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Specialisation and Concentration from a Twofold Geographical Perspective: Evidence from Europe

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Abstract

The paper investigates European location patterns during a period of economic integration, seeking to identify the distinct roles played by the different geographical levels. The evolution of localisation in Europe proved much more complicated empirically than the predictions based on the Krugman's hypothesis. Using Eurostat regional data for the period 1985-2001, the paper shows that while manufacturing employment trickled down among regions, after the completion of the European Single Market a slight agglomeration occurred, but only across national boundaries. National specialisation has emerged particularly in the EU founding member states. Moreover, there is evidence of an increasing polarisation of the North/South divide closely connected with the growing concentration of high-tech sectors.

JEL classification: C43, F15, N60, R12

Keywords: localisation, specialisation, concentration, European economic integration, twofold geographical analysis

La spécialisation et la concentration d'un point de vue géographique à deux temps: des preuves européennes.

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Cutrini

Cet article cherche à examiner la distribution européenne des emplacements pendant une période d'intégration économique et à identifier les rôles différents joués par les divers niveaux géographiques. L'évolution des emplacements en Europe s'est avérée beaucoup plus compliquée du point de vue empirique par rapport aux prévisions fondées sur l'hypothèse de Krugman. A partir des données régionales Eurostat pour la période allant de 1985 jusqu'à 2001, cet article cherche à démontrer que, pendant que l'emploi industriel s'infiltrait dans les régions au compte-gouttes, il y a eu une certaine tendance à l'agglomération suite à l'échéance du marché unique, mais seulement de façon transfrontalière. Une spécialisation nationale a vu le jour, notamment dans les pays fondateurs de l'Ue. Qui plus est, il y a des peuves d'une polarisation croissante du clivage Nord-Sud, ce qui se rapporte étroitement à la concentration croissante des secteurs à la pointe de la technologie.

Emplacements / Spécialisation / Concentration / Intégration économique européenne / Analyse géographique à deux temps

Classement JEL: C43; F15; N60; R12

Spezialisierung und Konzentration aus einer zweiteiligen geografischen Perspektive: Belege aus Europa

ELEONORA CUTRINI

Abstract

In diesem Beitrag untersuche ich die Standortmuster in Europa während einer Periode der wirtschaftlichen Integration, um die charakteristischen Rollen zu identifizieren, die von den verschiedenen geografischen Ebenen wahrgenommen werden. Die Evolution der Lokalisierung in Europa erwies sich in empirischer Hinsicht als weitaus komplizierter als die Prognosen auf der Grundlage der Krugman-Hypothese. Mit Hilfe von Eurostat-Regionaldaten weise ich für den Zeitraum von 1985 bis 2001 nach, dass das Beschäftigungsniveau der produzierenden Industrie innerhalb der Regionen zwar einem Trickle-Down-Effekt unterlag, aber nach Vollendung des Europäischen Binnenmarkts eine leichte Agglomeration auftrat, allerdings nur über nationale Grenzen hinweg. Eine nationale Spezialisierung hat sich insbesondere in den Gründungsmitgliedsstaaten der EU herausgebildet. Darüber hinaus liegen Belege für eine zunehmende Polarisierung des Nord-Süd-Gefälles vor, die eng mit der wachsenden Konzentration von High-Tech-Sektoren verknüpft ist.

JEL classification: C43, F15, N60, R12

Keywords:
Lokalisierung
Spezialisierung
Konzentration
Europäische Wirtschaftsintegration
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Especialización y concentración desde una perspectiva geográfica dual: el ejemplo de Europa

ELEONORA CUTRINI

Abstract

En este artículo examinamos los modelos de ubicación europea durante un periodo de integración económica con el fin de identificar los distintos papeles desempeñados por los diferentes niveles geográficos. La evolución de la localización en Europa resulta ser empíricamente mucho más complicada que las predicciones basadas en la hipótesis de Krugman. Usando datos regionales de Eurostat para el periodo 1985-2001, en este artículo mostramos que mientras el empleo manufacturero sufrió un efecto 'goteo' entre las regiones, tras la creación del Mercado Único Europeo ocurrió una ligera aglomeración, pero sólo entre fronteras nacionales. La especialización nacional ha surgido especialmente en los estados miembros fundadores de la UE. Además, hay muestras de una mayor polarización de la división norte/sur estrechamente conectada con la creciente concentración de sectores de alta tecnología.

Keywords:
Localización
Especialización
Concentración
Integración económica europea
Análisis geográfico dual

JEL classification: C43, F15, N60, R12

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INTRODUCTION

During the past two decades, declining trade barriers associated with the construction of the Single European Market have been supposed to engender drastic changes in the spatial distribution of economic activities, and they have become a prominent topic in political debate and in academic and research environments. The increasing clustering of high-value added economic activities in high incomes regions, together with the low-tech specialisation of lagging regions, is an example of the expected trend towards a greater inequality presumed to exacerbate the existing uneven spatial distribution of income and welfare.

Both traditional trade theories and the new trade theories envisage that countries will specialise as a consequence of international integration. According to the 'Krugman hypothesis' (KRUGMAN, 1991), European integration will give rise to the coalescence of industrial activities in order to mimic the geographical concentration that previously arose in the United States. On this view, various models developed in the New Economic Geography (NEG), intentionally designed for the case of Europe, predict that when international transaction costs fall below a certain threshold, international openness will lead to the agglomeration of industrial activities within countries (MONFORT and NICOLINI, 2000; PALUZIE, 2001; CROZET and KOENIG-SOUBEYRAN, 2004b; CROZET and KOENIG-SOUBEYRAN, 2004a; MONFORT and VAN YPERSELE, 2003). Although inspired by the territorial changes following the Mexican liberalisation programme (see HANSON, 1998) the study by KRUGMAN and LIVAS (1996) can be adopted as a theoretical framework for study of European integration. KRUGMAN and LIVAS's model highlights the importance of congestion costs as a centrifugal force pushing the internal dispersion of economic activities. Similarly, PUGA (1999) predicted a dispersion propelled by congestion-related forces.

Apart from international integration, further economic forces may disrupt the existing patterns of localisation and foster the dispersion of economic activities. Recent theoretical

studies have conceived widespread firm fragmentation as the cause of changes in within-country economic geography, which in many countries has been characterised by the agglomeration of executive functions in urban areas, with peripheral areas becoming the sites of routine tasks.

International integration in commodity markets and fragmentation of productive processes are bringing about the progressive irrelevance of national borders. Consequently, adopting subnational economies as units of spatial analysis is fundamental for understanding the complexity of structural change dynamics at different spatial scales. Moreover, from a normative perspective, the development of rigorous methodologies to disentangle structural changes at different geographical levels of analysis is becoming important in light of the existence of overlapping institutional levels. Assessing whether the concentration of economic activities is occurring mostly within countries or at wider distances aids understanding of how and to what extent European, national and regional policy-makers must be involved in designing appropriate policies.

