4. The changing location of European industry: a twofold geographical perspective*

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4.1. INTRODUCTION

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

One of the most widely debated issues raised by the process concerns 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 activity, so as to mimic the increasing geographical concentration previously arising across the United States.

So far the related theoretical literature has failed to provide irrefutable predictions. Empirically speaking, the great bulk of the evidence concerns patterns of international concentration with limited attention to intra-national evolution. Although inspection of the existing works provides some valuable insights, it is hard to come by conclusive evidence since the different studies are based on disparate spatial partitions of data, methods and time periods.

Disentangling the agglomeration within countries from that occurring internationally has attracted renewed interest strictly connected – from a normative perspective – to the multiplicity of institutions involved in designing policies to enhance industrial change and regional development. To this end, what is required is an integrated approach allowing the inclusion of two geographical levels within a single economic analysis.

The objective of this chapter is to shed light on the location patterns of manufacturing as a whole and its specific industries. Firstly, combining absolute and relative measures I draw a clear picture of what has happened in Europe in recent decades. Moreover, the methodology adopted allows contemplation of the nested geographical perspective (region-country)

recently incorporated in New Economic Geography models and the potential divergence in agglomeration patterns that may arise across and within countries.[1] Finally, significance tests, rarely adopted in the empirical literature, yield compelling results on developments occurring in recent years.

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

Different developments are found for the pre- and post-Single Market periods. International dispersion prevailing in the first period can be regarded as adjustments connected to the abolition of barriers to trade, while inner-country dispersion forces dominated in the 1990s.

The remainder of the chapter is organized as follows. The theoretical background of the chapter is set out in Section 4.2, where the disparate theoretical predictions are surveyed with a specific focus on the relationship between international economic integration and internal geography. Section 4.3 provides a survey of the empirical evidence on the evolution of the spatial distribution of European manufacturing across and within countries. Section 4.4 is devoted to describing the methodology and data used. Section 4.5 summarizes 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 4.6 concludes.

4.2. THEORETICAL INSIGHTS FROM THE NEW ECONOMIC GEOGRAPHY

The new economic geography has provided many theoretical insights into the effect of trade and international integration on business location. 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) defined the concept of agglomeration as the divergence of the spatial distribution of an industry from the one that would arise had only basic location characteristics (spread of natural resources and markets,[2] the transportability of different goods, the local differences in transportation resources and facilities) determined it. Divergence from this theoretical case is due to perturbation effects brought about by a 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 proceeds, to the well-known core–periphery outcome. Given the widespread barriers to international migration, the NEG was initially considered more suitable to analyse 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. His 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.[3] For the purpose of this analysis, we focus on the case of *absence of interregional labour mobility*,[4] in which a process of inverted-U gradual change should occur. Since the model assumes that regions have the same size in terms of population, when trade costs are high, firms are equally divided into 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 seek to locate in peripheral areas to lower labour costs. Hence economic activities spread across space.

Recent developments in the new economic geography have adopted a more focussed perspective on 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) and a number of internal regions in one or both countries are stylized.[5] 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, the workforce is represented as being 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.[6]

At high international transaction costs, manufacturing activities split between the internal regions. At an 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 non-monotonic and gradual inverted U-shaped adjustment, 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 spread of economic activities. Instead, further models suggest that, if interregional mobility of labour is allowed within countries, regional coalescence of industrial activities would arise when European economic integration has reached a mature stage (Monfort and Nicolini, 2000; Paluzie, 2001; Crozet and Koenig-Soubeyran, 2004).

Inspired by the Mexican liberalization 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) has lost the advantage it had in a relatively closed economy, firms that now mainly sell to external markets are more willing to migrate to peripheral regions, especially if relocation means better access to international markets. In spite of a general deconcentration of the overall manufacturing sector, the possibility of particular industries clustering is also acknowledged since different areas may specialize as a result of trade liberalization (Fujita et al., 1999).

As I will show, starting from the New Economic Geography framework, the theoretical predictions of Puga (1999) and particularly those of Krugman and Livas (1996) look consistent with my findings on the evolution of the location of manufacturing in Europe.

In reality, it is worth pointing out that further economic forces unrelated to international trade integration may engender a rupture of existing location patterns, fostering the dispersion of economic activities. Recent theoretical contributions conceived that widespread firm fragmentation lay at the root of changes in inner-country economic geography which, in many countries, has seen the agglomeration of executive functions in metropolitan areas and

smaller service-oriented towns, with peripheral areas becoming favoured sites for routine tasks. Following these lines of reasoning, the functional specialization of different areas is the aggregate implication of microeconomic change, induced by 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[7] (Davis and Henderson, 2004; Duranton and Puga, 2005; Rossi-Hansberg et al., 2006; Henderson and Ono, 2008). When spatial transaction costs (that is the cost of coordination and monitoring across fairly wide distances) decrease substantially, firms that used to perform managerial, R&D and production tasks under a single roof prefer to become multi-plant organizations.

4.3. EMPIRICAL EVIDENCE

The interest in empirical research on industrial location is gaining momentum in Europe, especially since the launch of the Single Market Programme and Monetary Union. Contrasting Europe's larger countries (France, Western Germany, Italy and the United Kingdom) with comparable US macro-regions, Krugman suggested that as they become more integrated, the former will also become less similar to each other (see Krugman, 1991a). The envisaged increase in relative specialization of European countries, and the mirroring agglomeration of industries, has come to be called the Krugman hypothesis. It is worth noting that the conjecture on an EU convergence to the US level of concentration was probably based on the theoretical framework introduced, and specifically on the supposition of 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 to this specific analysis, noticeably, in the propensity of workers to migrate.

Several empirical studies have sought to ascertain the actual location patterns in Europe. In the following, I will summarize the main empirical findings drawing from a survey of the existing literature. Prior to that, I shall clarify the meaning of the expressions extensively used throughout the chapter: 'geographical concentration' and 'localization'.

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 us to assess whether a specific sector tends 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 spread of overall economic activity (overall manufacturing, in this case). Relative concentration indices are used for this purpose, since they are more suitable to gauge the economic forces driven within-industry agglomeration economies. Perfect regularity, 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 interregional allocation of aggregate manufacturing, the higher are the agglomeration forces at work within the specific industry. These specific agglomeration forces are underpinned by intra-industry input–output linkages, labour market pooling and industry-specific knowledge spillovers. Geographical dispersion and de-agglomeration are two different economic phenomena and they do not necessarily evolve in parallel. This raises the necessity of assessing both geographical concentration and agglomeration.

A number of authors, in spite of the different methods adopted, agree on a pattern of increasing geographical concentration of manufacturing between European countries during the 1980s 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.

Previous studies have shown increasing relative concentration during the 1980s, a period on which several empirical results tend to agree (Brülhart, 1998; Amiti, 1999; Midelfart et al., 2004). On the basis of Eurostat production data for Belgium, France, Italy, Germany and the United Kingdom, Amiti (1999) reported an increasing relative concentration for a majority of manufacturing industries from 1976 to 1989.[9] Moreover, Brülhart (1998) observed that, during the 1980s, localization increased in 14 of the 18 European industries considered (especially labour-intensive industries and increasing returns-to-scale industries). Instead, relying on four-year averages for the period 1970–1997 to avoid cyclical bias, Midelfart et al. (2004) suggested that the upward trend in the 1980s was a brief interlude before returning to decreasing agglomeration 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. Absolute concentration levels of value added have already been found to decline significantly across countries in a majority of manufacturing industries[10] during the period 1992–1998 (Aiginger and Davies, 2004; Aiginger and Pfaffermayer, 2004).

