The changing location of the European industry: a twofold geographical perspective

Eleonora Cutrini*

Abstract

This paper empirically investigates the evolution of industrial location in Europe since the launching of the Single Market Programme. On the basis of Eurostat regional data and applying decomposition analysis and bootstrap significance tests, the paper draws a clear scenario for the Pre- and Post-Single Market periods. Results suggest that European industries trickled down among EU countries and regions prior the completion of the Programme, while afterwards national specialisation according to comparative advantage occurred in two core sectors: *textiles and wearing apparel* and *transport equipment*. Nonetheless, most of the structural change, particularly in more recent years, occurred in the internal geography of countries. Several economic forces pulling towards dispersion may rationalize the overwhelming significant decline in the *inner-country* localisation, congestion costs, intra-national decentralisation of production activities being among the most plausible.

This leads to recognize that European economic integration have been simply a part of the story and additional overlapping advances, like the improvements in communication and transportation technology, may have played a competing role in the new configuration of the European economic geography.

Keywords: *European economic integration, geographical concentration, localisation, manufacturing employment*

JEL classification: C43, L16, O18, R11

* Address: Department of Economics, University of Insubria, via Monte Generoso, 71, 21100, Varese, Italy
e.mail: ecutrini@eco.uninsubria.it, Phone: +39 0332 395807, Fax: +39 0332 395509.

INTRODUCTION

European economic integration have been substantially promoted in recent years by the enactment of the Single Market Program and the adoption of a common currency.

One of the most debated issues raised by the process deals with the expected far-reaching implications in the location of economic activities between the regions involved. According to the "Krugman hypothesis" European integration will propel the coalescence of industrial activities, so as to mimic the increasing geographical concentration previously arisen across United States.

So far the related theoretical literature have not provided irrefutable predictions. On the empirical ground, the great bulk of the evidence concerns the international concentration patterns with a limited attention to intra-national evolutions. An inspection of the existing works provides some valuable insights, however, it is hard to come to conclusive evidence since results are usually not significant and the different empirical studies are inconsistent in terms of spatial partitions of data, methodologies and time periods.

Particularly, disentangling the geographical concentration within countries from the one occurred internationally attracted a renewed interest strictly connected- from a normative perspective- to the multiplicity of institutions involved in designing policies aimed at enhancing industrial change and regional development. To this end, an integrated approach allowing to include two geographical levels into a single economic analysis is required.

The objective of this paper is to shed light on the location patterns of manufacturing as a whole and its specific industries. Firstly, combining absolute and relative measures I drawn a clear picture of what has happened in Europe during the last decades. Moreover, the methodology adopted allows to contemplate the nested geographical perspective (region-country) recently incorporated in New Economic Geography models and to account for the potential divergence in agglomeration patterns that may arise across and within countries. Finally, the significance tests –rarely adopted in the empirical literature- yield to compelling results on the evolution occurred in recent years.

Results suggest that regional dispersion of industries and decreasing localization underpinned industrial location patterns during the entire period, and the changes are significant for half of the industries considered. The decomposition analysis disclose that, in many sectors, a slight increase in localisation across countries occurred in parallel with internal dispersion.

Different developments are found for the Pre- and Post-Single Market periods. While

significant international changes prevailed in the first period and can be regarded as adjustments connected to the abolition of barriers to trade, inner-country dispersion forces dominated in the nineties.

The remainder of the paper is organised as follows. The theoretical background of the paper is set out in section 2, where the disparate theoretical predictions are surveyed with a specific focus on the relationship between international economic integration and internal geography. Section 3 provides a survey of the empirical evidence on the evolution of the spatial distribution of European manufacturing across and within countries. Section 4 is devoted to the description of the methodology and data. Section 5 summarises the main findings of the present study and provides a tentative interpretation in the light of the theoretical insights and the existing evidence. Finally, section 6 concludes.

2. THEORETICAL INSIGHTS FROM THE NEW ECONOMIC GEOGRAPHY

The new economic geography have provided many theoretical insights on the effect of trade and international integration on the location of economic activities. Within this strand, models feature scale economies at the firm level, transportation costs and factor mobility, so as to reproduce the crucial tension between centripetal and centrifugal forces already highlighted in the early contributions of international and development economists (Ohlin, 1957; Myrdal, 1957; Hirschman, 1958; Perroux, 1966).

Ohlin (1957) referred to the concept of localisation as the divergence of the spatial distribution of an industry from the one that would arise had only basic location characteristics[1] would determine it. The divergence from this "theoretical case" is due to perturbation effects brought about by combination of agglomerative tendencies and spreading forces. According to development economists (Myrdal, 1957; Hirschman, 1958; Perroux, 1966), the former typically referred to the indivisibility of the investment in large-scale industries, a selective migration, capital movement and trade, while the latter were associated to the external diseconomies of the central region, and the higher factor prices, typically land rents and wages. Similarly, in Krugman (1991b) the circular causation process emerges as a result of the interaction between increasing returns and interregional mobility of labour that gives rise, as integration proceed, to the well-known core-periphery outcome. Given the diffuse barriers to international migration, the NEG was initially considered more suitable to analysed issues related to the internal geography of countries. Krugman and Venables (1995) showed that complementarities between upstream and downstream firms may substitute labour migration as an important agglomeration force, even in forging international inequalities.

Puga (1999) provided a different framework. Puga's model assumed that labour is perfectly mobile between sectors within each region, and distinguished the case where labour is also interregionally mobile and the case where it is only intersectorally mobile[2]. For the purpose of the present analysis, we focus on the case of *absence of interregional labour mobility*[3], in which a process of gradual change of the type of an "inverted U" should occur.

1 Spread of natural resources and markets, the transportability of different goods, the local differences in transportation resources and facilities.

2 The difference in the extent of interregional(international) labour mobility determines whether the relationship between integration and agglomeration is monotonic or not.

3 In fact, this assumption sound consistent within the European landscape that continues to be characterized by low labour migration, despite the substantial wage differentials across countries.

Since the model assumes that regions have the same size in terms of population, when trade costs are high, firms are equally divided in regions so as to locate close to final demand. As soon as trade costs reach an intermediate level, geographical concentration arises to exploit input-output linkages, and consequently wages in the centre of the economy rise. When trade costs decrease further, firms want to locate so as to lower the costs of immobile factor, therefore economic activities spread across space.

Recent development in the new economic geography adopted a more focussed perspective to the relationship between international openness and the location of economic activities within the countries involved in the process (Krugman and Livas, 1996; Monfort and Nicolini, 2000; Paluzie, 2001; Behrens, 2003). Two countries (home and foreign country) and a number of internal regions in one or both countries are stylised[4]. Each economy is characterized by two sectors: a perfectly competitive agriculture sector and an industrial sector under increasing returns to scale. The distinction between international interdependencies and domestic regional interactions is allowed by differentiated assumptions on interregional and international mobility and on the level of transaction costs across and within countries. Since economic interdependence is deemed to be higher within a country, workforce is drawn to be willing to move interregionally but does not migrate to another country. Accordingly, separate parameters are introduced in the model to account for the different role of internal transport costs and external transaction costs[5].

At high international transaction costs, manufacturing activities split between the internal regions. At intermediate level of international trade costs, a multiple equilibria scenario arises. When international transaction costs fall below a certain threshold, core-periphery patterns are the only stable allocations within countries.