To date, few empirical studies have analysed specialisation as well as concentration (e.g. AIGINGER and DAVIES, 2004; AIGINGER and PFAFFERMAYR, 2004; MULLIGAN and SCHMIDT, 2005) but none adopted a two-scale framework (within and across perspective). Therefore, the integrated analysis of overall localisation conducted by this study - with concentration on one side and specialisation on the other - combined with adoption of a twofold geographical perspective is still a novelty in the literature. Its advantage is that it enables deeper and richer assessment than do the methodologies prevalent in previous studies.

My aim in the paper is to provide clear-cut evidence on the location patterns of European manufacturing industries during the period 1985-2001, adopting a new methodology developed in a previous work (CUTRINI, 2006). Starting from a twofold geographical perspective, I show that localisation within countries does not evolve in parallel with localisation across national boundaries. However, since relative measures were adopted[1],

the equivalence between specialisation and concentration trends is maintained at the level of each single geographical scale. In particular, the results suggest that national specialisation (and agglomeration of industries across countries) have slightly increased since the enactment of the European Single Market Programme, whilst substantial regional despecialisation (the deconcentration of industries within countries) is evident during the entire period. A new core/periphery pattern besides the North/South divide is emerging whereby Northern Europe is specialised in high-tech industries, and Southern Europe in labour-intensive industries.

The remainder of the paper is organised as follows. The next section reviews the empirical evidence on regional specialisation and concentration in Europe, focusing specifically on the main methodological issue of a multilevel analysis. The third section describes the data and the methodology: the identity between aggregate concentration of industries and aggregate specialisation of regions and its geographical decomposition. The forth section presents the results. The fifth section puts forward some conjectures on interpretation of the apparently contrasting results obtained. A final section makes some concluding remarks and indicates further directions for research.

SURVEY OF THE EMPIRICAL LITERATURE

The empirical literature has usually evaluated specialisation in Europe on the basis of a single scale analysis. The slow specialisation of countries during the 1970s and 1980s was identified by several studies (BRÜLHART and TORSTENSSON,1996; AMITI, 1999; WIFO, 1999; HAALAND *et al.*, 1999; MIDELFART *et al.*, 2004 among others). At the same time, some authors suggested that, from the 1970s to the 1990s, regional specialisation decreased in Spain (PALUZIE *et al.* (2001), in Italy (ROMBALDONI and ZAZZARO, 1997; DE ROBERTIS, 2001; CICIOTTI and RIZZI, 2003), and in Germany (SUEDEKUM, 2006). However, if one looks at the specialisation of EU regions disregarding national borders, one finds contrasting empirical evidence. In fact, MIDELFART-KNARVIK *et al.* (2002) show that a majority of regions (53 per cent) became more specialised, although only to a slight extent (COMBES and OVERMAN, 2004).

The evidence is similarly mixed if we focus on the geographical concentration of sectors. Adopting the region as unit of analysis gives rise to contrasting results on concentration trends, compared with those emerging from the more common country-based studies. If analysis relies on national borders, one finds that the pre-Single Market period was characterized by increasing international agglomeration in the majority of sectors, especially during the 1980s (BRÜLHART and TORSTENSSON, 1996; BRÜLHART, 1998; AMITI, 1999; HAALAND *et al.*, 1999; BRÜLHART, 2001; MIDELFART *et al.*, 2004), while during the post-Single Market period spreading forces prevailed (MIDELFART *et al.*, 2004; AIGINGER and PFAFFERMAYR, 2004).

Although a decreasing regional concentration of industries was a common result for specific countries,[2] EU-wide regional concentration analysis empirically supports the idea that the completion of the single market fostered the agglomeration of industries, allowing the better exploitation of regional localised advantages. On the basis of regional data on gross value added, HALLET (2000) suggested that concentration slightly declined during the 1980s,

while it increased during the first half of the 1990s. Although BRÜLHART and TRAEGER (2005) found generally mixed evidence for manufacturing industries, they obtained robust results for the EU-wide agglomeration of textile industry value added. More recently, EZCURRA *et al.* (2006) support the 'Krugman hypothesis', showing that, as soon as the European Single Act came into force, geographical concentration across European NUTS 2 regions increased in most manufacturing activities.

Assessment of straightforward evidence has been hindered until recent years, not only by the shortage of comparable regional data but also, as COMBES and OVERMAN (2004) claim, by the lack of an appropriate methodology with which to disentangle the geographical clustering internal to countries from cross-country location patterns. In fact, as COMBES and OVERMAN (2004) suggest, evaluating the regional specialisation patterns relative to a country is different from assessing the same process relative to Europe as a whole.[3]

To date, different basic units of analysis (either region or country); different geographical benchmarks (either country or Europe); or different measures (either absolute or relative)[4] have been the main variations adopted. The multiplicity of methodologies makes it difficult to define an unquestionable pattern of specialisation and concentration in Europe through simple comparison among existing empirical studies. Moreover, economists and geographers have continued to assess the two side of overall localisation[5] separately, thus disregarding their mutual dynamic relationship. To the best of my knowledge, only one work adopts an integrated approach: AIGINGER and ROSSI-HANSBERG (2006), who show that specialisation of countries and geographical concentration of industries do not necessarily evolve in parallel. Against the background of a theoretical model (ROSSI-HANSBERG, 2005),[6] the authors furnish consistent evidence for Europe and the US based on the application of absolute Gini. Nonetheless, they also suggest that the trends over time in specialisation and concentration cannot diverge when relative measures are adopted.

DESCRIPTION OF METHODOLOGY AND DATA

Sectoral and spatial partitions of data

The analysis relies on employment data subdivided by manufacturing sectors. The data are drawn from the EUROSTAT Region-SBS (Structural Business Statistics) for the years 1985, 1993 and 2001. The sample of the 145 regions considered almost completely covers the following European countries: Belgium and Luxembourg (consolidated), Finland, France, Western Germany, Greece, Italy, Netherlands, Spain and United Kingdom. Some regions have been dropped, either because of overwhelming missing data or because they are not included at all in the database. The regional grid is mainly based on the NUTS 2 grid except for Germany, for which reference has been made to the NUTS 1 regions (Länder). As to Belgium, the data are drawn from a dataset provided by the national statistics office and based on the previous NACE 70 classification. Therefore Bruxelles, Vlaams Brabant and Brabant Wallon have been clustered as a single region (for detailed information on geographical coverage see Table A1).

The analysis is restricted to the manufacturing sector, owing to a lack of data for the services sector.[7] Employment data are disaggregated by 12 manufacturing industries[8] according to NACE rev. 1 classification: food (DA), textiles (DB), wood (DD), paper (DE), chemicals (DG), rubber and plastic products (DH), other non-metallic mineral products (DI), basic metals and fabricated metal products (DJ), machinery and equipment n.e.c. (DK), electrical and optical equipment (DL), transport equipment (DM), manufacturing n.e.c. (DN).

Since the results may be affected by the scale aggregation problem - which is an expression of the *modifiable areal unit problem* (MAUP) (ARBIA, 1989) - I assess overall localisation, varying the basic unit of analysis and the intermediate aggregation level to control for the alleged sensitivity of the methodology to scale aggregation and basic

geographical partition. In Table 1, a set of European regions belonging to different countries is used as the intermediate aggregation level (instead of the country). In this case, *Northern Europe* consists of all the regions of the following European countries: Belgium and Luxembourg, Finland, France, Western Germany, Netherlands, United Kingdom and some regions of Northern Italy, namely Piemonte, Valle D'Aosta, Liguria, Lombardia, Friuli Venezia Giulia. The rest of Italy, Greece, and Spain are labelled as *Southern Europe*.