Until recent years empirical studies at the regional scale were hampered by the shortage of detailed regional information. Consequently, little research has been devoted to geographical concentration across a wide array of EU regions (Brülhart and Traeger, 2005; Hallet, 2000, Aiginger and Leitner, 2002). Moreover, once comparisons are made, no straightforward results emerge.

According to Aiginger and Leitner (2002), the interregional concentration of manufacturing employment has followed the wave-shaped path emerging at the international level. They report decreasing regional concentration of manufacturing employment across NUTS1 regions despite a temporary increase prior to the implementation of the Single Market Program. Further studies suggest that different – and sometimes even conflicting – evidence appears with respect to that found in country-based studies, when the region is adopted as the unit of analysis. On the basis of regional gross value added, Hallet (2000) failed to provide conclusive results. More recently, Brülhart and 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. They also emphasize that some industries recorded an increasing relative concentration across regions between the 1980s and early 1990s. Using non-parametric methodology, Ezcurra et al. (2006) empirically support the Krugman hypothesis for they show that, as soon as the European Single Act came into force, an increase in geographical concentration of most manufacturing activity occurred across European NUTS 2 regions. Sub-national empirical studies provide contradictory evidence on manufacturing location within countries. Decreasing agglomeration was widespread across Spanish provinces during the 1980s (Paluzie et al., 2001), across Italian regions from the early 1970s to the late 1990s (Rombaldoni and Zazzaro, 1997; De Robertis, 2001; Ciciotti and Rizzi, 2003) and, more recently, also within Germany (Suedekum, 2006).

The great bulk of empirical studies was carried out either on location across countries or within a single nation. Besides, most empirical works focussed either on geographical concentration (measured by absolute indices) or agglomeration (measured by relative measures) of industries (see Table 4.1 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.

Table 4.1. A smmary of the evidence

	Authors	*Method-ology*[a]	*Period*	*Geographical coverage*	*Activity variable*	*Geographical concentration*	*Industry agglomeration*
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		Declined from the mid-1980s to the mid-1990s
	Aiginger and Leitner (2002)	AC	1987–1998	EU-14 (NUTS-1)	Value added/employment	Inverted "U" hyphothesis confirmed	
	Brülhart and Traeger (2005)	RC	1975–1998	EU (NUTS2-1)	Value added/employment		Textiles industry and entire manufacturing becoming more localized
	Rombaldoni and Zazzaro (1997)	RC	1971–1991	Italy (NUTS2)	Employment		Agglomeration decreased in a majority of innovative industries
	De Robertis (2001)	RC	1971–1991	Italy (NUTS2)	Employment	Decreased	Differential patterns of agglomeration
	Paluzie et al. (2001)	RC	1979–1992	Spain (NUTS3)			Decreasing agglomeration prevailed
	Suedekum (2006)	RC	1993–2001	Germany (NUTS1-2-3)	Employment		Decreased

Note: [a] *A* stands for absolute concentration, *R* stands for relative concentration.

4.4. METHODOLOGY AND DATA

4.4.1. 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 $(j = 1,\ldots, r_i)$ 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 i

x_k = total employment in industry k in the supranational economy

x = total employment in the supranational economy

R is the number of regions.

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

Coefficient of variation: $$CV = \left[R \sum_{j=1}^{R} \left(\frac{x_{ij}}{x} \right) - 1^2 \right]$$

Absolute Gini: $$G = \frac{2 \sum_{j=1}^{R-1} \left(P_j - Q_j \right)}{R \sum_{j=1}^{R-1} P_j}$$

The Gini index measures the area between the Lorenz curve and the hypothetical line of absolute equality. In the present context, it is obtained ranking regions in increasing order according to their manufacturing employment. Q_j are cumulated shares of the ordered distribution of x_{ij}/x, while P_j are cumulative shares of the equi-distribution where each observation is equal to $1/R$.

Therefore, the Gini index measures the extent to which the distribution of manufacturing employment among regions within the European economy deviates from a perfectly equal distribution.

Relative mean deviation: $$RMD = \sum_{j=1}^{R} \left| \frac{x_{ij}}{x} - \frac{1}{R} \right|$$

Absolute Theil index: $$T = \ln(R) + \sum_{j=1}^{R} \frac{x_{ij}}{x} \ln\left(\frac{x_{ij}}{x}\right)$$

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 the *within* and *between* countries components of relative concentration patterns to be disentangled. Brülhart and Traeger (2005) exploited their decomposition properties to measure topographic and relative concentration across regions, their relative version being comparable to the present contribution. Their analysis, focusing on value added as an activity indicator, covers a different period (1980–95) 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 a straightforward economic interpretation of results: splitting the overall relative concentration into its different components allows us 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 agglomeration of an industry k is defined here as the divergence in the spatial distribution of that industry, controlling for the spread of the overall economic activity (the benchmark in the case of concentration, for example manufacturing).

The basic dissimilarity Theil index to measure the agglomeration of one industry k is:

$$T_k = \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{x_{ijk} / x_k}{x_{ij} / x}\right) \tag{4.1}$$

The relative concentration index has no upper bound[11] and the lower limit is 0. When $T_k = 0$ industry k is distributed across the regions in the same way as the total manufacturing span across the same regions of the whole area. An increasing relative concentration over time denotes a process of regional specialization in that industry somewhere in the whole economy considered.

The degree of agglomeration of each industry (T_k) can be thought of as a measure of the strength of localization economies and/or the importance of industry-specific natural advantages. In the case of perfect regularity $(T_k = 0)$ the location of the industry is mainly due to the advantage 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 repulsion forces prevail and industries are affected neither by localization economies (for example intra-industry spillover, labour market pooling) nor by industry-specific natural advantages (cf. 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 agglomeration index defined in Equation (4.1)). Hence:

$$T_k^w = \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln \left(\frac{x_{ijk} / x_{ik}}{x_{ij} / x_i} \right) \tag{4.2}$$

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

$$T_k^b = \sum_{i=1}^{m} \frac{x_{ik}}{x_k} \ln \left(\frac{x_{ik} / x_k}{x_i / x} \right) \tag{4.3}$$

assesses the *between-country* agglomeration 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, the more the inner regional allocation of each country differs from 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 within 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, revealing that the international distribution of industry k is overlapping with the allocation across countries of manufacturing as a whole Therefore, the higher the between-country component, the more national comparative advantages in industry k are important. Accordingly, increasing between-country agglomeration indicates that national economies are specializing according to comparative advantage

The relative entropy measure of industry agglomeration proposed in Equation (4.1) 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 agglomeration, $T_k = 0$);
3. It is suitable for statistical testing through bootstrap methods.

However, 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 has 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 agglomeration relying on a block-bootstrap, that is resampling observations from different countries separately.

The main issue to be addressed here is whether geographical concentration and agglomeration changed significantly over the period under scrutiny. This concern can be answered by bootstrapping the measures of absolute and relative concentration, and their components. The resampling process is repeated 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:

$$H_o : \Delta T_k = 0$$

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

4.4.2. 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 considerable impact on regional manufacturing location patterns. Accordingly, data were considered at three separate points of time – namely 1985, 1993, 2001 – to draw a distinction between pre-Single Market trend (1985–1993) 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 the UK. The regional breakdown is mainly based on the NUTS2 grid, except for Germany

for which I referred to the NUTS1 regions (for detailed information on geographical coverage see Table 4A.1).