To sum up, Puga (1999) clearly envisaged a process of no-monotonic and gradual adjustment of the kind of an inverted "U", as a consequence of international integration proceeding in the absence of interregional labour mobility. More specifically, the first agglomeration tendency will be followed by the spreading of economic activities. Instead, competing models suggested that, if interregional mobility of labour is allowed within countries, regional coalescence of industrial activities would arise when European economic integration have reached a mature stage (Monfort and Nicolini, 2000; Paluzie, 2001; Crozet

4 Two-country three-region models (as in Krugman and Livas, 1996; Paluzie, 2001; Behrens, 2003) allows assessing the domestic outcome of international integration-, while two-country four-region models encompass two geographical level of analysis (Monfort and Nicolini, 2000, Monfort and van Ypersele, 2003) and are better suited to account for the interdependence between the internal geography of integrating countries.

5 International transaction costs include frictions linked to institutional factors like trade policy, custom duties, harmonization of rules between countries as well as linguistic barriers.

and Koenig-Soubeyran, 2004).

Inspired by the Mexican liberalisation policy and the subsequent internal relocation of industry toward the northern areas of the country, Krugman and Livas (1996) draw an economy with one sector with increasing returns to scale -the industrial sector- and interregional mobile workers. The fundamental idea behind the model is that, in a restrictive trade policy, forward and backward linkages foster the clustering of economic activity. As soon as protective measures fall and the economy becomes less "inward-looking", the strength of congestion costs turns out to be much more important than before. Since the central place (usually the capital city) have lost the advantage it had in a relatively closed economy, firms that now mainly sell to external market are more willing to migrate to peripheral regions, especially if relocation implies better access to international market. In spite of a general deconcentration of the overall manufacturing sector, the possibility of clustering of particular industries is also acknowledged since different localities may specialize as a result of trade liberalisation (Fujita *et al*., 1999).

As I will show, starting from the New Economic Geography framework, the theoretical predictions of Puga (1999) and those of Krugman and Livas (1996) for intra-national patterns look consistent with the present empirical findings.

For the sake of completeness, it is important to stress that further economic forces unrelated to international trade integration may engender a rupture of the existing agglomeration fostering the dispersion of economic activities. Recent theoretical contributions conceived the widespread firm fragmentation at the root of the modifications of the inner-country economic geography which, in many countries, has been characterised by the agglomeration of executive functions in metropolitan areas and smaller service-oriented cities with peripheral areas becoming favoured sites for routine tasks. Following these lines of reasoning, functional specialisation of different localities is the aggregate implication of a microeconomic change - induced by the decreased transportation and communication costs - in the firm's trade-off between the benefits of vertical integration and the advantages of spreading the different functions across space[6] (Davis and Henderson, 2004; Duranton and Puga, 2005; Rossi-Hansberg et al., 2006, Henderson and Ono, 2006). When spatial transaction costs (i.e. the cost of coordination and monitoring across fairly wide distances) decrease substantially, firms that used to perform managerial, R&D and production tasks

6 Henderson and Ono (2006) suggested that, if the initial spatial configuration of a firm's production facilities is accounted for, the decision of relocating the headquarter involves the trade-off between the cost-saving in the distance-related coordination costs provided by the proximity between headquarters and production establishments, and the benefits of having managers operating within easy reach of a wide range of highly diversified pull of business service suppliers.

under a single roof prefer to become multi-plant organizations.

3. THE EMPIRICAL EVIDENCE

The interest for empirical research on industrial location is gaining momentum in Europe, especially since the launching of the Single Market Programme and the Monetary Union. Contrasting European larger countries[7] with comparable US macro-regions, Krugman suggested that as they become more integrated, the former will also become less similar from each others (see Krugman, 1991a). The envisaged increase in relative specialisation of European countries, and the mirroring localization of industries, has come to be called the "Krugman hypothesis". It is worth noting that the conjecture on a EU convergence to the US level of concentration was probably based on the theoretical framework introduced, and specifically, on the supposition of an increasing labour mobility within the European Single Market[8]. Yet, the two areas continue to be dissimilar in terms of some institutional and social traits relevant for this specific analysis, noticeably, in the propensity of workers to migrate.

Several empirical studies have tried to ascertain the actual location patterns in Europe. In the following, I will summarize the main empirical finding drawing from a survey of the existing literature. Before that, I shall clarify the meaning of the expressions "*geographical concentration*" and "*localization*" that are extensively used throughout the paper.

Geographical concentration (or spatial concentration) refers to the extent to which an economic activity (a given industry or manufacturing as a whole) is concentrated in just few regions. It is usually measured through absolute indices and their changes allow to assess whether a specific sector tend to cluster, in other words, to become more unevenly distributed in space. The degree of *localization (or agglomeration)* of an industry refers to the divergence in the spatial distribution of that industry with respect to the spreading of the overall economic activity (overall manufacturing, in this case). Relative concentration indices are used to this purpose, since they are more suitable to gauge the economic forces driven within-industry agglomeration economies. Perfect regularity (or randomness, in the words of Ellison and Glaeser (1997)) arises when industries are spatially distributed proportionally to total employment. The more the interregional distribution of industry employment departs from the

7 France, Western Germany, Italy and United Kingdom.
8 In NEG models (e.g. Krugman, 1991b, Puga, 1999) labour mobility has an important role in sustaining agglomerations, in a symmetric way, labour immobility constitutes an important dispersion force.

interregional allocation of aggregate manufacturing the higher are the localization forces at work within the specific industry[9].

A number of authors, in spite of the different methodologies adopted, agreed in depicting a pattern of increasing geographical concentration of manufacturing between European countries during the eighties followed by a process of dispersion in the following decade. Aiginger and Pfaffermayr (2004), focused on the spatial concentration of manufacturing value added between 1985 and 1998, and suggested that an upward trend occurred in the pre-Single Market period while dispersion dominated in recent years, and the changes are significant for each period.

Previous studies have also acknowledged an increasing relative concentration during the eighties, a period on which several empirical results tend to agree (Brülhart, 1998; Amiti, 1999; Midelfart *et al.*, 2000). On the basis of Eurostat production data for Belgium, France, Italy, Germany and United Kingdom, Amiti (1999) reported a significant increase in relative concentration for a majority of manufacturing industry from 1976 to 1989[10]. Moreover, Brülhart (1998) found out that, during the eighties, localization increased in 14 of the 18 European industries considered (especially labour-intensive industries and increasing returns to scale industries). Instead, relying on four years averages for the period 1970-1997 to avoid cyclical bias, Midelfart *et al.* 2004 suggested that the upward trend of the eighties was a brief interlude before returning to the decreasing localisation across European countries.

Location patterns of the Post-Single Market period are still under scrutiny, but the emerging evidence is in favour of geographical dispersion. Some scholars have already revealed that absolute concentration levels of value added have been declined significantly across countries in a majority of manufacturing industries[11] during the period 1992-98 (Aiginger and Davies, 2004; Aiginger and Pfaffermayer, 2004).

Until recent years empirical studies at the regional scale was hampered by the shortage of detailed regional information. Consequently, little research have been devoted to geographical concentration across a wide array of EU subnational spatial units (Brülhart and Traeger, 2005; Hallet, 2000, Aiginger and Leitner, 2002). Moreover, once they are compared,

9 These forces may be related to intra-industry input-output linkages, labour market pooling and industry-specific knowledge spillovers but they may also indicate a high dependence to natural resources.

10 She reported positive and significant change for 30 out of the 65 industries analysed, negative and significant change for 12 industries.

11 Absolute concentration fell in 56 out of 99 industries, 26 of them showed a significant change (Aiginger and Pfaffermayer, 2004).

they do not consent to accomplish straightforward results.