Different partitions in the sectoral dimension should be considered, since agglomeration in the real world may arise from inter-industry linkages (i.e. linkages across the artificial boundaries of industrial classifications derived from the available statistical data). Therefore, I complement the analysis on concentration based on the twelve manufacturing sectors with a dichotomic classification based on the taxonomy adopted by OECD (2003). In this case (e.g. in Fig. 2), chemicals, machinery and equipment n.e.c., electrical and optical equipment, transport equipment, furniture, recycling and manufacturing n.e.c. are considered, as they form a single sector labelled *high-tech industries*. Similarly, food, textiles, wood, paper, rubber and plastic products, other non-metallic mineral products, basic metals and fabricated metal products belong to the category *low-tech industries*.

The methodology

Notation and basic definition

In this section, I briefly summarize the analytical model introduced in CUTRINI (2006) and adapted to the purposes of this paper. AIGINGER and DAVIES (2004) have already analysed concentration and specialization as the two sides of the same matrix by using absolute entropy measures. The present study relies on relative measures, and specifically on dissimilarity entropy indices which assess the 'distance' between two distributions.[9]

Let x denote the variable of main interest (employment in the present case); subscripts i,

j, *k* index country, region and industry, respectively. Thus:

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

x_{ij} = total manufacturing employment in region *i* of country *j*

x_{ik} = total employment in the manufacturing industry *k* of country *i*

x_i = total employment in country *i*

x_k = total employment in manufacturing industry *k* in Europe

x = total manufacturing employment in Europe

N is the number of manufacturing industries, while *R* is the number of regions in the whole economy.

The concept of *overall localization* refers to the pattern of an aggregate economic activity (manufacturing employment, in the present case) which is composed of *N* industries and spans across *R* regions. Perfect regularity arises when all industries are distributed across space proportionally to total employment; accordingly, each region in the entire area has the same manufacturing structure as Europe.

Conceptually, specialization and concentration are tightly connected and can be condensed into the concept of overall localization. From a purely statistical viewpoint, measuring overall localization involves evaluating the entire distribution of manufacturing industries across regions.

Relative concentration, agglomeration, coalescence are used interchangeably in what follows. The degree of *concentration (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 for this purpose, since they are better suited to gauging the economic forces driving within-industry agglomeration economies. Perfect regularity arises when industries are

spatially distributed proportionally to total employment. The more the interregional distribution of one industry departs from the interregional allocation of aggregate manufacturing, the stronger the localization forces at work within the specific industry.[10]

Relative specialization of a basic unit of analysis (e.g. region *j* of country *i*) is taken to be the dissimilarity between the regional manufacturing structure (i.e. the allocation of the variable of main interest across all the manufacturing industries of the region) and the allocation of European employment across manufacturing industries. All the raw measures of concentration and specialization which constitute the background for the aggregate analytical model can be traced back to the dissimilarity Theil index (THEIL, 1967; MAASOUMI, 1993). THEIL (1967) first introduced a dissimilarity version of the entropy index to evaluate the information content of an indirect message. *Dissimilarity* is therefore synonymous here with divergence, discrepancy in the comparison of two overlapping distributions.

Raw measures of relative concentration

The basic dissimilarity entropy index adopted here to measure concentration of one industry k is:

$$T_k = \sum_{i=1}^{m}\sum_{j=1}^{r_i} \frac{x_{ijk}}{x_k} \ln\left(\frac{\frac{x_{ijk}}{x_k}}{\frac{x_{ij}}{x}}\right) \qquad \textit{(total relative concentration of industry k)} \qquad (1)$$

The degree of concentration of each industry (T_k) can be conceived as a measure of the strength of localization economies and/or the importance of industry-specific natural advantages. In fact, in the 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 highest density of the aggregate economic activity.The concentration of an industry may be explained in terms of the regional agglomeration economies that arise *within countries* and the national comparative advantages shaping the *between-countries* location pattern. Hence:

$$T_k^w = \sum_{i=1}^{m}\sum_{j=1}^{r_i}\frac{x_{ijk}}{x_k}\ln\left(\frac{\frac{x_{ijk}}{x_{ik}}}{\frac{x_{ij}}{x_i}}\right) \qquad \textit{(within-country relative concentration of industry k)} \qquad (2)$$

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

$$T_k^b = \sum_{i=1}^{m}\frac{x_{ijk}}{x_k}\ln\left(\frac{\frac{x_{ik}}{x_k}}{\frac{x_i}{x}}\right) \qquad \textit{(between-country relative concentration of industry k)} \qquad (3)$$

assesses the *between-country* concentration of industry *k.*[11]

Raw measures of relative specialisation

Turning to the specialization side, it is possible to evaluate the dissimilarity between the economic structure of one region (composed by the *n* manufacturing industries) and that of a supra-regional economy.

Therefore, further raw specialisation indices are derived from the dissimilarity Theil index:

$$T_{ij} = \sum_{k=1}^{n}\frac{x_{ijk}}{x_{ij}}\ln\left(\frac{\frac{x_{ijk}}{x_{ij}}}{\frac{x_k}{x}}\right) \qquad \textit{(specialisation of region j belonging to country i relative to EU)} \qquad (4)$$

$$T_{ij}^w = \sum_{k=1}^{n}\frac{x_{ijk}}{x_{ij}}\ln\left(\frac{\frac{x_{ijk}}{x_{ij}}}{\frac{x_{ik}}{x_i}}\right) \qquad \textit{(specialisation of region j of country i relative to the respective country)} \qquad (5)$$

$$T_i^b = \sum_{i=1}^{m}\frac{x_{ik}}{x_i}\ln\left(\frac{\frac{x_{ik}}{x_i}}{\frac{x_k}{x}}\right) \qquad \textit{(national specialisation of country i relative to EU)} \qquad (6)$$

When the dissimilarity logic is adopted, the national specialisation relative to Europe (T_i^b) can be envisaged as a residual of the averaged regional specialisation relative to the same

benchmark, once the divergence of the regional manufacturing structures with reference to the country has been accounted for.

Let us define:

$$aRS_i = \sum_{j=1}^{r_i} T_{ij} \frac{x_{ij}}{x_i} \quad \textit{(average regional specialisation of all the regions of country i relative to the European manufacturing structure)} \tag{7}$$

and

$$aRS_i^w = \sum_{j=1}^{r_i} T_{ij}^w \frac{x_{ij}}{x_i} \quad \textit{(average regional specialisation of all the regions of country i relative to the country's manufacturing structure)} \tag{8}$$

When a regional perspective is adopted, the average regional specialisation of a country relative to Europe (aRS_i) is composed of two elements: the *within-country* component and the *country bias*. Specifically, the following relation holds:

$$aRS_i = aRS_i^w + T_i^b \tag{9}$$

The entropy index of overall localization

The entropy index with which I measure overall localization (*L-index*) is a weighted sum of the logarithms of location quotients where the weights are the industry-region shares of the aggregate manufacturing ($\frac{x_{ijk}}{x}$):

$$L = \sum_{k=1}^{n} \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x} \ln\left(\frac{\frac{x_{ijk}}{x_k}}{\frac{x_{ij}}{x}}\right) \tag{10}$$

In the present analytical model, the L-index represents the equivalence between geographical concentration and regional specialization.