The present study focuses on the agglomeration of employment because it is the only activity indicator at the regional level in the Eurostat database for detailed manufacturing sectors. The survey of the previous studies indicates that results may be affected by the activity variable chosen. This is not a drawback: by combining the evidence based on employment data with that based on value added it is possible to advance an interpretation of the recent agglomeration patterns in Europe (see the next section).

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* and *manufacturing n.e.c.*

The *food* industry encompasses the manufacture of food products, beverages and tobacco. The *textile* industry includes the manufacture of textiles, clothing, 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 comprises the manufacture of chemicals and manufacture of chemical and pharmaceutical products. The *rubber and plastics* 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* comprises the manufacture of basic metals (iron and steel) and metallurgy, except *machinery* which constitutes 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 (divisions 34–35) includes the manufacture of motor vehicles, ships, boats, aircraft, motorcycles and bicycles. The *other manufacturing industry n.e.c.* (division 36) includes the manufacture of furniture and recycling, musical instruments, jewellery, games and toys and other activities not classified elsewhere.

Manufacturing of leather and leather products and *manufacture of coke, refined petroleum products and nuclear fuel* are excluded from the analysis because of the overwhelming lack of available data for reasons of

confidentiality. To extend the analysis, data for Belgium were provided by the national statistics office and, since they are based on the previous NACE 70 classification, some regional aggregation was required: *Bruxelles*, *Vlaams Brabant* and *Brabant Wallon* are clustered as a single region.

4.5. THE EMPIRICAL EVIDENCE FOR EUROPE

4.5.1. Geographical Concentration and Agglomeration: an Overview

From the second half of the 1980s the manufacturing industry became less geographically concentrated across European countries and regions. Table 4.2 clearly shows that results of a general dispersion are robust at the different spatial scales and for different absolute measures.

For the entire period 1985–2001, disaggregated sectoral analysis reinforces the evidence of overwhelming regional dispersion (see Table 4A.2). The international spread of manufacturing employment is linked to the industrialization experienced by peripheral countries and the concurrent de-industrialization and tertiarisation in highly developed EU economies. In fact, Mediterranean countries – Italy and, to a lesser extent, Spain – actually increased their share of European manufacturing employment during the

Table 4.2. Geographical concentration of manufacturing employment, percentage 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

1990s. By contrast, the fall of employment in Western Germany (see Figure 4.1) is related to the general deindustrialization of the country, the recession following national reunification, and subsequent decentralization toward Eastern regions.

It is plausible that peripheral countries have benefited from the European integration process, not only for having gained better access to markets, but also because of the role played by EU policies for regional and industrial development. Indeed, Italy and Spain were among the top six recipients of

EU aid and state aid to manufacturing during the period 1994–1996 (Greece, Portugal, Ireland and Denmark were the others, see Midelfart-Knarvik and Overman (2002), p. 334). Thus, it would be misleading to conceive these changes as a mere outcome of the European Single Market, since regional and industrial policy at the national and EU level may have played a key role, while advances in information and communication technology change the rules of the game for localization.

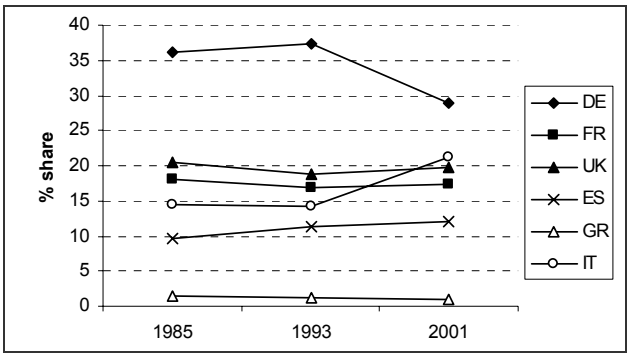

Figure 4.1. Employment shares, total manufacturing

Table 4.3 ranks the manufacturing industries according to their average relative concentration (reported in the third column), calculated on the basis of the 145 NUTS2 regions for the observation period. Textiles and clothing emerge as the industry endowed with pronounced localization economies, for it exhibits the highest divergence with the spread of overall manufacturing. Other resource-based industries, with a relatively low technology level, like *wood production* and *non-metallic mineral products*, rank among the most localized. Instead, innovative industries have an intermediate level of agglomeration, like *chemicals* and *transport equipment*, or they are spread even more similarly to total manufacturing, 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.

Brülhart and Traeger (2005) found that relative concentration of value added increased in the majority of manufacturing industries even though changes are generally minimal and not significant (Table 4.3, 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 worth pointing out that the regional agglomeration of value added combined with the spreading of employment evokes the occurrence of within-industry spatial fragmentation according to functional lines.

Table 4.3. Relative concentration of manufacturing industries across EU regions: absolute change

	OECD tech.class.	Average 1985–2001	1985–2001	1980–1995[a]
Textiles and clothing	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 **	–

Notes:

*/**/*** denotes rejection of the null hypothesis that $\Delta Tk = 0$ 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).

Increasing returns-to-scale sectors – *non-metal products*, *chemicals*, *transport equipment* and *paper and publishing* – are characterized by consolidated regional localization patterns. Indeed, not only did they emerge as highly clustered at the beginning of the period, but they also exhibited minimal changes. In *textiles and clothing*, where external economies are very important, relative concentration increased 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 polarization forces, albeit weak, still drained a part of sectoral employment towards the EU core regions (reported in Table 4A.8) until 1993, while dispersion certainly dominated the post-Single Market environment. This is a very interesting point which is shown by the combination of geographical concentration and agglomeration indices (Table 4A.4).

Evolution in the first group of industries – *food*, *non-metallic products*, *electrical and optical equipment*, and *miscellaneous manufacturing* – mimicked that of total manufacturing (reported in the last row of Table 4A.4), increasing until 1993 and decreasing thereafter. 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 during the 1990s.

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 localization for the majority of industries can be considered as the tendency of firms to locate towards more industrialized and urbanized EU regions in the first period, and a tendency of industry-specific dispersion to be patterned on that 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, while this was not the case for the industry-specific rising tendencies of the first period (Table 4A.4). Hence, the considerable EU-wide interregional spread of employment appears consistent with the theoretical predictions of Puga (1999) which eventually envisaged a dispersion propelled by congestion-related forces (high wages of the core regions, in the specific model surveyed in Section 4.2).

Textiles and clothing and *transport equipment* represent outstanding cases. Between 1993 and 2001, they did not change in line with all manufacturing, becoming more geographically concentrated and, therefore, more localized (Table 4A.4).

4.5.2. Within- and Between-Country Evolutions in the Context of European Economic Integration

So far I have outlined some of the major changes that occurred in industrial concentration and localization across EU regions. In this section I shall look in greater depth at the transformations which took place in localization within and across countries during EU economic integration. In order to do so, the decomposition analysis introduced in Cutrini (2006) and reported in Appendix B is used.

