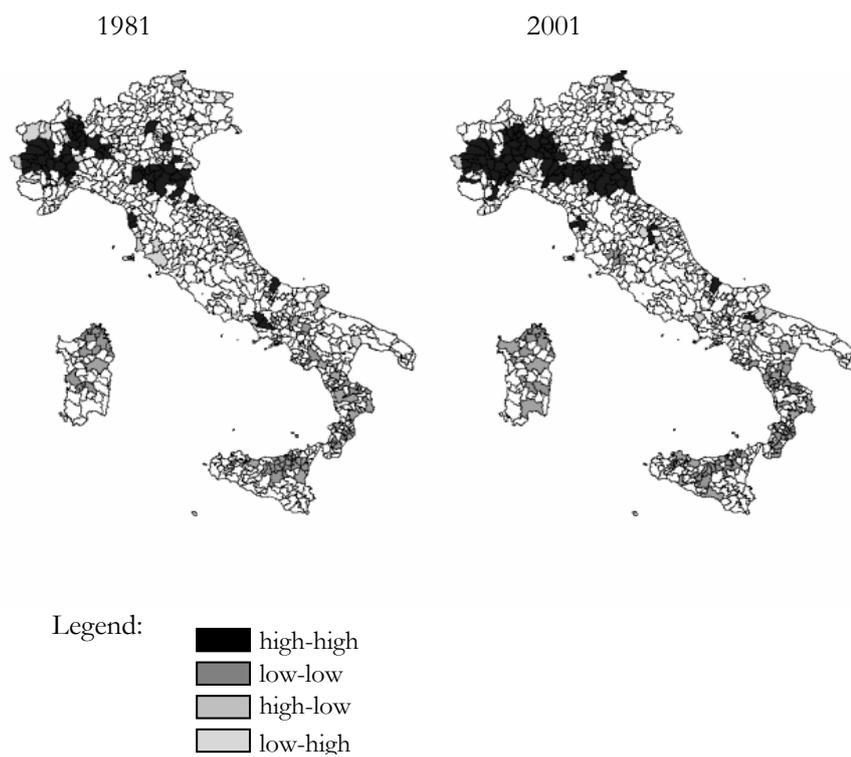


Legend:

- high-high
- low-low
- high-low
- low-high

Source: ISTAT, Industry and Services Censuses 1981, 2001

Figure 4. Medium-high technology industries clusters. 1981, 2001



Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 8. Moran local index for high tech clusters. 2001.

	cod. SLL	Moran I.	signif.
Cluster Ivrea	6	15.024	0.000
	53	17.338	0.000
	54	13.670	0.000
Cluster Belluno	195	148.611	0.000
	196	94.684	0.000
	197	36.957	0.000
	198	11.635	0.001
	199	75.403	0.000
	200	228.337	0.000
	201	77.268	0.000
Cluster Roma- L'Aquila	399	30.765	0.000
	403	14.371	0.000
	410	20.875	0.000
	415	12.264	0.000
	482	35.654	0.000
	485	51.27	0.000

Source: ISTAT, industry and services census 2001

Table 9. Technological convergence. Dependent variable: variation of the high and medium-high tech industries shares. 1981-2001. Estimates: OLS, spatial error model

	<i>OLS<sup>a</sup></i>	<i>Spatial error model</i>
Log(hmtec81)	-0.774***	-0.776***
Log(spec81)	-1.931***	-1.992***
dumNS	-0.055	-0.073
Constant	1.302***	1.397***
$\lambda$		0.152**
R <sup>2</sup>	0.59	
F	127.3	
Var. ratio		0.593

Source: ISTAT, Industry and Services Censuses 1981, 2001

Legend:

\*\*\*= significance level  $\leq$  1%

\*\* = significance level  $\leq$  5%

\* = significance level  $\leq$  10%

Variables:

hmtec81: medium-high and high tech sectors share in 1981

dumNS: dummy North-South

spec81: Krugman specialization index in 1981

<sup>a</sup> corrected for heteroschedasticity

Table 10. Sign test. Krugman, Gini, Theil concentration indices. 1981-2001.

	<i>Krugman</i>	<i>Gini</i>	<i>Theil</i>
% var. positive	34.7	30.6	28.6
% var. negative	65.3	69.4	71.4
significatività	0.00	0.00	0.00

Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 11. Cross section test. Krugman, Gini, Theil concentration indices. 1981-2001.

	<i>Krugman</i>	<i>Gini</i>	<i>Theil</i>
A	0.019	-0.020***	0.025***
B	0.911***	0.923***	0.884***
R <sup>2</sup>	0.85	0.85	0.81
Init.val. > a/(1- b)	0.93	0.93	0.95
1-R	0.08	0.08	0.10

Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 12. Initially concentrated industries that have stayed concentrated between 1981 and 2001.