In fact, it is possible to derive the *L-index* as a composite index of both relative specialization measures and relative concentration ones (see CUTRINI, 2006):

$$L = \sum_{j=1}^{r} \frac{x_{ij}}{x} T_{ij} = \sum_{k=1}^{n} \frac{x_k}{x} T_k \qquad (11)$$

The evolution of overall localization *within* countries may depart from localization *between* countries (for details on the spatial decomposition of the *L-index*, see CUTRINI, 2006). Here, I point out how specialization and concentration conceptually and analytically underpin each factor component of the composite index of overall localization.

The *between-country* component (L^b) of overall localization is defined as:

$$L^b = \sum_{k=1}^{n} \sum_{i=1}^{m} \frac{x_{ik}}{x} \ln\left(\frac{\frac{x_{ik}}{x_k}}{\frac{x_i}{x}}\right) \qquad (12)$$

The twofold definition of the concept of overall localization still holds at the between-country level, since the following identity holds:

$$L^b = \sum_{i=1}^{m} \frac{x_i}{x} T_i^b = \sum_{k=1}^{n} \frac{x_k}{x} T_k^b \qquad (13)$$

The within-country component (L^w) of overall localization is:

$$L^w = \sum_{k=1}^{n} \sum_{i=1}^{m} \sum_{j=1}^{r_i} \frac{x_{ijk}}{x} \ln\left(\frac{\frac{x_{ijk}}{x_{ik}}}{\frac{x_{ij}}{x_i}}\right) \qquad (14)$$

Again, specialisation and concentration underpin the overall localisation pattern within countries:

$$L^w = \sum_{j=1}^{r} \frac{x_{ij}}{x} T_{ij}^w = \sum_{k=1}^{n} \frac{x_k}{x} T_k^w \quad (15)$$

Each component defined in equations (13) and (15) assesses the average dissimilarity between the two distributions of interest. They are both the average sum of the raw indices of relative concentration and relative specialization.

This implies that the L-index will be also a valuable reference for the analysis of specialisation and concentration. In the case of specialisation patterns, it represents the weighted average of raw indices and is therefore a valuable reference with which to understand "how large is large" (see McCloskey and Ziliak, 1996), particularly in the absence of an upper bound on the specialisation and concentration measures.

In fact, the overall localization index (L) is a summary statistics of regional specialization indices (T_{ij}°) weighted by the regional manufacturing shares ($\frac{x_{ij}}{x}$):

$$L = \sum_{j=1}^{r} \frac{x_{ij}}{x} T_{ij} = \sum_{i=1}^{m} \frac{x_i}{x} T_i^b + \sum_{j=1}^{r} \frac{x_{ij}}{x} T_{ij}^w \quad (16)$$

On the concentration side, overall localization can be seen as a summary statistics of relative concentration Theil indices (T_k) weighted by the industry shares ($\frac{x_k}{x}$):

$$L = \sum_{k=1}^{n} \frac{x_k}{x} T_k = \sum_{k=1}^{n} \frac{x_k}{x} T_k^b + \sum_{k=1}^{n} \frac{x_k}{x} T_k^w \quad (17)$$

To conclude, both equation (16) and equation (17) correspond to:

$$L=L^b+L^w \quad (18)$$

The *L-index* and each single components are non-negative. Perfect regularity ($L = 0$) implies that $L^b = 0$ and $L^w = 0$. Any departure from the case of perfect regularity ($L > 0$) means that some localization economies are at work within countries ($L^w > 0$) or some comparative advantage between countries exists ($L^b > 0$), or both. Usually, overall localization is jointly

explained by international and intra-national components.

However, like all measures based on aggregate regional data, the index of overall localization is affected by the modifiable areal unit problem and the checkerboard problem (ARBIA, 1989). Recently developed has been a line of methodological development based on spatial disproportionality measures of polarisation and concentration to deal with the checkerboard and the MAUP problems (BICKENBACH and BODE, 2006).

Entropy measures are suitable for statistical testing. Bootstrapping is a valuable method with which to ascertain whether the observed localization has significantly changed over time. The bootstrap was introduced by EFRON (1979), and it has been more recently adopted in the context of inequality measures, although its implementation for the spatial distribution of economic activities has been quite rare[12]. The main issue to be addressed here is whether overall localisation, relative concentration, and relative specialisation changed significantly over the period under scrutiny. This issue can be resolved by bootstrapping the entropy measures and their components. The resampling process is repeated 10,000 times and the following hypothesis test is conducted:

$$H_0 : \Delta I = 0$$

$$H_1 : \Delta I \neq 0$$

where I refers to each entropy measure of relative concentration, relative specialisation, or overall localisation.

LOCATION PATTERNS IN EUROPE: THE EMPIRICAL EVIDENCE

A declining trend in overall localisation: an overview

From the mid-1980s onwards manufacturing employment as a whole became less localised across European regions. Figure 1 illustrates the trend in overall localisation during the period 1985-2001. The internal geography of countries was much more differentiated than the European landscape evaluated on the basis of national borders. Put differently, the spatial organisation of manufacturing industries was driven mostly by the regional scale, and only to a minor extent it is due to the different national characteristics, e.g. comparative advantages. On average, the latter component accounts for less than one third of the overall localisation.

As for the dynamics, the spreading forces acting within countries were stronger than the contrasting trends across countries.

[FIGURE 1 about here]

In fact, the evolution of overall localisation is explained mostly by the modification of the regional agglomeration of manufacturing industries. The sub-national component accounted for more than 80% of the total variation of the *L-index* (see Table A2). Internal regions of each country converged towards the manufacturing structure of the country to which they belonged. As a result, the spatial distribution of each industry became more similar to the interregional allocation of total manufacturing employment. Compared with the within-country pattern, the international component was rather stable, with a slight decrease in the first period (-17.7%) which was partly recovered from 1993 onwards (+5.6%).

The sensitivity of the results on the evolution of overall localisation to the choice of the basic unit of analysis and to the choice of the intermediate aggregation level[13] is presented in

Table 1, where the same geographical benchmark (Europe[14]) is used to evaluate overall localisation by adopting different spatial hierarchical structures. This comparison makes it possible to assess the robustness of the findings. The main conclusion to be drawn is that a pronounced declining localisation at the smaller scale - namely, within countries - is a robust finding irrespective of the basic unit (NUTS2 or NUTS1) and the intermediate aggregation level adopted (NUTS1, country).

[TABLE 1 about here]

After the completion of the European Single Market, localisation at higher spatial aggregations – namely across national boundaries and over the North/South divide - displayed an upward trend (Table 1). The positive changes between-country and over the North-South divide are almost zero and they are not significant. Nevertheless, they may represent a relevant sign of a change for the second period of analysis. In fact, the interesting point here is the differential patterns at the lower geographical scale (within-country) compared to the international evolutions (i.e. between-country and the North-South divide). The declining polarisation at the smaller spatial scale and the contemporaneous slight localisation at larger distances are shown to be robust to different basic units and intermediate aggregations and call for differential economic forces that may have been at work internationally and locally.