The inner-country evolution and the national change jointly explain the variation in overall relative concentration but they do not evolve in parallel. During the entire period, the significant decline in inner-country localization was accompanied by a slight specialization of national economies.[13] Some of the industries showing a substantial decrease in the internal localization also

experienced intensifying between-country concentration associated to a process of national specialization (reported in grey in Table 4.4).

Employment in low-tech production trickled down (*wood* and *miscellaneous manufacturing*) or polarised towards the EU periphery (*textiles and clothing*). The falling trend in the *wood* and *miscellaneous manufacturing* sectors is associated to a loss of employment in core countries mirrored by a process of specialization in peripheral countries. The between-country polarisation of *textiles and clothing* employment is clearly explained by a context which continued to privilege the traditionally less industrialized Mediterranean countries.

Instead, in the *food* industry the major shift occurred between France, Spain and Netherlands, on the one hand, and the United Kingdom, on the other. The former group has specialized, the latter has lost its previous comparative advantage in this industry (Table 4A.5).

International restructuring went along with the European integration process. Although some of the objectives of the Common Market programme had already been achieved by the beginning of the 1970s, trade barriers had still not been completely removed by the mid-1980s. With the aim of totally eliminating the 'frontier' concept, the 1985 White Paper established the legislation to be adopted by the end of 1992 in order to achieve the elimination of physical, technical and tax frontiers.

Table 4.4. Within- and between-country components of relative concentration: absolute change, 1985–2001

	Total	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 ***

Note:
Sectors whose within- and between-country components evolved in opposite directions are in grey.

The construction of the Single Market was dominated by international adjustments towards decreasing specialization of countries (Table 4.5). Absolute changes of the between-country factors were generally negative and in half of the industries significant. It is conceivable that national specialization occurred mostly intra- rather than inter-industry. It may also be the case that European countries, in a context of high trade barriers, protected industries in which they were not endowed with a comparative advantage (Amiti, 1999). Accordingly, international integration has disrupted previous artificial industrial structures that are to be replaced with the disclosure of the real specialization patterns. The evidence provided may be regarded as confirmation of a temporary adjustment to the new environment that dominated the first period, followed by specialization once the Internal Market is fully completed.[14] In fact, during the second period, additional industries agglomerated across countries, and further national specialization according to comparative advantage may possibly be imminent as the EU proceeds to deepen and widen further.

This conjecture is confirmed first of all by the location patterns experienced by *textiles* and *transport equipment*. Once the Internal Market was completed, international agglomeration of *textiles* was mainly due to the higher and increasing shares of Spain and Italy in European textiles employment against their respective shares in European manufacturing employment. Instead, the production of transport equipment remained highly embedded in Germany (from 37 to 39 per cent of European employment, cf. Figure 4.1) despite the loss of industrial employment and deindustrialization experienced by the country during the last decade. Italy and Netherlands also improved in terms of specialization.

Whatever the shape of national specialization in Europe in the future, so far most of the structural changes, particularly after the completion of the Single Market programme, has occurred in the internal geography of countries (see Table 4.5). From a theoretical viewpoint, these results appear consistent with the equilibrium of dispersion outlined by Krugman and Livas (1996) since congestion costs have propelled the disappearance of previous core–periphery patterns, even if the latter may also be underpinned by further possible explanations.

Why have within-industry localization economies weakened in Europe during recent years? While European integration was being strengthened, transportation and communication technology also improved, and in some industries, spatial fragmentation of functions becomes the most efficient organizational form at the firm level. Hence, allowing for the simultaneous development in transportation infrastructure and communication technology may prove important for a clearer understanding of the underlying reasons. The former allowed firms to localize different stages of the production

process without the need to be close to final demand, and the latter led to easier flows of information with distant economic agents, affording the possibility to spatially disperse economic linkages along the value chain.

Table 4.5. A comparison of pre- and post-Single Market periods: absolute change, 1985–1993 and 1993–2001

	Pre-Single Market		Post-Single Market	
	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 ***

For example, a general de-agglomerative pattern of manufacturing industries occurred across all German regions between 1993 and 2001. High-tech industries, such as the chemical industry, synthetic material, motor vehicles, metal products and office supplies, information technology, and optics, dispersed 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, for dispersion emerged even within Western Germany itself. Instead, it is more plausible that it was fostered by suburbanization related to congestion costs and by decentralization of production sustained by the development of information technologies (Suedekum, 2006; Bade et al., 2007).

Turning to Italy, interregional dispersion in the 1970s and 1980s was conceived in terms of the *filtering-down* theory (Crivellini and Pettenati, 1989) associated to rising congestion costs and disamenities of the country's main industrial areas. The change in the internal geography was also reinforced by lagging regions (the so-called *Third-Italy*) that subsequently

grew faster than core regions, leading to extensive reshuffling of previous relative positions (Garofoli, 1992). Moreover, public policies and fiscal incentives, aimed at supporting the industrialization of the *Mezzogiorno*, are deemed to have played a significant role.

More recently, local linkages have vanished in Italy, because decentralization of labour-intensive production tasks has 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 1970s and 1980s (Rombaldoni and Zazzaro, 1997; De Robertis, 2001) has continued in more recent years: the economic crisis of the early 1990s forced Fiat to restructure its supply chain with a further decentralization of routine tasks toward the *Mezzogiorno*.[15]

More generally, from an EU-wide regional perspective, the geographical dispersion was a phenomenon that was particularly pronounced during the 1990s.

4.6. CONCLUDING REMARKS AND FURTHER DEVELOPMENTS

This chapter has investigated manufacturing location patterns in Europe during a period of trade integration. Decomposition methodology based on the use of entropy indices served the main purpose of the analysis, allowing inner-country to be disentangled from cross-country divergence in agglomeration patterns.

Contrasting with previous studies, I found robust results in the evolution of EU-wide regional changes, providing 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 specialization along functional lines is occurring within industry (Duranton and Puga, 2005) implying, in turn, concentration of high value-added functions in some core regions and specializing in routine tasks in peripheral sites. Accordingly, European economic integration has to be regarded as part of the story, while the diffusion of new technologies could have substantially contributed to forging the new inner-country economic geography.

Less clear results are found for the international industrial location patterns. Specialization of countries according to comparative advantage, as predicted by traditional trade theory, should have resulted in increasing agglomeration of industries across national boundaries. Instead I found a

decreasing and significant across-country trend which was particularly pronounced from the launching of the White Paper and until 1992, parallel to the far-reaching liberalization of manufactured goods markets. The emerging scenario may be conceived as a temporary adjustment to the new environment and, if this is the case, further European integration may propel national specialization as happened in two core industries (*textiles* and *transport equipment*), in the second period analysed. Nonetheless, the absence of across-country polarization may well be 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 prove useful to ascertain whether European industrial location is still changing and in which direction.

Nonetheless, conceiving the transformation as a pure outcome of the European Single Market Programme and Monetary Union would be misleading. Instead, it is more plausible that differential stages of countries' industrialization processes, institutional changes and regional and industrial policy at the EU and national level, have reinforced the emerging trickle-down of manufacturing employment in Europe. Whether the observed location patterns can actually be considered as the outcome of the construction of the Single European Market, or they are instead underpinned by changes in the strength of agglomeration economies and firm organization remains an open issue that is left for future research.