According to some scholars, interregional concentration of manufacturing employment followed the weaved-shaped path emerged at the international level (Aiginger and Leitner, 2002). They reported decreasing regional concentration of manufacturing employment across NUTS1 regions, despite a temporary increase prior the implementation of the Single Market Program. Additional studies suggest that, a different- and sometimes even contrasting-evidence appears with respect to the one arisen from the country-based studies, when the region is adopted as unit of analysis. On the basis of regional gross value added, Hallet (2000) did not provide conclusive results. More recently, Brülhart e Traeger (2005) found mixed evidence for the interregional concentration of value added in manufacturing industries, though they found robust results for the interregional agglomeration of textiles value added. Using a non-parametric methodology, Ezcurra *et al.* (2006) empirically support the "Krugman hypothesis" while sub-national studies provide a contrasting evidence. Decreasing localisation is widespread across Spanish provinces during the eighties (Paluzie *et al.*, 2001), across Italian regions from the early seventies to the late nineties (Rombaldoni e Zazzaro, 1997; De Robertis, 2001; Ciciotti and Rizzi, 2003) and, more recently, also within Germany (Suedekum, 2006).

TABLE 1- A SUMMARY OF THE EVIDENCE

	Authors	Methodology[a]	Period	Geographical coverage	Activity variable	Geographical concentration	Industry localisation
Country-based studies	Midelfart *et al.* (2004)	RC	1970-1997	EU-14	Export and value added		inverted "U" pattern, not significant
	Amiti (1999)	RC	1976-1989	Belgium, France, Germany, Italy and UK	Production at current prices		positive and significant change for 30 out of 65 industries, negative and significant change for 12 industries
	Brülhart (1998)	RC	1980-1990	EU-11	Employment		Increased in most manufacturing industries
	Aiginger and Pfaffermayr (2004)	AC	1985-1998	EU-14	Value added	inverted "U" pattern (results are significant)	
	Aiginger and Davies (2004)	AC	1985-1998	EU-14	Value added	Decreased	
	Leitner (2001)	AC	1987-1998	EU-14	Value added/employment	Decreased	
Regional studies	Hallet (2000)	RC	1981-1995	EU (NUTS2-1, country)	Gross value added		Not conclusive results
	Aiginger and Leitner (2002)	AC	1987-1998	EU-14 (NUTS-1)	Value added/employment	inverted "U" hyphothesis confirmed	
	Brülhart e Traeger (2005)	RC	1975-1998	EU (NUTS2-1)	Value added/employment		textiles industry and entire manufacturing becoming more localised
	Rombaldoni e Zazzaro (1997)	RC	1971-1991	Italy (NUTS2)	Employment		Localisation decreased in a majority of innovative industries
	De Robertis (2001)	RC	1971-1991	Italy (NUTS2)	Employment	Decreased	Differential patterns of localisation
	Paluzie et al. (2001)	RC	1979-1992	Spain			Decreasing localisation prevailed
	Suedekum (2006)	RC	1993-2001	Germany (NUTS1-2-3)	Employment		Decreased

[a]***AC stands for absolute concentration, RC stands for relative concentration.***

The great bulk of empirical studies was carried out either on location across countries or within single nation. Besides, most empirical works focussed either on geographical concentration or localisation of industries (see Table 1 for a summary of the empirical evidence).

The interpretation of the evidence will instead benefit from a unifying approach, the integrated methodology underpinning the subsequent sections of the present work.

4. METHODOLOGY AND DATA

4.1 Methodology

Let us first define the notation:

x denotes the variable of main interest, employment in the present case; the subscripts i, j, k index country, region and industry, respectively. Thus:

x_{ijk} = number of workers in industry k (k=1,...,n) in region j (j=1,…, r_i) belonging to country i (i=1,...,m)

x_{ij} = total employment in region ij

x_{ik} = total employment in industry k in country i

x_i = total employment in country

x_k = total employment in industry k in the supranational economy

x = total employment in the supranational economy

To evaluate geographical concentration I rely on the following absolute concentration measures:

Coefficient of variation:

$$CV = \left[R\sum_{j=1}^{R}\left(\frac{L_{ij}}{L} \right) - 1^2 \right]$$

Absolute Gini:

$$G = \frac{2}{R}\frac{\sum_j \left(P_j - Q_j \right)}{\sum_j P_j}$$

Relative mean deviation:

$$RMD = \sum_{j=1}^{R}\left| \frac{L_{ij}}{L} - \frac{1}{R} \right|$$

Absolute Theil index:

$$T = \ln(R) + \sum_{j=1}^{R}\frac{L_{ij}}{L}\ln(\frac{L_{ij}}{L})$$

To measure the degree of industrial localization, the present contribution relies on the entropy-based methodology developed in an earlier work (Cutrini, 2006). Because of their decomposability, entropy indices allow to disentangle the *within* and *between* countries components of relative concentration patterns. Brülhart and Traeger, 2005 exploited their decomposition properties as to measures topographic and relative concentration across regions, their relative version being comparable to the present contribution. Their analysis focused on value added as activity indicator, covers a different period (1980-1995) and a smaller set of regions (116 NUTS2), but since they relied on the same methodology, in the empirical section I will provide evidence from the combination of their results with mine.

Decomposition analysis allows for a straightforward economic interpretation of results. In fact, splitting the overall relative concentration into its different components allows to disentangle the contribution of national borders in defining comparative advantages from the magnitude of internal regional agglomeration which may be the result of external economies or intra-firm increasing returns to scale.

The degree of localisation of an industry k is defined here as the divergence in the spatial distribution of that industry controlling for the spreading of the overall economic activity (the benchmark in the case of concentration, e.g. manufacturing).

The basic dissimilarity Theil index, to measure localisation of one industry industry k is:

$$T_k = \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{\frac{x_{ijk}}{x_k}}{\frac{x_{ij}}{x}}\right) \qquad (1)$$

The degree of localisation of each industry (T_k) can be though as a measure of the strength of localization economies and/or the importance of industry specific natural advantages. In fact, in case of perfect regularity ($T_k = 0$) the location of the industry is mainly due to the advantages of being located in those regions with the higher density of the aggregate economic activity. If all industries follow the regular case (employment is allocated across regions in the same way as total employment), then it means that industries neither are affected by localization economies (e.g. intra-industry spillover, labor market pooling) nor are affected by industry-specific natural advantages (cfr. Ellison and Glaeser, 1997).

The two geographical components of the concentration index for each industry k can be easily derived by factor decomposition (see appendix A for details on the formal

decomposition of the localisation index defined in equation (1)). Hence:

$$T_k^w = \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{\frac{x_{ijk}}{x_{ik}}}{\frac{x_{ij}}{x_i}}\right) \tag{2}$$

evaluates *within-country* localisation of industry *k,* while:

$$T_k^b = \sum_{i=1}^{m} \frac{x_{ijk}}{x_k} \ln\left(\frac{\frac{x_{ik}}{x_k}}{\frac{x_i}{x}}\right) \tag{3}$$

assesses the *between-country* localisation of industry *k*.

- $T_k^w = 0$ defines a benchmark of *perfect regularity within countries* which implies that industry *k* is proportionally distributed to total manufacturing employment in the internal regions of each country. The higher the domestic component is, the more the inner regional allocation of each country is different to total manufacturing. An increasing value of the within factor component is related to a process of rising dissimilarity in the spatial distribution of the industry internal to the countries, and therefore of an increasing importance of regional localization economies in industry *k*.

- $T_k^b = 0$ defines a situation of *perfect regularity between countries,* unrevealing that the international distribution of industry *k* is overlapping the allocation across countries of manufacturing as a whole Therefore, the higher the between-country component is, the more national comparative advantages in industry *k* are significant. Accordingly, increasing between-country localisation indicates that national economies are specialising according to comparative advantages.