Overall localisation patterns can be also viewed in terms of relative concentrations of manufacturing industries. As already shown, after 1993 the general fall in overall localisation over long distances stopped not only across countries but also between the North/South divide (Table 1). It is interesting to note that the rising overall localisation during the 1990s derived mainly from an increasing agglomeration of high-tech manufacturing activities which happened both at the local level and between the North/South divide.

PACI and USAI (2000) already showed that, in 1990, the distribution of technological activity was highly concentrated in Europe due to substantial differences between southern and northern regions.

[FIGURE 2 about here]

The evidence of the present work confirms that innovative industries are more geographically clustered than traditional industries. Moreover, during the nineties, instead of spreading across European economies, the former become more concentrated across regions and across the North-South divide (Figure 2). In other words, proximity matters particularly in the knowledge-intensive sector[15] plausibly, because of the higher intensity of knowledge spillovers[16], and input-output linkages within the sector.

The increasing polarisation of the knowledge-intensive industries in the 1990s that favoured Northern European countries is usually associated to the wider availability of highly-skilled labour. During the nineties, structural changes in Northern Europe occurred towards greater specialisation in high-technology manufacturing industries, while Southern regions lagged behind.

In the following sections, I conduct more detailed analysis of the concentration and specialisation trends across and within countries.

Internal dispersion and the associated mixed trends in manufacturing concentration between countries

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

Textiles and wearing apparel emerge as an industry endowed with pronounced localization economies, for it exhibits the highest divergence from the spreading of overall manufacturing. Other resource-based industries, like *wood production* and *non-metallic mineral products*, rank among the most localised. Innovative industries, like *chemicals* and *transport equipment*, have intermediate levels of concentration or, like *electrical and optical equipment* and *machinery*, they are spreading even more similarly to total manufacturing. This may be due to the fact that these industries are usually highly represented where manufacturing employment is geographically concentrated.

[TABLE 2 about here]

BRÜLHART and TRAEGER (2005) found that the relative concentration of value added increased in the majority of manufacturing industries, even though the changes were generally minimal and not significant (Table 2, last column). At the same time, employment data show

a widespread decline in relative concentration, and the results are highly significant in half of the industries. To be stressed is that the regional agglomeration of value added combined with the spreading of employment suggests the importance of within-industry spatial fragmentation along functional lines[17] (DURANTON and PUGA, 2005). The widespread increase in relative concentrations of value added found in a previous study by BRÜLHART and TRAEGER (2005) (Table 2, last column) was almost simultaneous with a significant decline in employment agglomeration (Table 2, third column) in the majority of manufacturing industries.

Increasing returns to scale sectors - *non-metallic products*, *chemicals*, *transport equipment* and *paper and publishing* - are characterized by consolidated regional localisation economies. In fact, not only do they emerge as highly clustered at the beginning of the period, but they also exhibit minimal changes. Relative concentration increases in *textile and wearing apparel*, where external economies are notably important, and, if value added is considered, the change is also significant.

Apart from the above-mentioned exceptional case, de-agglomeration is a widespread and robust result for the entire period considered. The most important feature of the overall modification is that it conceals different changes, which occurred within and between countries, respectively. The within-country evolution and the national change did not evolve in parallel. Some of the industries characterized by a substantial decrease in internal localization experienced intensifying between-country relative concentration associated with a process of the national specialisation of EU economies.

[FIGURE 3 about here]

More specifically, although diminishing polarisation within countries is common to almost all manufacturing industries (paper is the only exception), it should be stressed that the evolution of cross-border concentration is mixed. Agglomeration between countries occurred in *no-metallic mineral products*, *chemicals*, *textiles* and *transport equipment* (top panel of Figure 3), although changes were significant only for the latter two industries during the 1990s (see Table A7, appendix). Once the Internal Market was completed, the international agglomeration of *textiles and wearing apparel* was mainly due to the higher and increasing shares of Spain and Italy in European textiles employment with respect to their share in European manufacturing employment. As for transport equipment, the increasing concentration is the outcome of a manufacturing industry that remained highly embedded in Germany, despite the loss of industrial employment and deindustrialisation experienced by the country during the 1990s.

In a second group of industries, the falling relative concentration was driven mostly by de-agglomeration within countries, with a low level of *between*-country concentration which remained almost unchanged. This group consists of medium to high-tech industries, namely *basic metals, rubber and plastic products* and *electrical and optical equipment* (middle panel of Figure 3). In the remaining sectors - *food, wood, machinery, and miscellaneous manufacturing* - the territorial organisation converged on the spatial distribution of overall manufacturing both *across* countries and *within* countries (bottom panel of Figure 3).

Internal structural changes and national patterns of specialisation

The magnitude of the change over time was remarkably higher during the entire period in the peripheral and smaller countries – namely Greece, Belgium and Luxembourg, Spain and Finland – which had been also characterised by a higher level of dissimilarity throughout the period (Table 3). For the Mediterranean Cohesion countries – namely Greece and Spain - this

trend may be regarded as an expression of the catching-up which involved the whole national economy.

[TABLE 3 about here]

By contrast, the larger countries – such as Great Britain, France, Italy and Western Germany – did not change much in terms of their region-based specialisation relative to Europe (aRS_i°). It is interesting to note that the minor falling changes experienced by these countries conceal a substantial and significant despecialisaton that occurred internally, particularly in Italy and Western Germany (Table 3). These countries are characterized by a falling regional specialisation which occurred simultaneously with an increasing specialisation of the national manufacturing structure.

Therefore, to gain better understanding of specialisation patterns in Europe, it is useful to distinguish international trends from intra-national evolutions. In fact, as explained in the methodology section, the overall trend in specialisation of an economy delimited by national boundaries is the outcome of separate, and somehow different, trends in specialisation that occur simultaneously at the regional and national levels: that is, internal regional specialisation does not go hand in hand with the specialisation of the whole country.

There is a group of countries in which national specialisation increased while internal regional specialisation was declining. This group includes Germany, Italy and, to a lesser extent, France. Their regional economies became less specialised relative to the national reference, but the national manufacturing structure increasingly differed from Europe (top panel of Figure 4). In particular, in Western Germany, national patterns were mainly the

outcome of increasing specialisation in knowledge-intensive industries, such as *chemicals, rubber and plastics products, metallurgy, electrical products, and the automobile industry.*

In the mid-1990s, Italy was a traditional light and labour-intensive producer, with significant specialisation in the production of machinery. During the subsequent periods, Italy constantly increased the distinctive nature of its manufacturing structure (see Table A8).

Despecialisation was only a national phenomenon in a second group composed of small European countries. Specifically, the pronounced downward trend in national specialisation was associated with mixed trends within countries. Slight regional specialisation occurred in Greece, while general internal stability characterized the cases of Netherlands and Finland. The convergence of the Greek national manufacturing structure to Europe's is due to catching-up by the Greek economy[18] since its entry into the European Community, despite its internal core/periphery divide widened over time (middle panel of Figure 4).