APPENDIX A: DECOMPOSING THE INDEX OF INDUSTRY AGGLOMERATION

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

$$T_k = \sum_{i=1}^{m}\sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{x_{ijk}/x_k}{x_{ij}/x}\right) \tag{4A.1}$$

Adding and subtracting the term $\sum_{i=1}^{m}(x_{ik}/x_k)\ln(x_{ik}/x_i)$ to Equation (4.1A) yields:

$$T_k = \sum_{i=1}^{m}\sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{x_{ijk}}{x_{ij}}\right) - \sum_{i=1}^{m}\sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{x_k}{x}\right) + \sum_{i=1}^{m} \frac{x_{ik}}{x_k} \ln\left(\frac{x_{ik}}{x_i}\right) - \sum_{i=1}^{m} \frac{x_{ik}}{x_k} \ln\left(\frac{x_{ik}}{x_i}\right) \tag{4A.2}$$

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:

$$T_k=\sum_{i=1}^{m}\sum_{j=1}^{r_i}\frac{x_{ijk}}{x_k}\ln\left(\frac{x_{ijk}}{x_{ij}}\right)-\sum_{i=1}^{m}\frac{x_{ik}}{x_k}\ln\left(\frac{x_k}{x}\right)+\sum_{i=1}^{m}\frac{x_{ik}}{x_k}\ln\left(\frac{x_{ik}}{x_i}\right)-\sum_{i=1}^{m}\sum_{j=1}^{r_i}\frac{x_{ijk}}{x_k}\ln\left(\frac{x_{ik}}{x_i}\right) \quad (4A.3)$$

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

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

Instead, the *within country* component is obtained by combining the first element of Equation (4A.3) with the fourth one:

$$T_k^w=\sum_{i=1}^{m}\sum_{j=1}^{r_i}\frac{x_{ijk}}{x_k}\ln\left(\frac{x_{ijk}/x_{ik}}{x_{ij}/x_i}\right) \quad (4A.5)$$

such that

$$T_k=T_k^b+T_k^w \quad (4A.6)$$

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 (x_{ik}/x_k). It may be expressed as follows:

$$T_k^w=\sum_{i=1}^{m}\frac{x_{ik}}{x_{ik}}T_{ik}^{br} \quad (4A.7)$$

where

$$T_{ik}^{br}=\sum_{j=1}^{r_i}\frac{x_{ijk}}{x_{ik}}\ln\left(\frac{x_{ijk}/x_{ik}}{x_{ij}/x_i}\right)$$

again can be thought of as Theil dissimilarity (Theil, 1967).

APPENDIX B

Table 4A.1. Geographical coverage

	NUTS	REGION		NUTS	REGION
Belgium	BE1	Région Brabant	*Finland*	FI11	Uusimaa
	BE21	Prov. Antwerpen		FI12	Etelä-Suomi
	BE22	Prov. Limburg		FI13	Itä-Suomi
	BE23	Prov. Oost-Vlaanderen	*France*	FR1	Île de France
	BE25	Prov. West-Vlaanderen		FR21	Champagne-Ardenne
	BE32	Prov. Hainaut		FR22	Picardie
	BE33	Prov. Liège		FR23	Haute-Normandie
	BE34	Prov. Luxembourg		FR24	Centre
	BE35	Prov. Namur		FR25	Basse-Normandie
Germany	DE1	Baden-Württemberg		FR26	Bourgogne
	DE2	Bayern		FR3	Nord - Pas-de-Calais
	DE3	Berlin		FR41	Lorraine
	DE4	Brandenburg		FR42	Alsace
	DE5	Bremen		FR43	Franche-Comté
	DE6	Hamburg		FR51	Pays de la Loire
	DE7	Hessen		FR52	Bretagne
	DE8	Mecklenburg-Vorpommern		FR53	Poitou-Charentes
	DE9	Niedersachsen		FR61	Aquitaine
	DEA	Nordrhein-Westfalen		FR62	Midi-Pyrénées
	DEB	Rheinland-Pfalz		FR63	Limousin
	DEC	Saarland		FR71	Rhône-Alpes
	DED	Sachsen		FR72	Auvergne
	DEE	Sachsen-Anhalt		FR81	Languedoc-Roussillon
	DEF	Schleswig-Holstein		FR82	Provence-Alpes-Côte d'Azur
	DEG	Thüringen		FR83	Corse
Spain	ES11	Galicia	*Greece*	GR11	Anatoliki Makedonia, Thraki
	ES12	Principado de Asturias		GR12	Kentriki Makedonia
	ES13	Cantabria		GR13	Dytiki Makedonia
	ES21	Pais Vasco		GR14	Thessalia
	ES22	Comunidad Foral de Navarra		GR21	Ipeiros
	ES23	La Rioja		GR22	Ionia Nisia
	ES24	Aragón		GR23	Dytiki Ellada
	ES3	Comunidad de Madrid		GR24	Sterea Ellada
	ES41	Castilla y León		GR25	Peloponnisos
	ES42	Castilla-la Mancha		GR3	Attiki
	ES43	Extremadura		GR43	Kriti
	ES51	Cataluña	*Italy*	ITC1	Piemonte
	ES52	Comunidad Valenciana		ITC2	Valle d'Aosta
	ES53	Illes Balears		ITC3	Liguria
	ES61	Andalucia		ITC4	Lombardia
	ES62	Región de Murcia		ITD3	Veneto
	ES7	Canarias (ES)		ITD4	Friuli-Venezia Giulia

Table 4A.1. Continued

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

Table 4A.2. Geographical concentration by manufacturing sector, 1985–2001

	Across countries (n=9)				Across NUTS2 regions (n=145)			
		change				change		
	Level	Diff 1985–2001	Boot. Std. Err.	Sign.	Level	Diff 1985–2001	Boot. Std. Err.	Sign.
Food	0.27	0.024	0.05		0.37	–0.004	0.02	
Textiles	0.37	0.113	0.08		0.83	0.080	0.08	
Wood	0.38	–0.091	0.14		0.63	–0.226	0.09	**
Paper	0.29	–0.006	0.04		0.64	–0.069	0.03	**
Chemicals	0.39	–0.066	0.04	*	0.86	–0.121	0.06	**
Rubber and plastic products	0.44	–0.032	0.04		0.75	–0.162	0.04	***
Other non-metallic mineral products	0.34	–0.002	0.05		0.60	–0.035	0.05	
Basic metals and fabricated metal products	0.39	–0.024	0.08		0.76	–0.161	0.12	
Machinery and equipment nec	0.56	–0.123	0.08		0.99	–0.091	0.06	
Electrical and optical equipment	0.53	–0.111	0.06	*	0.93	–0.203	0.05	***
Transport equipment	0.52	–0.032	0.07		0.83	–0.023	0.06	
Manufacturing nec	0.47	–0.196	0.13		0.83	–0.316	0.09	***
Total manufacturing	0.38	–0.040	0.05		0.63	–0.080	0.04	*

Notes:

*/**/*** denotes rejection of the null hypothesis that $\Delta T_k = 0$ at the 90%, 95% or 99% significance level based on 10,000 replications.

Level is the average level of absolute Theil index for the period 1985–2001, change is the variation of the index over time.