The relative entropy measure of industry localisation proposed in equation (1) meets several desirable principles outlined by Combes and Overman (2004) :

1) It is comparable across spatial units and scales (additively decomposable by geographical subgroups);
2) It specifies an unambiguous and meaningful null hypothesis (absence of localisation, $T_k = 0$)
3) It is suitable for statistical testing through bootstrap methods.

Although, like all the measures based on aggregate regional data, it is affected by the

modifiable areal unit problem and the checkerboard problem[12].

Bootstrapping is a valuable method to ascertain whether the observed localization have significantly changed over time. The bootstrap was introduced by Efron (1979) and more recently adopted in the context of inequality measures (see for example Mills and Zandvakili, 1997; Biewen, 2002), though its implementation for the spatial distribution of economic activities has been quite rare. As far as relative entropy measures are concerned, Mori *et al.* (2005) assumed that the spatial distributions to be compared were independent and discussed the construction of confidence intervals for the true value of the D-index based on the normal approximation. Brülhart and Traeger (2005) test for the significance of temporal changes of regional localisation relying on a block-bootstrap, i.e. resampling observations from different countries separately.

The main issue to be addressed here is whether geographical concentration and localisation changed significantly over the period under scrutiny. This concern can be answered bootstrapping the measures of absolute and relative concentration, and their components. The resampling process is repeated for 10,000 times. Given the bootstrap estimate of the sampling distribution, it is possible to derive standard errors, compute confidence intervals, and conduct the following hypothesis testing:

$$H_o : \Delta T_k = 0$$

$$H_1 : \Delta T_k \neq 0$$

12 Recently, a line of methodological development based on spatial disproportionality measures of concentration to deal with these problems was set up (Bickenbach and Bode, 2006).

4.2 Data

Data are drawn from the Region-Structural Business Statistics which is a section of the Eurostat database. It is the only source providing comparable EU-wide regional data based on a standardised classification of regions (NUTS). Clearly, European economic integration is deemed to have had a significant impact on regional manufacturing location patterns. In this view, data have been considered in three separate points of time - such as 1985, 1993, 2001- to draw a distinction between pre-Single Market trend (1985-93) and post-Single Market evolution (1993-2001) and speculate about possible effects of the integration process.

The analysis concerns almost all the regions of the following European countries: Belgium and Luxembourg (consolidated), Finland, France, Western Germany, Greece, Italy, Netherlands, Spain and UK. The regional breakdown is mainly based on the NUTS 2 grid, except for Germany for which I referred to the NUTS 1 regions (for detailed information on geographical coverage see table B1).

Employment data are disaggregated by 2-digit manufacturing industries according to NACE rev. 1 classification: *food*, *textiles*, *wood*, *paper*, *chemicals*, *rubber and plastic products*, *other non-metallic mineral products*, *basic metals and fabricated metal products*, *machinery, electrical and optical equipment*, *transport equipment*, *manufacturing n.e.c.*.

The *food* industry encompasses the manufacture of food products, beverages and tobacco. The *textile* industry includes the manufacture of textiles, wearing apparel, dressing and dyeing of fur. The *wood* industry comprises manufacture of wood and products of wood and cork. The *paper* sector includes the manufacture of pulp, paper and paper products, publishing and printing. The *chemical* industry is composed by the manufacture of chemicals and manufacture of chemical and pharmaceutical products. The *rubber and plastic* sector is the manufacture of rubber and plastic products. The manufacture of *other non-metallic mineral products* is constituted by non-metallic mineral products such as glass products, ceramic goods, ceramic tiles, bricks and construction products and cutting, and the shaping and finishing of ornamental and building stone. The *metal industry* is composed by the manufacture of basic metals (iron and steel) and metallurgy, except *machinery* which constitute a separate industry comprising the manufacture of general purpose machinery, agricultural and forestry machinery, machine-tools, and special purpose machinery. The *electrical and optical equipment* sector encompasses the manufacture of office machinery and computers, electrical machinery and devices, television and communication equipment, electronic components, the manufacture of medical, precision, optical instruments and photographic equipment, watches and clocks. The *transport equipment* industry includes the

manufacture of motor vehicles, ships, boats, aircraft, motorcycles and bicycles. The *other manufacturing industry n.e.c.* (division 36) includes mainly the manufacture of furniture and recycling, musical instruments, jewellery, games and toys and other activities not elsewhere classified.

Manufacturing of leather and leather products and *manufacture of coke, refined petroleum products and nuclear fuel* have been excluded from the analysis because of the overwhelming missing and confidential data. To enlarge the analysis, data for Belgium was provided by the national statistics office and, since they are based on the previous NACE 70 classification, some regional aggregation was required. Particularly, *Bruxelles*, *Vlaams Brabant* and *Brabant Wallon* have been clustered as a single region.

5. THE EMPIRICAL EVIDENCE

5.1 Geographical concentration and localisation: an overview

Since the second half of the eighties manufacturing industry had become less geographically concentrated across European countries and regions. Table 1 straightforwardly shows that results of a general dispersion are robust at the different spatial scales irrespective of the absolute measures adopted.

TABLE 1 – Geographical concentration of manufacturing employment, % change 1985-2001

	across countries (n=9)		**across NUT2 regions (n=145)**	
	level	change	level	change
coefficient of variation	0.92	-11.9	1.53	-11.3
Gini coefficient	0.47	-8.0	0.56	-4.2
Theil entropy measure	0.38	-10.3	0.63	-11.6
relative mean deviation	0.73	-4.9	0.80	-3.9

Particularly, the spreading of overall manufacturing employment at the international scale is deemed to be linked to the catching-up of peripheral countries and the inverse transformations that contemporaneously occurred in advanced EU economies. Mediterranean countries - Italy and, to a lesser extent, Spain - have actually gained share in European

manufacturing employment during the nineties. On the other side, the falling trend in Western Germany (see graph. 1) is more possibly related to the general de-industrialisation of the area, the recession following the national reunification, and the successive decentralisation toward Eastern regions.

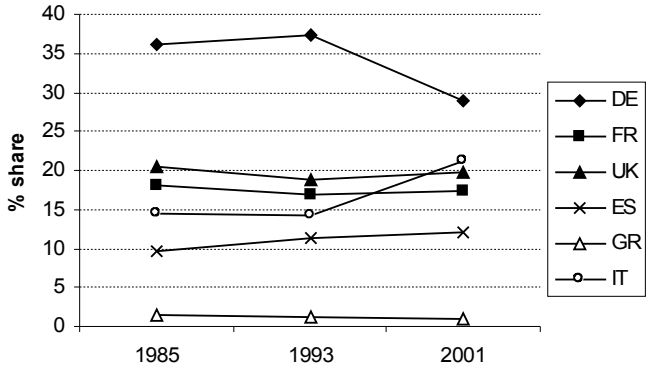

FIGURE 1 – Employment shares, total manufacturing

Peripheral countries have certainly benefited from the European integration process, not only for they gained better access to the market, but also because of the role played by EU policies for regional and industrial development. It is worth noting that Italy and Spain were among the first six countries in terms of EU and state aid to manufacturing during the period 1994-96 (Greece, Portugal, Ireland and Denmark are the others, see Midelfart-Knarvik and Overman (2002), p. 334).

For the entire period, disaggregated sectoral analysis confirmed the evidence on an overwhelming regional dispersion (see table B2 for industry-specific results). Since the EU-wide diffusion of manufacturing sub-industries at the lower geographical level (NUTS2) is far more significant than the spreading across countries, it is worth investigating in more detail industry-specific regional localisation patterns.

Table 2 ranks industries according to their average value of relative concentration (reported in the third column), calculated on the basis of the 145 NUTS2 regions for the entire observation period.