<i>NACE</i>	<i>Sector</i>	<i>K 81</i>	<i>K 01</i>
23.1	Manufacture of coke oven products	0.99	0.99
24.2	Manufacture of agro-chemical products	0.93	0.95
24.7	Manufacture of man-made fibres	0.94	0.95
34.1	Manufacture of motor vehicles, and trailers	0.96	0.95
35.3	Manufacture of aircraft and spacecraft	0.97	0.95
35.5	Manufacture of other transport equipment	0.95	0.95
27.1	Manufacture of basic iron and steel	0.92	0.94
16	Manufacture of tobacco products	0.90	0.93
31.4	Manufacture of accumulators, primary cells and primary batteries	0.93	0.93
33.5	Manufacture of watches and clocks	0.95	0.93
35.2	Manufacture of railway and tramway locomotives and rolling stock	0.94	0.92
24.4	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	0.91	0.89
32.3	Manufacture of television and radio receivers	0.90	0.89
27.2	Manufacture of tubes	0.91	0.87
22.3	Reproduction of recorded media	0.93	0.87

Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 13. Initially deconcentrated industries that have stayed deconcentrated between 1981 and 2001.

<i>NACE</i>	<i>Sector</i>	<i>K81</i>	<i>K01</i>
20.3	Manufacture of builders' carpentry and joinery	0.47	0.47
26.6	Manufacture of articles of concrete, plaster and cement	0.57	0.53
15.8	Manufacture of other food products	0.60	0.54
28.1	Manufacture of structural metal products	0.63	0.56
26.7	Cutting, shaping and finishing of ornamental and building stone	0.58	0.57
15.4	Manufacture of vegetable and animal oils and fats	0.57	0.59
28.7	Manufacture of other fabricated metal products	0.62	0.62
15.6	Manufacture of grain mill products, starches and starch products	0.54	0.64
18.2	Manufacture of other wearing apparel and accessories	0.63	0.64
20.1	Sawmilling and planing of wood; impregnation of wood	0.59	0.64
20.5	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	0.65	0.65
15.5	Manufacture of dairy products	0.64	0.65
15.9	Manufacture of beverages	0.63	0.66
25.2	Manufacture of plastic products	0.69	0.66
15.1	Production, processing and preserving of meat and meat products	0.67	0.67
20.4	Manufacture of wooden containers	0.67	0.67

Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 14. Concentration, innovativeness and scale economies.  
 Dependent variable: Krugman conc. index. Estimate: OLS

obs.: 784

	<i>Krugman 81</i>	<i>Krugman 91</i>	<i>Krugman 01</i>
Htec	0.151** (0.074)	0.106 (0.075)	0.070 (0.077)
hmtec	0.123*** (0.047)	0.127*** (0.047)	0.109** (0.049)
Hrs	0.143** (0.056)	0.144** (0.057)	0.142** (0.059)
Mrs	0.153** (0.047)	0.120** (0.046)	0.114** (0.048)
cost.	1.480*** (0.029)	1.465*** (0.029)	1.467*** (0.031)
R <sup>2</sup>	0.23	0.20	0.15
F	8.3	7.0	5.2

Source: ISTAT, Industry and Services Censuses 1981, 1991, 2001

Legend:

\*\*\*= significance level  $\leq$  1%

\*\* = significance level  $\leq$  5%

\* = significance level  $\leq$  10%

Variables:

htec: high tech sectors dummy

hmtec: medium-high tech sectors dummy

hrs: High scale economies sectors dummy

mrs: Medium scale economies sectors dummy

Table 15. Concentrating and deconcentrating industries between 1981 and 2001. Krugman concentration index.

<i>NACE</i>	<i>Concentrating industries</i>	<i>Δconc.</i>
15.6	Manufacture of grain mill products, starches and starch products	0.16
29.6	Manufacture of weapons and ammunition	0.12
26.4	Manufacture of bricks, tiles and construction Products	0.12
20.1	Sawmilling and planing of wood; impreg. of wood	0.09
20.2	Manufacture of veneer sheets; manufacture of plywood, laminboard, and other panels	0.08
26.5	Manufacture of cement, lime and plaster	0.07
19.1	Tanning and dressing of leather	0.06
25.1	Manufacture of rubber products	0.05
26.3	Manufacture of ceramic tiles and flags	0.05
15.4	Manufacture of vegetable and animal oils and fats	0.04
<i>NACE</i>	<i>Deconcentrating industries</i>	
26.8	Manufacture of other non-metallic mineral products	-0.20
30	Manufacture of office machinery and computers	-0.15
33.1	Manufacture of medical and surgical equipment and orthopaedic appliances	-0.14
26.1	Manufacture of glass and glass products	-0.14
28.1	Manufacture of structural metal products	-0.13
28.5	Treatment and coating of metals; general mechanical engineering	-0.11
15.8	Manufacture of other food products	-0.11
29.2	Manufacture of other general purpose machinery	-0.11
27.3	Other first processing of iron and steel	-0.11
22.2	Printing and service activities related to printing	-0.09

Source: ISTAT, Industry and Services Censuses 1981, 2001

Table 16. Correlation between industry shares by SLL in 1981 and 2001.

<i>Sector</i>	R	<i>Sector</i>	R
35.5	0.22	26.3	0.99
23.1	0.30	22.1	0.99
28.2	0.36	22.2	0.98
36.4	0.36	24.4	0.98
15.2	0.44	17.1	0.97
33.5	0.50	24.5	0.97
31.4	0.54	24.3	0.96
32.3	0.55	32.2	0.96
33.4	0.61	35.3	0.96
20.1	0.61	24.1	0.95

Source: ISTAT, Industry and Services Censuses 1981, 2001

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