Table 4A.3. International absolute concentration (Theil absolute measure)

	Level			Diff. 1985–1993			Diff. 1993–2001		
	1985	1993	2001	Value	Boot. Std. Err.	Sign.	Value	Boot. Std. Err.	Sign.
Food	0.25	0.29	0.28	0.035	0.029		–0.011	0.040	
Textiles	0.33	0.33	0.44	0.004	0.028		0.109	0.067	
Wood	0.43	0.38	0.34	–0.044	0.116		–0.047	0.092	
Paper	0.29	0.29	0.28	0.004	0.034		–0.010	0.024	
Chemicals	0.43	0.39	0.36	–0.031	0.015	**	–0.035	0.031	
Rubber and plastic products	0.43	0.48	0.40	0.047	0.029		–0.079	0.050	
Other non-metallic mineral products	0.33	0.35	0.33	0.021	0.029		–0.023	0.044	
Basic metals and fabricated metal products	0.38	0.41	0.36	0.032	0.038		–0.056	0.071	
Machinery and equipment nec	0.61	0.58	0.49	–0.031	0.040		–0.092	0.060	
Electrical and optical equipment	0.56	0.58	0.45	0.020	0.033		–0.130	0.068	*
Transport equipment	0.54	0.51	0.51	–0.036	0.064		0.004	0.016	
Manufacturing nec	0.55	0.51	0.35	–0.042	0.046		–0.154	0.118	
Total manufacturing	0.39	0.40	0.35	0.010	0.017		–0.050	0.051	

Notes:

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

Table 4A.4. Geographical concentration and agglomeration across regions, 1985–1993 and 1993–2001

	% share	Absolute changes											
		1985–1993						1993–2001					
		RC	Boot. Std. Err.	Sign.	AC	Boot. Std. Err.	Sign.	RC	Boot. Std. Err.	Sign.	AC	Boot. Std. Err.	Sign.
Food	11	–0.02	0.008	**	0.02	0.013		–0.04	0.011	***	–0.02	0.021	
Other non-metallic mineral products	4.5	–0.02	0.014		0.04	0.021	*	–0.01	0.016		–0.08	0.048	
Electrical and optical equipment	13	–0.02	0.007	***	0.00	0.029		–0.03	0.008	***	–0.21	0.060	***
Manufacturing nec	4.6	–0.05	0.017	***	0.04	0.049		–0.07	0.027	***	–0.35	0.100	***
Wood	2.3	–0.09	0.042	**	–0.04	0.042		–0.04	0.031		–0.19	0.084	**
Paper	7.1	–0.01	0.010		–0.03	0.026		0.00	0.011		–0.04	0.022	
Chemicals	7.3	–0.01	0.011		–0.02	0.032		–0.01	0.015		–0.10	0.035	***
Rubber and plastic products	4.9	–0.04	0.016	**	–0.03	0.034		–0.02	0.009	**	–0.13	0.056	**
Basic metals and fabricated metal products	14.1	–0.06	0.010	***	–0.04	0.034		–0.03	0.008	***	–0.12	0.099	
Machinery and equipment nec	11.2	–0.02	0.011	*	–0.01	0.029		0.00	0.010		–0.08	0.049	*
Textiles	8.8	0.00	0.017		0.05	0.034		0.04	0.029		0.03	0.059	
Transport equipment	11.1	–0.02	0.009	*	–0.03	0.036		0.04	0.020	**	0.01	0.037	
Total Manufacturing	**100**				**0.01**	**0.013**					**–0.09**	**0.045**	****

Notes:

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 4A.5. 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 4A.6 Bootstrap results for concentration measures: absolute changes, 1985–2001

		Obs. differ.	Boot. Std. Err.	z	$P>\|z\|$
Food	T_k	–0.054	0.016	–3.41	0.001
	T_k^w	–0.018	0.008	–2.37	0.018
	T_k^b	–0.036	0.015	–2.38	0.017
Textiles	T_k	0.034	0.034	0.99	0.322
	T_k^w	–0.034	0.019	–1.81	0.071
	T_k^b	0.068	0.025	2.72	0.007
Wood	T_k	–0.130	0.057	–2.31	0.021
	T_k^w	–0.037	0.021	–1.76	0.078
	T_k^b	–0.093	0.047	–1.97	0.049
Paper	T_k	–0.014	0.018	–0.8	0.424
	T_k^w	0.005	0.012	0.42	0.674
	T_k^b	–0.019	0.012	–1.59	0.112
Chemicals	T_k	–0.020	0.018	–1.12	0.264
	T_k^w	–0.029	0.016	–1.79	0.074
	T_k^b	0.009	0.012	0.75	0.453
Rubber and plastic products	T_k	–0.056	0.024	–2.35	0.019
	T_k^w	–0.061	0.022	–2.72	0.006
	T_k^b	0.005	0.005	0.97	0.331
Other non-metallic mineral products	T_k	–0.032	0.028	–1.17	0.241
	T_k^w	–0.045	0.020	–2.31	0.021
	T_k^b	0.013	0.015	0.82	0.411
Basic metals and fabricated metal products	T_k	–0.083	0.014	–6.15	0.000
	T_k^w	–0.069	0.012	–5.85	0.000
	T_k^b	–0.014	0.011	–1.26	0.207
Machinery and equipment nec	T_k	–0.025	0.016	–1.59	0.112
	T_k^w	–0.008	0.008	–1.06	0.29
	T_k^b	–0.017	0.011	–1.55	0.121
Electrical and optical equipment	T_k	–0.046	0.011	–4.18	0.000
	T_k^w	–0.042	0.010	–4.41	0.000
	T_k^b	–0.004	0.008	–0.53	0.595
Transport equipment	T_k	0.021	0.023	0.95	0.344
	T_k^w	–0.005	0.010	–0.47	0.635
	T_k^b	0.026	0.023	1.13	0.256
Manufacturing nec	T_k	–0.125	0.036	–3.46	0.001
	T_k^w	–0.041	0.018	–2.25	0.025
	T_k^b	–0.084	0.028	–2.98	0.003

Table 4A.7. Bootstrap results for concentration measures: absolute changes by sub-period

		1985–1993				1993–2001			
		Obs. differ.	Boot. Std. Err.	z	P>|z|	Obs. differ.	Boot. Std. Err.	*z*	*P*>|*z*|
Food	T_k	–0.019	0.008	–2.32	0.02	–0.036	0.011	–3.21	0.001
	T_k^w	–0.007	0.005	–1.20	0.23	–0.012	0.006	–1.93	0.053
	T_k^b	–0.012	0.007	–1.81	0.07	–0.024	0.012	–2.07	0.039
Textiles	T_k	–0.002	0.017	–0.14	0.89	0.036	0.029	1.25	0.213
	T_k^w	–0.019	0.013	–1.44	0.15	–0.015	0.012	–1.22	0.223
	T_k^b	0.017	0.013	1.26	0.21	0.051	0.021	2.43	0.015
Wood	T_k	–0.093	0.042	–2.20	0.03	–0.037	0.031	–1.19	0.235
	T_k^w	–0.013	0.019	–0.69	0.49	–0.024	0.013	–1.82	0.069
	T_k^b	–0.080	0.039	–2.08	0.04	–0.013	0.025	–0.50	0.617
Paper	T_k	–0.010	0.010	–1.09	0.28	–0.004	0.011	–0.33	0.740
	T_k^w	–0.004	0.008	–0.50	0.62	0.009	0.007	1.23	0.218
	T_k^b	–0.007	0.007	–0.94	0.35	–0.013	0.008	–1.55	0.120
Chemicals	T_k	–0.008	0.011	–0.72	0.47	–0.012	0.015	–0.82	0.410
	T_k^w	–0.005	0.010	–0.52	0.60	–0.024	0.009	–2.52	0.012
	T_k^b	–0.003	0.007	–0.40	0.69	0.012	0.012	0.99	0.321
Rubber and plastic products	T_k	–0.037	0.016	–2.27	0.02	–0.019	0.009	–2.01	0.044
	T_k^w	–0.045	0.016	–2.89	0.00	–0.016	0.008	–1.91	0.056
	T_k^b	0.008	0.005	1.82	0.07	–0.003	0.004	–0.88	0.379