Textiles and wearing apparel arise as the industry endowed with pronounced localization economies, for it exhibits the highest divergence to the spreading of overall

manufacturing. Other resource-based industries, with a relatively low technology level, like *wood production* and *no-metallic mineral products*, rank among the most localised. Instead, innovative industries have intermediate level of localisation, like *chemicals* and *transport equipment*, or they are spreading even more similarly as total manufacturing does, like *electrical and optical equipment* and *machinery.* This may be related to the fact that they are usually highly represented where manufacturing employment is geographically concentrated.

TABLE 2- Relative concentration of manufacturing industries across EU regions

	OECD tech. class.	Average 1985-2001	Absolute change 1985-2001	Absolute change 1980-95[a]
Textiles and wearing apparel	L	0,26	0,034	0.165 **
Wood	L	0,22	-0,130 **	--
Non-metallic mineral products	M-L	0,18	-0,032	0.017
Chemicals	M-H	0,17	-0,020	0.000
Manufacturing nec	M-L	0,16	-0,125 ***	-0.004
Transport equipment	M-H	0,15	0,021	0.020
Food	L	0,14	-0,054 ***	0.011
Paper, publishing and printing	L	0,13	-0,014	0.010
Electrical and optical equipment	M-H	0,10	-0,046 ***	-0.006
Basic metals and fabricated metal products	M-L	0,11	-0,083 ***	-0.056
Machinery	M-H	0,10	-0,025	-0.006
Rubber and plastic products	M-L	0,10	-0,056 **	--

//*** denotes rejection of the null hypothesis that ΔTk=0 at the 90%, 95% or 99% significance level.*
OECD technology classification: L: Low-tech, M-L: medium to low-tech; M-H: medium to high-tech

[a] Results for the period 1980-95 are drawn from Brülhart and Traeger (2005).

Brülhart and Traeger (2005) found that relative concentration of value added increased in a slight majority of manufacturing industries even though changes are generally minimal and not significant (table 2, last column). Instead, on the basis of employment data, a widespread decline in relative concentration emerged, and results are highly significant in half of the industries. It is interesting to pointing out that the regional agglomeration of value added combined with the spreading of employment evokes the occurrence of within-industry spatial fragmentation of functions with low-value added tasks drifting apart from R&D and executive functions as recently suggested by the theory (Duranton and Puga, 2005 among others).

In *textile and wearing apparel*, where external economies are notably important, agglomeration increase and, if value added is considered, the change was also significant.

Regional dispersion and de-agglomeration is a robust result for the entire period

considered, although, polarisation forces, albeit weak, still drained a part of sectoral employment towards the EU core regions (reported in table B6) until 1993, while dispersion have certainly dominated the post-Single Market environment. This is a very interesting point which is showed by the combination of geographical concentration and localisation indices (table B4).

The evolution in a first group of industries – *food, no-metallic products*, *electrical and optical equipment*, and *miscellaneous manufacturing*-, mimicked the one of total manufacturing (reported in the last row, table B4), increasing until 1993 and decreasing thereafter, though the changes were generally not significant in the first period.

A second group of industries – *wood, paper, chemicals, rubber and plastics, metallurgy and machinery* – experienced a geographical dispersion which proceeded at increasing pace, being more pronounced and, in half of the sample, also significant during nineties.

In any case, the convergence of industrial employment to the interregional allocation of total manufacturing is revealed by the prevalent decreasing values of relative concentration measures in both periods. The consequent decreasing localisation for the majority of industries can be reckoned as the tendency of firms to locate towards more industrialised and urbanised EU regions in the first period, and a tendency of industry-specific dispersion to be patterned on the one experienced by total manufacturing in the second period. It is interesting to note that the slight geographical concentration of the first period rapidly vanished, the second period being characterized by a considerable dispersion, that was also significant, while this was not the case for the industry-specific rising tendencies of the first period (table B4). For that reason, the considerable EU-wide interregional spreading of employment sound consistent with the theoretical predictions of Puga (1999) that eventually envisaged a dispersion propelled by congestion-related forces (high wages of the centre, in the specific model surveyed in section 2).

Textiles and wearing apparel and *transport equipment* represent outstanding cases. Between 1993 and 2001, they did not changed in line with the whole manufacturing, becoming more geographically concentrated and, therefore, more localized (table B4).

5.2 Within-between country evolutions in the context of the European economic integration

So far I have outlined some of the major changes that occurred in the overall localization of industries. In this section I shall look more in depth at the within- and across-country agglomeration patterns during the European economic integration. In order to do so, the decomposition analysis introduced in Cutrini (2006) and reported in Appendix B is used.

TABLE 3 – Relative concentration, *overall, within-* and *between-country* components
Absolute change 1985-2001

	Overall		Within		Between	
Food	-0.054	***	-0.018	**	-0.036	**
Textiles	0.034		-0.034	*	0.068	***
Wood	-0.130	**	-0.037	*	-0.093	**
Paper	-0.014		0.005		-0.019	
Chemicals	-0.020		-0.029	*	0.009	
Rubber and plastic products	-0.056	**	-0.061	***	0.005	
Other non-metallic mineral products	-0.032		-0.045	**	0.013	
Basic metals and fabricated metal products	-0.083	***	-0.069	***	-0.014	
Machinery and equipment nec	-0.025		-0.008		-0.017	
Electrical and optical equipment	-0.046	***	-0.042	***	-0.004	
Transport equipment	0.021		-0.005		0.026	
Manufacturing nec	-0.125	***	-0.041	**	-0.084	***

Sectors whose within and between-country components evolved in opposing directions are in grey.

A clear point is that inner-country and national components, jointly explaining overall relative concentration, do not necessary evolve in parallel. During the entire period, the significant decline in the inner-country localisation was accompanied by a slight specialisation of national economies[13]. Some of the industries characterized by a substantial decrease in the internal localization, also experienced intensifying between-country concentration associated to a process of national specialisation (reported in grey in table 2A). During the entire period, significant changes are found in traditional production activities. Some of them -namely *wood*, *miscellaneous manufacturing* - trickled down towards European Southern countries, while *textiles and wearing apparel* became increasingly polarised in the EU periphery. In fact, the falling trend for *wood* and *miscellaneous manufacturing* sectors is associated to a loss of employment in core countries mirrored by a process of specialisation of peripheral countries, while polarisation of *textiles and wearing apparel* employment across

13 When relative measures are adopted, specialisation of regions and nations and localisation of industries, can be seen as intertwined economic phenomena (See Cutrini, 2007).

national boundaries is clearly explained by a setting which continues to privilege Mediterranean countries, particularly Italy and Spain. Instead, as far as the production of *food, beverages and tobacco* is concerned, the major shift occurred between France, Spain and Netherlands, on one hand and United Kingdom, on the other hand. The former group have specialised, the latter country has lost its previous comparative advantage in the industry (see Table B5).

Table 4 distinguished the industrial localisation throughout the Pre- and Post-Single Market period. This distinction allow to speculate about the possible implications of the Common Market Programme since the expected abolition of trade barriers was not completely attained by the mid-1980s. With the aim of totally abolished the "frontier" concept, the 1985 White Paper established the legislation to be adopted by the end of 1992 in order to reach the full elimination of physical, technical and tax frontiers.