[FIGURE 4 about here]

An analogous development took place in Spain, which specialised in *textiles and wearing apparel* and in *non-metallic mineral products, basic metals*, partly losing its comparative advantage in the *food* industry, the *wood* industry, and *miscellaneous manufacturing*. Spain – together with Belgium, Luxembourg and the UK - belongs to the group of countries in which internal development replicated the national specialisation patterns. This group of countries saw their manufacturing structures converge on the supra-regional reference: both regions

came closer to the national manufacturing structure and the national economy converged *vis à vis* Europe (bottom panel of Figure 4).

Within- and between-country evolution in the context of European economic integration

With the aim of totally abolishing the 'frontier' concept, the 1985 White Paper established the legislation to be adopted by the end of 1992 in order to achieve full elimination of physical, technical and tax frontiers. To be noted is that 90% of the legislative projects listed in the 1985 White Paper had been adopted by 1993 (EUROPEAN COMMISSION, 1996). In the following period, further progress was made in the transposition of EU legislation into national law and in its implementation - which had previously limited the full completion of the internal market by 1992.

Table 4 suggests that international restructuring (ΔT_i^b) may have been affected by the European integration process, while regional depolarisation (aRS_i^w) was a generalised trend invariable to the development of a new institutional environment. That is to say, while regional specialisation declined continuously throughout the whole period, for national trends, 1993 can represent a significant turning point. The present analysis confirms the first evaluation by SAPIR (1996), who suggested that the internal market programme did not produce the general increase in the specialisation of European economies envisaged by KRUGMAN (1991) at least until 1992.

[TABLE 4 about here]

In fact, increasing specialisation can hardly be considered a stylized fact, neither within countries nor across countries. By contrast, it was a temporary exception to the rule which occurred, before enactment of the Single Market programme, within Greece and, to a lesser extent, in France. Moreover, national specialisation decreased in all the European countries in the sample between 1985 and 1993, except for Italy, which specialised throughout the entire period. It is likely that European countries, in a context of high trade barriers, protected industries not endowed with comparative advantages, and that the Single Market Programme imposed a structural change on their economies (AMITI, 1999) which gave rise to 'U-shaped' national specialisation patterns. On this view, further national specialisation may possibly be imminent as EU deepening and widening proceed further. A first possible confirmation of this conjecture is provided by some of the founding members of the European Union, namely Belgium and Luxembourg, France, and Western Germany, which according to the present analysis, experienced increasing specialisation from the post-Single Market period onwards.

The evolution of specialisation was matched by the agglomeration of industries across and within national borders. We have just seen that the construction of the Single Market was dominated by international adjustments towards the decreasing specialisation of countries (see Table 4).

[TABLE 5 about here]

The results on decreasing national specialisation are matched by the between-country variations over the period 1985-1993. Changes were generally negative, and in half of the industries they were significant. Therefore, international de-agglomeration of industries prevailed across countries, as suggested by MIDELFART *et al.* (2004), and seems also to be consistent with the geographical dispersion across countries of manufacturing industries between 1985 and 1992 (AIGINGER and PFAFFERMAYR, 2004; AIGINGER and DAVIES, 2004).[19]

By contrast, during the second period, agglomeration across national boundaries rose in additional industries (see Table 5). To sum up, after a temporary adjustment to the liberalisation of manufactured goods markets, from 1993 onwards founding member states (Belgium, Luxembourg, France, Italy and Western Germany) experienced increasing specialisation which reflected significant international agglomeration in two core industries (*textiles and wearing apparel* and *transport equipment*) accompanied by rising trends in the *chemicals industry*, *metal products* and *non-metallic mineral products* (see Table 4 and Table 5).

DISCUSSION OF RESULTS AND CONJECTURES

Whatever international localisation will come about in the future, to date most of the structural change, particularly since completion of the Single Market Programme, has occurred in the internal geography of countries (see Table 4 and Table 5). In particular, industrial regional de-agglomeration within countries throughout the period confirms, and extends to further European countries, the evidence provided by previous studies on Italy, Spain and Germany (ROMBALDONI and ZAZZARO, 1997; DE ROBERTIS, 2001; PALUZIE *et al.*, 2001; SUEDEKUM, 2006).

These results are probably due to a combination of several forces which pushed towards internal de-agglomeration. Congestion costs[20] and the tertiarisation of metropolitan areas, together with the information technology revolution and advances in transportation infrastructure, may have driven the emerging trend. Moreover, falling trade barriers may have affected firms' locations, as suggested by the model of KRUGMAN and LIVAS (1996), because firms became less 'inward-looking' and the strength of congestion costs proved much more important than before.[21] The importance of congestion costs was also emphasized by the Italian literature on the development of peripherial regions in the 1970s and 1980s. Italian interregional dispersion was conceived in terms of the *filtering-down* theory (CRIVELLINI and PETTENATI, 1989) associated with the increasing congestion costs and disamenities of the main industrial area in the country. The change in the internal geography was also reinforced by lagging regions (the *Third Italy*), which subsequently grew faster than core regions, giving rise to profound changes in the previous relative positions (GAROFOLI, 1992). In addition, national industrial policies and European Regional Policy in favour of peripherial and underdeveloped regions may have contributed to the large-scale de-polarisation experienced in Southern Europe. In fact, Italy and Spain were among the first six countries in terms of EU aid and state aid to manufacturing during the period 1994-96 (Greece, Portugal, Ireland and Denmark were the others, see MIDELFART-KNARVIK and OVERMAN (2002), p. 334).

Moreover, at the same time as European integration increased, transportation and communication technology also improved, and industry-specific agglomeration economies were partly substituted by incentives for functional specialization within the same industry. Hence, accounting for the simultaneous development in transportation infrastructure and communication technology is essential to gain better understanding of the underlying reasons for the new patterns in the spatial organisation of industries. In fact, when the costs of coordinating the value chain decreased, firms found it easier to relocate their production units, maintaining their headquarters close to metropolitan areas so that managers were still

proximate to business service suppliers. In fact, if the spreading of labour that emerges is combined with the agglomeration of value added found by comparable previous studies (BRÜLHART and TRAEGER, 2005), it is likely that regional specialisation along functional lines is occurring within industry (DURANTON and PUGA, 2005), implying in its turn the concentration of high value added functions in core regions and the specialisation of peripheral sites in routine tasks. Consequently, European economic integration should be regarded as part of the story, whilst the diffusion of 'unbounded' organisational forms may have helped forge the new inner-country economic geography. In fact, evidence of a general spreading of knowledge-intensive manufacturing industries was found in West Germany during the 1990s (SUEDEKUM, 2006), and in Italy throughout the 1970s and 1980s, particularly for transport equipment production (ROMBALDONI and ZAZZARO, 1997, DE ROBERTIS, 2001). In Italy, the decentralisation of production tasks has continued in more recent years, because the economic crisis of the early 1990s forced Fiat to restructure its supply chain with a further relocation of routine tasks to South Italy.