Table 4A.7. Continued

		1985–1993				1993–2001			
		Obs. differ.	Boot. Std. Err.	z	$P>\|z\|$	Obs. differ.	Boot. Std. Err.	z	$P>\|z\|$
Other non-metallic mineral products	T_k	–0.020	0.014	–1.42	0.16	–0.012	0.016	–0.75	0.454
	T_k^w	–0.025	0.010	–2.6	0.01	–0.020	0.013	–1.60	0.110
	T_k^b	0.005	0.009	0.58	0.56	0.008	0.009	0.88	0.381
Basic metals and fabricated metal products	T_k	–0.057	0.010	–5.69	0.00	–0.026	0.008	–3.50	0.000
	T_k^w	–0.041	0.010	–4.18	0.00	–0.029	0.006	–4.90	0.000
	T_k^b	–0.017	0.010	–1.62	0.11	0.002	0.006	0.39	0.700
Machinery and equipment nec	T_k	–0.020	0.011	–1.88	0.06	–0.004	0.010	–0.42	0.674
	T_k^w	–0.005	0.006	–0.95	0.34	–0.003	0.006	–0.51	0.610
	T_k^b	–0.015	0.008	–1.88	0.06	–0.001	0.007	–0.22	0.826
Electrical and optical	T_k	–0.019	0.007	–2.64	0.01	–0.027	0.008	–3.21	0.001
equipment	T_k^w	–0.023	0.006	–3.88	0.00	–0.019	0.006	–3.24	0.001
	T_k^b	0.004	0.004	0.99	0.32	–0.008	0.007	–1.15	0.250
Transport equipment	T_k	–0.016	0.009	–1.71	0.09	0.037	0.020	1.82	0.069
	T_k^w	–0.002	0.008	–0.24	0.81	–0.003	0.007	–0.41	0.684
	T_k^b	–0.014	0.007	–2.11	0.04	0.040	0.022	1.85	0.064
Manufacturing nec	T_k	–0.054	0.017	–3.23	0.00	–0.071	0.027	–2.65	0.008
	T_k^w	–0.016	0.013	–1.27	0.20	–0.025	0.012	–2.05	0.040
	T_k^b	–0.038	0.015	–2.55	0.01	–0.047	0.021	–2.20	0.027

Table 4A.8- First ten EU regions in terms of manufacturing employment

1985			1993			2001		
Nordrhein-Westfalen	1,837,117	8.0	Nordrhein-Westfalen	1,675,553	8.1	Nordrhein-Westfalen	1,384,789	5.9
Baden-Württemberg	1,475,465	6.4	Baden-Württemberg	1,377,165	6.7	Baden-Württemberg	1,267,150	5.4
Bayern	1,362,379	5.9	Bayern	1,289,072	6.2	Lombardia	1,235,829	5.3
Lombardia	904,788	3.9	Lombardia	802,243	3.9	Bayern	1,202,247	5.1
Île de France	783,240	3.4	Île de France	591,181	2.9	Cataluña	675,524	2.9
Hessen	638,893	2.8	Niedersachsen	585,809	2.8	Veneto	608,668	2.6
Niedersachsen	622,528	2.7	Hessen	570,832	2.8	Île de France	574,816	2.4
Cataluña	473,692	2.1	Cataluña	557,720	2.7	Niedersachsen	546,036	2.3
Piemonte	440,750	1.9	Rhône-Alpes	375,224	1.8	Piemonte	522,479	2.2
Rhône-Alpes	425,013	1.8	Piemonte	374,221	1.8	Emilia-Romagna	521,243	2.2
	23,044,512	39		20,660,868	40		23,539,362	36

NOTES

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1. The present work does not claim to test New Economic Geography predictions although some of the theoretical insights will be used to interpret the main empirical findings.
2. The spreading of markets, in turn, depends chiefly on the spreading of productive factors, natural resources, labour and capital.
3. The difference in the extent of interregional (international) labour mobility determines whether or not the relationship between integration and agglomeration is monotonic.
4. In fact, this assumption sounds consistent within the European scenario which continues to experience low labour migration despite substantial wage differentials across countries.
5. Two-country three-region models (as in Krugman and Livas, 1996; Paluzie, 2001; Behrens, 2003) allow the domestic outcome of international integration to be assessed, while two-country four-region models encompass two geographical levels 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.
6. International transaction costs include frictions linked to institutional factors like trade policy, custom duties, harmonization of rules between countries as well as linguistic barriers.
7. 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 headquarters 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 a highly diversified pool of business service suppliers.
8. In NEG models (for example Krugman, 1991b; Puga, 1999) labour mobility has an important role in sustaining agglomerations; in a symmetric way, labour immobility constitutes an important dispersion force.
9. She reported positive and significant changes for 30 of the 65 industries analysed, negative and significant changes for 12.
10. Absolute concentration fell in 56 out of 99 industries, 26 of which showed a significant change (Aiginger and Pfaffermayer, 2004).
11. Although the work focuses on the dynamics of industry agglomeration, it may be interesting to note that, since the index adopted is a dissimilarity index (Maasoumi, 1993), to assess 'how large is large' (McCloskey and Ziliak, 1996) it may be helpful to compare it to the composite index of overall localization. Moreover, to test the null hypothesis of absence of localization, Monte Carlo simulations are required (Cutrini, 2008a).
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).
13. When relative measures are adopted, specialization of regions and nations and localization of industries can be seen as intertwined economic phenomena (Cutrini, 2008a).
14. It is worth noting that 90 per cent of the legislative projects listed in the 1985 White Paper had been adopted by 1993. However, some relevant legislative omissions, failure to transpose legislation and lack of implementation had limited the full completion of the internal market at the end of the pre-Single Market period.
15. The Melfi production plant in Basilicata was set up in 1993.

REFERENCES

Aiginger, K. and S.W. Davies (2004) 'Industrial Specialisation and Geographic Concentration: Two Sides of the Same Coin? Not for the European Union', *Journal of Applied Economics*, **7**(2), 231–48.

Aiginger, K. and W. Leitner (2002), 'Regional Concentration in the United States and Europe: Who Follows Whom?', *Weltwirtschaftliches Archiv*, **138**(4), 652–79.

Aiginger, K. and M. Pfaffermayr (2004), 'The Single Market and Geographic Concentration in Europe', *Review of International Economics*, **12**(1), 1–11.

Amiti, M. (1999), 'Specialisation Patterns in Europe', *Weltwirtschaftliches Archiv*, **127**(4), 573–93.

Bade F.-J., E. Bode and E. Cutrini (2007), 'The Spatial Fragmentation of Production Activities: Patterns of Industrial and Functional Localization', paper presented at the International Workshop *Agglomeration and Growth in Knowledge-Based Societies*, 20–21 April 2007, Kiel, Germany.