TABLE 4- A comparison on Pre- and Post-Single Market periods- *Absolute changes*

	1985-1993		**1993-2001**	
	between	*within*	*between*	*within*
Rubber and plastic products	0.008 *	-0.045 ***	-0.003	-0.016 *
Wood	-0.080 **	-0.013	-0.013	-0.024 **
Machinery	-0.015 *	-0.005	-0.001	-0.003
Food	-0.012 *	-0.007	-0.024 **	-0.012 *
Manufacturing nec	-0.038 ***	-0.016	-0.047 ***	-0.025 ***
Transport equipment	-0.014 **	-0.002	0.040 **	-0.003
Textiles	0.017	-0.019	0.051 *	-0.015
Paper	-0.007	-0.004	-0.013	0.009
Chemicals	-0.003	-0.005	0.012	-0.024 **
Other non-metallic mineral products	0.005	-0.025 ***	0.008	-0.020
Basic metals and fabricated metal products	-0.017	-0.041 ***	0.002	-0.029 ***
Electrical and optical equipment	0.004	-0.023 ***	-0.008	-0.019 ***

The construction of the Single Market was dominated by international adjustments towards decreasing specialisation of countries (Table 4). It is conceivable that European countries, in a context of high trade barriers, protected industries in which they were not endowed with a comparative advantages (Amiti, 1999). Accordingly, the international integration has fostered the disruption of previous artificial industrial structures would had been replaced with the disclosure of the real specialisation patterns. Absolute changes of the between-country factors were generally negative and in half of the industries also significant between 1985 and 1993.

Table 4 provide additional evidence confirming that the temporary adjustments of the first period, were followed by a slight specialisation once the Internal Market was almost completed[14]. Between 1993 and 2001, several industries experienced an upward trend, and more and significant national specialisation according to comparative advantage may possibly be imminent as EU deepening and widening proceed further. This conjecture finds a first confirmation by the substantial and significant changes experienced by *textiles* and *transport equipment*. EU international agglomeration of *textiles and wearing apparel* was mainly due to the higher and increasing shares of Spain and Italy in the European textiles employment with respect to the share they come to represent in overall manufacturing employment. Instead, the production of transport equipment remained highly embedded in Germany (from 37 to 39% of European employment, cfr. graph. 1), despite the loss of industrial employment and de-industrialisation experienced by the country during the last decade. Italy and Netherlands also improved in terms of specialisation.

Whatever the national specialisation in Europe will be shaped in the future, so far, most of the structural change, particularly after the completion of the Single Market Programme, occurred in the internal geography of countries (see table 4). From a theoretical viewpoint, these results appear as consistent with the equilibrium of dispersion outlined by Krugman and Livas (Krugman e Livas, 1996) in which congestion costs propelled the disappearance of previous internal core-periphery patterns.

Why have the strength of within-industry localization economies weakened in Europe during recent years?

At the same time as European integration had been enhanced also transportation and communication technology improved, and industry-specific localization economies have been substituted by incentives to spatial fragmentation of functions belonging to the same industry. Hence, accounting for the simultaneous development in transportation infrastructure and communication technology may prove to be important for a deeper understanding of the underlying motives. The former allowed firms to localize different stages of the production process without the necessity of being close to final demand, and the latter has caused flows of information with distant economic agents to be easier, fostering the possibility to spatially disperse economic linkages along the value chain.

For example, a general de-agglomerative patterns of manufacturing industries occurred

14 It is worth noting that the 90% of the legislative projects listed in the 1985 White Paper had been adopted by 1993 (European Commission, 1996). In the following period, further progresses in the transposition of EU legislation into national law and in their implementation -that had previously limited the full completion of the internal market within 1992-occurred.

across all German regions between 1993 and 2001. High-tech industries -such as chemical industry, synthetic material, motor vehicles, metal products and office supplies, information technology, optics- spread out within Germany irrespective of the intra-national spatial scale adopted (NUTS3, NUTS2, NUTS1). It was not simply the results of relocation from Western to Eastern regions, dispersion emerged even focussing merely on West Germany. Instead, it is more plausible that it was fostered by suburbanisation related to congestion costs, and decentralisation of production sustained by the development of information technologies (Suedekum, 2006, Bade *et al*., 2007).

Turning to Italy, the interregional dispersion in the seventies and eighties was conceived in terms of the *filtering-down* theory (Crivellini e Pettenati, 1989) associated to the rising congestion costs and disamenities of the main industrial area of the country. The modification of the internal geography was also reinforced by lagging regions (the so-called *Third-Italy*) that subsequently grew faster than core regions, determining an extensive reshuffling of the previous relative positions (Garofoli, 1992). Moreover, public policies and fiscal incentives, aimed at supporting the industrialisation of Mezzogiorno, is deemed to have played a significant role.

More recently, local input-output linkages have been vanished in Italy, because decentralisation of labour-intensive production tasks occurred in many industries not only at the international but also at the intra-national level. To give a clear example, the spreading within Italy of the automobile and transport equipment industries throughout the seventies and the eighties (Rombaldoni e Zazzaro, 1997, De Robertis, 2001) have continued in more recent years, for the economic crisis of the early nineties forced Fiat to a restructuring of the supply chain with a further decentralization of routine tasks toward the Mezzogiorno[15].

More generally, from a EU-wide regional perspective, the weakening of localisation economies and the associated geographical dispersion was a phenomenon that was particularly pronounced during the last decade.

15 The Melfi production plant in Basilicata was set up in 1993.

6. CUNCLUDING REMARKS AND FUTURE DEVELOPMENTS

This paper has investigated manufacturing location patterns in Europe during a period of trade integration. The methodology decomposition based on the use of entropy indices has served the main purpose of the analysis allowing to disentangle the inner-country from the cross-country divergence in localisation patterns.

Differently with respect to previous studies, I found robust results in the temporal evolution of EU-wide regional changes, providing a compelling evidence in favour of regional dispersion and de-agglomeration of manufacturing employment in Europe.

If the emerged dispersion of labour is combined with the agglomeration of value added found in comparable previous studies, it is plausible that regional specialisation along functional lines are occurring within industry (Duranton and Puga, 2005) implying, in turn, concentration of high value added functions in some core regions and specialising in routine tasks in peripheral sites. Accordingly, European economic integration has to be regarded as a part of the story, while the diffusion of new technologies could have substantially contributed in forging the new inner-country economic geography.

Less clear results are found for the international localisation patterns. Specialisation of countries according to comparative advantages as predicted by traditional trade theory would have been resulted in increasing localisation of industries across national boundaries. Instead I found a decreasing and significant trend across-country that was particularly pronounced since the launching of the White Paper and until 1992, in parallel with the far-reaching liberalisation of manufactured goods markets. The emerged scenario may be conceived as a temporary adjustment to the new environment and, if this is the case, further European integration may propel significant specialisation as happened in two core industries (*textiles and wearing apparel* and *transport equipment*), in the second period analysed. Although, it is also possible that the absence of polarisation across-country is due to the low international mobility of workers across the EU and accordingly dispersion will continue to dominate. Therefore, further research on more recent years may turns out to be useful to ascertain whether the European industrial location is still changing and in which direction.

Nonetheless, conceiving the transformation as a purely outcome of the European Single Market Programme and Monetary Union would be biased. Instead, it is more plausible that differential stages of countries' industrialisation process, institutional changes and regional and industrial policy at the EU and national level reinforced the emerged trickling-down of

manufacturing employment in Europe. Whether it can actually be regarded as the outcome of international economic integration, or it is instead underpinned by changes in the strength of localisation economies and firm organisation remains an open issue that is left for future research.