A second interesting point is that, once the Single Market was almost completed, only a slight polarisation across national boundaries occurred, concomitant with the substantial fall in localisation in the internal geography of countries. Hence the drastic specialisation of European countries, implying the greater concentration of industries (KRUGMAN, 1991), is far from being fully accomplished. One possible reason for the gap between the theory and the reality is the discrepancy between the assumptions of NEG models and the real European economic landscape. The conjecture of convergence by the EU to the US level of concentration was probably based on the assumption of increasing labour mobility within the European Single Market.[22] Yet, Europe and US continue to differ in terms of some institutional and social features relevant for the agglomeration of economic activities: notably the low propensity of workers to migrate internationally, even though since 1985 the Shengen Treaty has established the free movement of people across national borders, and more

recently (December 2007) with almost all the new member states as well. It is therefore also possible that scant cross-country polarisation has been the outcome of the low international mobility of workers among the European countries analysed.

CONCLUSIONS AND FURTHER DEVELOPMENTS

The paper has investigated manufacturing location patterns in Europe during a period of trade integration. The decomposition methodology of entropy indices has allowed distinction between inner-country and cross-country localisation.

In contrast to the mixed empirical evidence provided by existing studies, the methodology adopted has identified a clear trend in European localisation which supports the idea that, in recent decades, substantial regional spreading has occurred simultaneously with less international polarisation. The paper has obtained robust results for EU-wide regional changes, providing compelling evidence on the regional de-agglomeration of manufacturing employment among regions within European countries. Instead, once the Internal Market had been completed, there began a polarisation between the supra-regional economies (i.e. countries and the macro areas defined by the North/South dichotomy).

The divergence between international patterns and domestic ones is not a contradictory finding if one considers that it has probably been driven by simultaneous dispersion and agglomeration forces acting at the different spatial scales.

The emerging opposite pattern of change may be connected with advances in European integration because, between 1993 and 2001, localisation across countries slightly increased, as suggested by theoretical models. Increasing overall localisation patterns across countries are explained by the international agglomeration of *textiles and wearing apparel* and *transport equipment*. Similarly, it is accounted for by the divergence of the national manufacturing structures of European founding member states - Western Germany and Italy and, to a lesser extent, France, Luxembourg and Belgium - from that of Europe.

The increasing polarisation across wider spatial scales during the period 1993-2001 may also be explained by the slight increase in specialisation in Northern Europe, and by the

rise in the relative concentration of high-tech industries across the North/South divide. It is likely that peripheral countries have also benefited from the dismantling of trade barriers as they have gained better access to the market. However, it would be simplistic to conceive these changes as purely the outcome of the European Single Market, because regional policy for lagging regions may have played a key role.

It is usually considered that specialisation in knowledge-intensive industries is growth-enhancing since innovation and technical progress are critical determinants of productivity improvements and international competitiveness. However, the increasingly uneven distribution of innovative activities across North and South Europe may, by itself, exacerbate regional disparities. Moreover, Cohesion Policy, for the period 2007-2013, included the goals of the Lisbon Strategy to foster regional growth and competitiveness through investment in innovation. These policy directions are highly important to attain higher efficiency but they may also deepen further the existing differences between Northern European industrial structure and the Mediterranean one. The former have more suitable specialisation patterns than the latter to seize the development opportunities provided by the European Regional Policy.

Although the paper does not claim to test the validity of the New Economic Geography's predictions, some final considerations may help bridge the gap between theory and evidence. In the New Economic Geography framework a causal link is established between international integration and the location of economic activities. The empirical facts presented here show that localisation has followed an unexpected path contrary to the one suggested by the theory. This evidence raises several questions: has European economic integration not yet reached the level at which agglomeration economies should prevail? Do simultaneous overlapping changes reshape the European geography of industrial activities in a contrasting way? Are agglomeration economies within specific industries vanishing? These unresolved issues require further research.

NOTES

[1] AIGINGER and DAVIES (2004) already showed that specialisation and concentration cannot diverge if relative measures are used.

[2] Decreasing concentration was widespread across Spanish NUTS3 regions during the 1980s (PALUZIE *et al.*, 2001), across Italian NUTS2 regions from the early 1970s to the late 1990s (ROMBALDONI and ZAZZARO, 1997; DE ROBERTIS, 2001; CICIOTTI and RIZZI, 2003) and, more recently, also in Germany (SUEDEKUM, 2006).

[3] COMBES and OVERMAN (2004) pointed out that *"the fact that Spanish regions did not change much with respect to one another does not mean that Spanish regions did not become more specialised relative to the rest of the EU"*.

[4] See BICKENBACH and BODE (2006) for a classification of different polarisation, concentration and specialisation measures.

[5] Overall localisation is conceptually and analytically composed of two economic phenomena: the specialisation of economies and the agglomeration of industries (see CUTRINI, 2008).

[6] The model suggests that decreasing transport costs will lead to an increase in specialisation and a decrease in regional concentration.

[7] Today, services make up the largest sector in most European economies and there are services that are of great importance for the distribution of regional income and welfare (e.g. financial services and R&D). Any full assessment of concentration and specialisation in Europe should include them.

[8] The sectors *manufacturing of leather and leather products* (DC, division 19) and *manufacture of coke, refined petroleum products and nuclear fuel* (DF, division 23) have been excluded from the analysis because of the overwhelming missing and confidential data.

[9] In this study I refer to the distinction between absolute and relative measures drawn by BICKENBACH and BODE (2006). Therefore, measures based on the uniform reference are considered as *absolute* measures, while those based on a nonuniform reference are labelled as *relative* measures.

[10] 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 on natural resources.

[11] The two geographical components of the concentration index for each industry *k* can be easily derived by factor decomposition (see CUTRINI (2006) for details on the formal decomposition of the localisation indices).

[12] BRÜLHART and TRAEGER (2005) test for the significance of temporal changes of regional localisation by relying on a block-bootstrap, i.e. resampling observations from different countries separately.

[13] I define intermediate spatial aggregation level as the level at which I disentangle the within- from the between-group component. Instead, the highest level of aggregation is the macroeconomic geographical benchmark (the set of European regions).

[14] Throughout the present paper, 'Europe' refers to the 145 European regions taken together.

[15] The sector includes *chemicals, machinery and equipment n.e.c., electrical and optical equipment, transport equipment, furniture, recycling and manufacturing n.e.c.*

[16] AUDRETSCH and FELDMAN (1996) showed the different propensity of manufacturing industries to generate spatial knowledge spillovers.

[17] On this reasoning, the functional specialisation of different localities is the aggregate outcome 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. 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 under a single roof prefer to become multi-plant organizations.

[18] From 1985 onwards, Greece was characterized by increasing specialisation in labour-intensive industries (food, textiles and wearing apparel) and in non-metallic mineral products, which is a manufacturing industry closely linked to the construction industry (see Table A8).

[19] I refer to geographical dispersion in the latter two cases, since AIGINGER and PFAFFERMAYR (2004) and AIGINGER and DAVIES (2004) used absolute concentration measures and their results are not directly comparable with the present ones. Moreover, nominal value added is the activity indicator.

[20] A crucial dispersion force in the models of KRUGMAN and LIVAS (1996) and PUGA (1999).