Behrens, K. (2003), 'International Trade and Internal Geography Revisited', *LATEC Discussion Paper*, University of Bourgogne.

Bickenbach, F. and E. Bode (2006), 'Disproportionality Measures of Concentration, Specialization, Polarization', *Kiel Working Paper No. 1276*, Kiel Institute for the World Economy.

Biewen, M. (2002), 'Bootstrap Inference for Inequality, Mobility and Poverty Measurement', *Journal of Econometrics*, **108**(2), 317–42.

Brülhart, M. (1998), 'Trading Places, Industrial Specialisation in the European Union', *Journal of Common Market Studies*, **36**(3), 329–46.

Brülhart, M. and R. Traeger (2005), 'An Account of Geographic Concentration Patterns in Europe', *Regional Science and Urban Economics*, **37**(6), 597–624.

Ciciotti, E. and P. Rizzi (2003), 'Capacità innovativa e sviluppo regionale: Alcune evidenze delle regioni italiane negli anni novanta', in G. Garofoli (ed.), *Impresa e territorio*, Istituto Guglielmo Tagliacarne, Bologna: Il Mulino.

Combes, P.P. and H.G. Overman (2004), 'The Spatial Distribution of Economic Activities in the European Union', in J.V. Henderson and J.F. Thisse (eds), *Handbook of Regional and Urban Economics*, vol. 4, Amsterdam: Elsevier-North Holland, pp. 2845–909.

Crivellini, M. and P. Pettenati (1989), 'Modelli locali di sviluppo', in G. Becattini (ed.), *Modelli locali di sviluppo*, Bologna: Il Mulino.

Crozet, M. and P. Koenig-Soubeyran (2004), 'EU Enlargement and the Internal Geography of Countries', *Journal of Comparative Economics*, **32**(2), 265–79.

Cutrini, E. (2006), 'The Balassa Index Meets the Dissimilarity Theil Index. A Decomposition Methodology for Location Studies', *Economic Growth – Institutional and Social Dynamics, PRIN 2005*, Working Paper Series, No. 5, June.

Cutrini, E. (2008a), 'Using Entropy Measures to Disentangle Regional from National Localisation Patterns', *Regional Science and Urban Economics*, in press.

Cutrini, E. (2008b), 'Specialization and Concentration from a Twofold Geographical Perspective: Evidence from Europe', forthcoming in *Regional Studies*.

Davis, J.C. and J.V. Henderson (2004), 'The Agglomeration of Headquarters', Brown University, mimeo.

De Robertis, G. (2001), 'European Integration and Internal Economic Geography: The Case of the Italian Manufacturing Industry 1971–1991', *The International Trade Journal*, **15**(3), 345–71.

Duranton, G. and D. Puga (2005), 'From Sectoral to Functional Urban Specialisation', *Journal of Urban Economics*, **57**(2), 343–70.

Efron, B. (1979), 'Bootstrap Methods: Another Look at the Jackknife', *Annals of Statistics*, **7**(1), 1–26.

Ellison, G. and E.L. Glaeser (1997), 'Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach', *Journal of Political Economy*, **105**(5), 889–927.

Ezcurra, R., P. Pascual and M. Rapún (2006), 'The Dynamics of Industrial Concentration in the Regions of the European Union', *Growth and Change*, **37**(2), 200–229.

Fujita, M., P. Krugman and A.J. Venables (1999), *The Spatial Economy: Cities, Regions and International Trade*, Cambridge: MIT Press.

Garofoli, G. (1992), *Economia del territorio. Trasformazioni economiche e sviluppo regionale*, Milan: ETAS Libri.

Hallet, M. (2000), 'Regional Specialisation and Concentration in the EU', *European Commission Economic Papers no. 141*, Directorate General for Economic and Financial Affairs.

Henderson, J. and Y. Ono (2008), 'Where do Manufacturing Firms Locate their Headquarters?', *Journal of Urban Economics*, **63**(2), 431–50.

Hirschman, A.O. (1958), *The Strategy of Economic Development*, Oxford: Oxford University Press.

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

Krugman, P. (1991b), 'Increasing Returns and Economic Geography', *Journal of Political Economy*, **99**(3), 483–99.

Krugman, P. and R.E. Livas (1996), 'Trade Policy and the Third World Metropolis', *Journal of Development Economics*, **49**(1), 137–50.

Krugman, P. and A.J. Venables (1995), 'Globalization and the Inequality of Nations', *Quarterly Journal of Economics*, **110**(4), 857–80.

Leitner, W. (2001), *Regional Concentration of Manufacturing in the United States and the EU: A Comparative Approach with the Background of New Economic Geography*, Diploma Thesis, University of Linz.

Maasoumi, E. (1993), 'A Compendium to Information Theory in Economics and Econometrics', *Econometric Reviews*, **12**(2), 137–81.

McCloskey, D. and S. Ziliak (1996), 'The Standard Error of Regressions', *Journal of Economic Literature*, **34**(1), 7–114.

Midelfart, K.H., H.G. Overman, S.J. Redding and A.J. Venables (2004), 'The Location of European Industry', in A. Dierx, F. Ilzkovitz and K. Sekkat (eds), *European Integration and the Functioning of Product Markets*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.

Midelfart-Knarvik K.H. and Overman H.G. (2002), 'Delocation and European Integration. Is Structural Spending Justified?', *Economic Policy*, **17**(35), 323–59.

Mills, J.A. and S. Zandvakili (1997), 'Statistical Inference Via Bootstrapping for Measures of Inequality', *Journal of Applied Econometrics*, **12**(2), 133–50.

Monfort, P. and R. Nicolini (2000), 'Regional Convergence and International Integration', *Journal of Urban Economics*, **48**(2), 286–306.
Monfort, P and T. van Ypersele (2003), 'Integration, Regional Agglomeration and International Trade', *CEPR Discussion Paper 3752.*
Mori, T., K. Nishikimi and T.E. Smith (2005), 'A Divergence Statistic for Industrial Localization', *Review of Economics and Statistics*, **87**(4), 635–51.
Myrdal, G. (1957), *Economic Theory and Under-Developed Regions*, London: Duckworth & Co.
Ohlin, B. (1957), *Interregional and International Trade*, Cambridge, MA: Harvard University Press.
Paluzie E. (2001), 'Trade Policy and Regional Inequalities', *Papers in Regional Science*, **80**(1), 67–85.
Paluzie, E., J. Pons and D.A. Tirado (2001), 'Regional Integration and Specialization Patterns in Spain', *Regional Studies*, **35**(4), 285–96.
Perroux F. (1966), *L'economia del XX secolo*, Milan: Comunità.
Puga, D. (1999), 'The Rise and Fall of Regional Inequalities', *European Economic Review*, **43**(2), 303–34.
Rombaldoni, R. and A. Zazzaro (1997), 'Localizzazione delle imprese manifatturiere e specializzazione regionale in Italia: 1970-1990', *Rassegna di lavori dell'ISCO*, anno XIV, no. 151–81.
Rossi-Hansberg, E. (2005), 'A Spatial Theory of Trade', *American Economic Review*, **95**(5), 1464–91.
Suedekum J. (2006), 'Concentration and Specialization Trends in Germany Since Reunification', *Regional Studies*, **40**(8), 861–73.
Theil, H. (1967), *Economics and Information Theory*, Amsterdam: North-Holland.