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APPENDIX A

Decomposing the index of industry localisation

As already pointed out relative concentration refers to the dissimilarity in the localization of each industry *k* with respect to the spreading of the overall manufacturing industry across the spatial units considered (countries, regions). If a industry *k* spreads exactly proportionally to total manufacturing employment the relative concentration index will exhibits a nil value.

$$T_k = \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{\frac{x_{ijk}}{x_k}}{\frac{x_{ij}}{x}}\right) \qquad (1.A)$$

Adding and subtracting the term $\sum_{i=1}^{m} \frac{x_{ik}}{x_k} \ln\left(\frac{x_{ik}}{x_i}\right)$ to equation (1.A) yields:

$$T_k = \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{x_{ijk}}{x_{ij}}\right) - \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{x_k}{x}\right) + \sum_{i=1}^{m} \frac{x_{ik}}{x_k} \ln\left(\frac{x_{ik}}{x_i}\right) + \sum_{i=1}^{m} \frac{x_{ik}}{x_k} \ln\left(\frac{x_{ik}}{x_i}\right) \qquad (2.A)$$

and since $\sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} = \sum_{i=1}^{m} \frac{x_{ik}}{x_k}$

then:

$$T_k = \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{x_{ijk}}{x_{ij}}\right) - \sum_{i=1}^{m} \frac{x_{ik}}{x_k} \ln\left(\frac{x_k}{x}\right) + \sum_{i=1}^{m} \frac{x_{ik}}{x_k} \ln\left(\frac{x_{ik}}{x_i}\right) - \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{x_{ik}}{x_i}\right) \qquad (3.A)$$

Combining the second and the third elements the *between country* component is obtained:

$$T_k^b = \sum_{i=1}^{m} \frac{x_{ijk}}{x_k} \ln\left(\frac{\frac{x_{ik}}{x_k}}{\frac{x_i}{x}}\right) \tag{4.A}$$

instead, the *within country* component is obtained combining the first element of equation (3.A) with the forth one:

$$T_k^w = \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{\frac{x_{ijk}}{x_{ik}}}{\frac{x_{ij}}{x_i}}\right) \tag{5.A}$$

so that

$$T_k = T_k^b + T_k^w \tag{6.A}$$

The Theil within countries (T_k^w) is a weighted average of the relative Theil indices of industry *k* between regions inside each country (T_{ik}^{br}); where the weights are the shares of the countries in total employment in industry *k* ($\frac{x_{ik}}{x_k}$).

$$T_k^w = \sum_{i=1}^{m} \frac{x_{ik}}{x_{ik}} T_{ik}^{br} \tag{7.A}$$

where $T_{ik}^{br} = \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_{ik}} \ln\left(\frac{\frac{x_{ijk}}{x_{ik}}}{\frac{x_{ij}}{x_i}}\right)$ again can be though as dissimilarity Theil (Theil, 1967).

APPENDIX B

TABLE B1 – GEOGRAPHICAL COVERAGE

	NUTS	REGION
Belgium	BE1	Région Brabant
	BE21	Prov. Antwerpen
	BE22	Prov. Limburg
	BE23	Prov. Oost-Vlaanderen
	BE25	Prov. West-Vlaanderen
	BE32	Prov. Hainaut
	BE33	Prov. Liège
	BE34	Prov. Luxembourg
	BE35	Prov. Namur
Germany	DE1	Baden-Württemberg
	DE2	Bayern
	DE3	Berlin
	DE4	Brandenburg
	DE5	Bremen
	DE6	Hamburg
	DE7	Hessen
	DE8	Mecklenburg-Vorpommern
	DE9	Niedersachsen
	DEA	Nordrhein-Westfalen
	DEB	Rheinland-Pfalz
	DEC	Saarland
	DED	Sachsen
	DEE	Sachsen-Anhalt
	DEF	Schleswig-Holstein
	DEG	Thüringen

	NUTS	REGION
Spain	ES11	Galicia
	ES12	Principado de Asturias
	ES13	Cantabria
	ES21	Pais Vasco
	ES22	Comunidad Foral de Navarra
	ES23	La Rioja
	ES24	Aragón
	ES3	Comunidad de Madrid
	ES41	Castilla y León
	ES42	Castilla-la Mancha
	ES43	Extremadura
	ES51	Cataluña
	ES52	Comunidad Valenciana
	ES53	Illes Balears
	ES61	Andalucia
	ES62	Región de Murcia
	ES7	Canarias (ES)
Finland	FI11	Uusimaa
	FI12	Etelä-Suomi
	FI13	Itä-Suomi
France	FR1	Île de France
	FR21	Champagne-Ardenne
	FR22	Picardie
	FR23	Haute-Normandie
	FR24	Centre

	NUTS	REGION
	FR25	Basse-Normandie
	FR26	Bourgogne
	FR3	Nord - Pas-de-Calais
	FR41	Lorraine
	FR42	Alsace
	FR43	Franche-Comté
	FR51	Pays de la Loire
	FR52	Bretagne
	FR53	Poitou-Charentes
	FR61	Aquitaine
	FR62	Midi-Pyrénées
	FR63	Limousin
	FR71	Rhône-Alpes
	FR72	Auvergne
	FR81	Languedoc-Roussillon
	FR82	Provence-Alpes-Côte d'Azur
	FR83	Corse
	GR11	Anatoliki Makedonia, Thraki
	GR12	Kentriki Makedonia
	GR13	Dytiki Makedonia
	GR14	Thessalia
	GR21	Ipeiros
Greece	GR22	Ionia Nisia
	GR23	Dytiki Ellada
	GR24	Sterea Ellada

TABLE B1 (continued)

	NUTS	REGION
	GR25	Peloponnisos
	GR3	Attiki
	GR43	Kriti
	ITC1	Piemonte
	ITC2	Valle d'Aosta
	ITC3	Liguria
	ITC4	Lombardia
	ITD3	Veneto
Italy	ITD4	Friuli-Venezia Giulia
	ITD5	Emilia-Romagna
	ITE1	Toscana
	ITE2	Umbria
	ITE3	Marche
	ITE4	Lazio
	ITF1	Abruzzo
	ITF2	Molise
	ITF3	Campania
	ITF4	Puglia
	ITF5	Basilicata
	ITF6	Calabria
	ITG1	Sicilia
	ITG2	Sardegna
	LU	Luxembourg
Luxembourg		
Netherlands	NL11	Groningen
	NL12	Friesland
	NL13	Drenthe
	NL21	Overijssel
	NL22	Gelderland
	NL23	Flevoland
	NL31	Utrecht
	NL32	Noord-Holland
	NL33	Zuid-Holland
	NL34	Zeeland
	NL41	Noord-Brabant
	NL42	Limburg (NL)
United Kingdom	UK11	Cleveland, Durham
	UK12	Cumbria
	UK13	Northumberland,Tyne and Wear
	UK21	Humberside
	UK22	North Yorkshire
	UK23	South Yorkshire
	UK24	West Yorkshire
	UK31	Derbyshire, Nottinghamshire
	UK32	Leicestershire, Northamptonshire
	UK33	Lincolnshire
	UK4	East Anglia
	UK51	Bedfordshire, Hertfordshire
	UK52	Berkshire, Buckinghamshire, Oxfordshire
	UK53	Surrey, East-West Sussex
	UK54	Essex
	UK55	Greater London
	UK56	Hampshire, Isle of Wight
	UK57	Kent
	UK61	Avon, Gloucestershire, Wiltshire
	UK62	Cornwall, Devon
	UK63	Dorset, Somerset
	UK71	Hereford and Worcester, Warwickshire
	UK72	Shropshire, Staffordshire
	UK73	West Midlands
	UK81	Cheshire
	UK82	Greater Manchester
	UK83	Lancashire
	UK84	Merseyside
	UK91	Clwyd, Dyfed, Gwynedd, Powys
	UK92	Gwent, Mid-South-West Glamorgan
	UKA1	Borders-Central-Fife-Lothian-Tayside
	UKA2	Dumfries and Galloway, Strathclyde
	UKA3	Highlands, Islands
	UKA4	Grampian
	UKB	Northern Ireland

TABLE B.2- GEOGRAPHICAL CONCENTRATION BY MANUFACTURING SECTORS, 1985-2001

	across countries (n=9)		across NUT2 regions (n=145)	
	level	change	level	change
Food	0.27	9.5	0.37	-1.1
Textiles and wearing apparel	0.37	34.6	0.83	10.1
Wood	0.38	-21.4	0.63	-30.3 **
Paper, publishing and printing	0.29	-1.9	0.64	-10.2 **
Chemicals	0.39	-15.6 *	0.86	-13.3 **
Rubber and plastic products	0.44	-7.3	0.75	-19.8 ***
Other non-metallic mineral products	0.34	-0.5	0.60	-5.9
Basic metals and fabricated metal products	0.39	-6.4	0.76	-19.4
Machinery	0.56	-20.0	0.99	-8.9
Electrical and optical equipment	0.53	-19.7 *	0.93	-20.4 ***
Transport equipment	0.52	-5.9	0.83	-2.7
Manufacturing nec	0.47	-35.7	0.83	-34.4 ***
TOTAL MANUFACTURING	0.38	-10.3	0.63	-11.6 *

*/**/*** denotes rejection of the null hypothesis that $\Delta T_k=0$ at the 90%, 95% or 99% significance level.

Level is the average level of absolute Theil index for the period 1985-2001, change is the percentage variation of the index.

TABLE B3 – INTERNATIONAL ABSOLUTE CONCENTRATION

(Theil absolute measure)

	1985	1993	2001	var 85-93	var 93-01
Food	0.25	0.29	0.28	0.035	-0.011
Textiles and wearing apparel	0.33	0.33	0.44	0.004	0.109
Wood	0.43	0.38	0.34	-0.044	-0.047
Paper, publishing and printing	0.29	0.29	0.28	0.004	-0.010
Chemicals	0.43	0.39	0.36	-0.031 **	-0.035
Rubber and plastic products	0.43	0.48	0.40	0.047	-0.079
Other non-metallic mineral products	0.33	0.35	0.33	0.021	-0.023
Basic metals and fabricated metal products	0.38	0.41	0.36	0.032	-0.056
Machinery	0.61	0.58	0.49	-0.031	-0.092
Electrical and optical equipment	0.56	0.58	0.45	0.020	-0.130 *
Transport equipment	0.54	0.51	0.51	-0.036	0.004
Manufacturing nec	0.55	0.51	0.35	-0.042	-0.154
Total manufacturing	0.39	0.40	0.35	0.010	-0.050

****/**/** denotes rejection of the null hypothesis that $\Delta T=0$ based on 10,000 bootstrap replications.*

***TABLE B4 – GEOGRAPHICAL CONCENTRATION AND LOCALISATION ACROSS REGIONS,* 1985-1993 and 1993-2001**

		Absolute changes			
		1985-1993		*1993-2001*	
	% share	**RC**	**AC**	**RC**	**AC**
Food	*11*	-0.02 **	0.02	-0.04 ***	-0.02
Other non-metallic mineral products	*4.5*	-0.02	0.04 *	-0.01	-0.08
Electrical and optical equipment	*13*	-0.02 ***	0.00	-0.03 ***	-0.21 ***
Manufacturing nec	*4.6*	-0.05 ***	0.04	-0.07 ***	-0.35 ***
Wood	*2.3*	-0.09 **	-0.04	-0.04	-0.19 **
Paper, publishing and printing	*7.1*	-0.01	-0.03	0.00	-0.04
Chemicals	*7.3*	-0.01	-0.02	-0.01	-0.10 ***
Rubber and plastic products	*4.9*	-0.04 **	-0.03	-0.02 **	-0.13 **
Basic metals and fabricated metal products	*14.1*	-0.06 ***	-0.04	-0.03 ***	-0.12
Machinery	*11.2*	-0.02 *	-0.01	0.00	-0.08 *
Textiles and wearing apparel	*8.8*	0.00	0.05	0.04	0.03
Transport equipment	*11.1*	-0.02 *	-0.03	0.04 **	0.01
TOTAL MANUFACTURING	*100*		**0.01**		**-0.09 ** **

RC stands for relative concentration (Theil relative), AC stands for absolute concentration (Theil absolute)

****/**/* denotes rejection of the null hypothesis that ΔT=0 based on 10,000 bootstrap replications.*

TABLE B5-NATIONAL LOCATION QUOTIENTS FOR SELECTED INDUSTRIES

Textiles and wearing app.

	1985	2001
DE	0.6	0.4
FR	1.1	0.8
NL	0.4	0.4
UK	1.0	1.1
ES	1.2	1.3
FI	0.8	0.4
GR	2.9	2.2
IT	1.5	1.7

Transport equipment

	1985	2001
DE	1.1	1.4
FR	1.0	0.8
NL	1.6	2.6
UK	1.4	0.9
ES	0.4	0.6
FI	0.3	0.2
GR	0.1	0.0
IT	7.4	8.6

Miscell. manufacturing

	1985	2001
DE	1.2	0.7
FR	1.0	0.9
NL	0.6	1.0
UK	0.3	1.0
ES	1.8	1.3
FI	0.9	0.8
GR	0.7	0.7
IT	1.0	1.3

Rubber and plastic products

	1985	2001
DE	1.0	1.0
FR	0.9	1.0
NL	1.9	3.1
UK	1.4	1.0
ES	0.5	0.6
FI	0.3	0.3
GR	0.1	0.1
IT	8.1	11.7

Food

	1985	2001
DE	0.6	0.7
FR	1.0	1.3
NL	1.3	1.4
UK	1.2	1.0
ES	1.7	1.2
FI	1.2	0.8
GR	1.9	1.9
IT	0.8	0.8

Machinery

	1985	2001
DE	1.4	1.3
FR	0.6	0.6
NL	2.4	3.7
UK	1.4	0.8
ES	0.2	0.4
FI	0.5	0.4
GR	0.0	0.0
IT	8.0	16.0

Wood

	1985	2001
DE	0.9	0.6
FR	0.2	0.9
NL	0.5	0.9
UK	1.5	0.8
ES	1.5	1.5
FI	2.9	2.1
GR	0.8	0.8
IT	0.6	1.4

Electrical and optical equipment

	1985	2001
DE	1.2	1.2
FR	0.9	0.9
NL	2.6	3.9
UK	1.4	1.0
ES	0.2	0.4
FI	0.2	0.4
GR	0.0	0.0
IT	7.2	11.9

Table B6- First ten EU regions in terms of manufacturing employment

	1985			**1993**			**2001**	
Nordrhein-Westfalen	1837117	*8.0*	Nordrhein-Westfalen	1675553	*8.1*	Nordrhein-Westfalen	1384789	*5.9*
Baden-Württemberg	1475465	*6.4*	Baden-Württemberg	1377165	*6.7*	Baden-Württemberg	1267150	*5.4*
Bayern	1362379	*5.9*	Bayern	1289072	*6.2*	Lombardia	1235829	*5.3*
Lombardia	904788	*3.9*	Lombardia	802243	*3.9*	Bayern	1202247	*5.1*
Île de France	783240	*3.4*	Île de France	591181	*2.9*	Cataluña	675524	*2.9*
Hessen	638893	*2.8*	Niedersachsen	585809	*2.8*	Veneto	608668	*2.6*
Niedersachsen	622528	*2.7*	Hessen	570832	*2.8*	Île de France	574816	*2.4*
Cataluña	473692	*2.1*	Cataluña	557720	*2.7*	Niedersachsen	546036	*2.3*
Piemonte	440750	*1.9*	Rhône-Alpes	375224	*1.8*	Piemonte	522479	*2.2*
Rhône-Alpes	425013	*1.8*	Piemonte	374221	*1.8*	Emilia-Romagna	521243	*2.2*
	23044512	39		20660868	40		23539362	36