[21] The model of KRUGMAN and LIVAS (1996) - inspired by the Mexican liberalisation programme - suggests that falling trade barriers may affect firm's location within each country. The fundamental idea is that, in a restrictive trade policy, forward and backward linkages foster the clustering of economic activity. As soon as protective

measures are removed, the central place (usually the capital city) loses the advantage it had in a relatively closed economy, and firms, which now mainly sell to external markets, are more willing to migrate to peripheral regions, especially if relocation means better access to international market.

[22] In NEG models (e.g. KRUGMAN, 1991, PUGA, 1999) labour mobility has an important role in sustaining agglomerations; in a symmetric way, labour immobility is an important dispersion force.

APPENDIX

Table A1. Geographical coverage of the dataset

Country	Administrative partition	Number of regions included
Belgium	Provinces (NUTS2)	9
Luxembourg		1
Germany	Länder (NUTS1)	16
Spain	Comunidades autónomas (NUTS2)	17
Finland	Suuralueet (NUTS2)	3
France	Régions (NUTS2)	22
Greece	Development regions (NUTS2)	11
Italy	Regioni (NUTS2)	19
Netherland	Provincies (NUTS2)	12
United Kingdom	Counties (NUTS2)	35
Total		145

Notes: Bruxelles (BE10), Vlaams Brabant (BE24) and Brabant Wallon (BE31) have been clustered as a single region; Ceuta y Melilla (ES63), Åland (FI2), 'Departments d'Autre Mar' (FR91, FR92, FR93, FR94), Voreio Aigaio (GR41) and Notio Aigaio (GR42), Trentino-Alto Adige (IT31) have been excluded. Regional partition of data for UK is according to NUTS 95 classification.

Table A2. Bootstrap results for localisation measures, absolute changes 1985-2001

		1985-2001			
		Obs. differ.	**Boot. Std. Err.**	**z**	**P>|z|**
	L	-0.042	0.009	-4.52	0
	L^w	-0.035	0.005	-6.66	0
	L^b	-0.007	0.006	-1.08	0.01

Table A3. Bootstrap results for specialisation measures, absolute changes 1985-2001

		1985-2001			
		Obs. differ.	**Boot. Std. Err.**	**z**	**P>|z|**
Belgium and Luxembourg	aRS_i	-0.131	0.030	-4.37	0

	aRS_i^w	-0.062	0.023	-2.73	0.006
	T_i^b	-0.069	0.025	-2.74	0.006
Western Germany	aRS_i	-0.016	0.020	-0.83	0.408
	aRS_i^w	-0.035	0.012	-2.78	0.005
	T_i^b	0.018	0.012	1.56	0.118
Spain	aRS_i	-0.078	0.029	-2.68	0.007
	aRS_i^w	-0.038	0.015	-2.45	0.014
	T_i^b	-0.041	0.022	-1.86	0.064
Finland	aRS_i	-0.079	0.052	-1.52	0.128
	aRS_i^w	-0.009	0.005	-2.1	0.036
	T_i^b	-0.069	0.051	-1.35	0.178
France	aRS_i	-0.011	0.016	-0.66	0.512
	aRS_i^w	-0.009	0.011	-0.79	0.43
	T_i^b	-0.002	0.010	-0.19	0.846
Greece	aRS_i	-0.125	0.035	-3.63	0
	aRS_i^w	0.017	0.015	1.12	0.265
	T_i^b	-0.142	0.040	-3.53	0
Italy	aRS_i	-0.015	0.021	-0.71	0.476
	aRS_i^w	-0.039	0.017	-2.31	0.021
	T_i^b	0.024	0.012	2.08	0.037
Netherlands	aRS_i	-0.094	0.023	-4.11	0
	aRS_i^w	-0.022	0.010	-2.23	0.026
	T_i^b	-0.072	0.022	-3.25	0.001
United Kingdom	aRS_i	-0.061	0.015	-3.96	0
	aRS_i^w	-0.044	0.012	-3.66	0
	T_i^b	-0.018	0.008	-2.3	0.021

Table A4. Bootstrap results for concentration measures, absolute changes 1985-2001

		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
	T_k^w	-0.069	0.012	-5.85	0
	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
	T_k^w	-0.042	0.010	-4.41	0
	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 A5. Bootstrap results for localisation 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|
L	-0.028	0.005	-5.7	0	-0.014	0.006	-2.16	0.031
L^w	-0.019	0.003	-5.59	0	-0.016	0.004	-4.15	0.000
L^b	-0.009	0.003	-2.84	0.01	0.002	0.004	0.47	0.639

Table A6. Bootstrap results for specialisation 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|
Belgium and Luxembourg	aRS_i	-0.111	0.025	-4.43	0.000	-0.021	0.017	-1.25	0.212
	aRS_i^w	-0.041	0.021	-1.93	0.053	-0.022	0.012	-1.77	0.077
	T_i^b	-0.070	0.024	-2.92	0.003	0.001	0.009	0.11	0.914
Western Germany	aRS_i	-0.031	0.014	-2.28	0.023	0.015	0.009	1.64	0.102
	aRS_i^w	-0.027	0.010	-2.85	0.004	-0.008	0.005	-1.58	0.114
	T_i^b	-0.004	0.006	-0.7	0.482	0.022	0.009	2.4	0.016

Spain	aRS_i	-0.035	0.020	-1.71	0.088	-0.044	0.017	-2.63	0.009
	aRS_i^w	-0.030	0.014	-2.18	0.029	-0.008	0.007	-1.17	0.243
	T_i^b	-0.005	0.014	-0.34	0.735	-0.036	0.015	-2.48	0.013
Finland	aRS_i	-0.011	0.015	-0.72	0.470	-0.068	0.038	-1.78	0.076
	aRS_i^w	-0.008	0.003	-2.72	0.006	-0.001	0.003	-0.59	0.558
	T_i^b	-0.003	0.016	-0.21	0.837	-0.066	0.038	-1.75	0.080
France	aRS_i	0.004	0.015	0.24	0.810	-0.014	0.006	-2.33	0.020
	aRS_i^w	0.015	0.011	1.32	0.187	-0.024	0.005	-4.8	0.000
	T_i^b	-0.011	0.007	-1.59	0.112	0.009	0.006	1.51	0.132
Greece	aRS_i	-0.018	0.034	-0.52	0.600	-0.107	0.040	-2.69	0.007
	aRS_i^w	0.035	0.013	2.65	0.008	-0.018	0.013	-1.36	0.173
	T_i^b	-0.053	0.039	-1.37	0.171	-0.089	0.046	-1.92	0.055
Italy	aRS_i	-0.001	0.012	-0.12	0.906	-0.013	0.017	-0.77	0.443
	aRS_i^w	-0.009	0.009	-1.04	0.298	-0.030	0.013	-2.29	0.022
	T_i^b	0.008	0.007	1.05	0.296	0.017	0.011	1.45	0.148
Netherlands	aRS_i	-0.071	0.022	-3.23	0.001	-0.023	0.013	-1.73	0.083
	aRS_i^w	-0.013	0.008	-1.64	0.101	-0.009	0.007	-1.42	0.157
	T_i^b	-0.058	0.021	-2.72	0.006	-0.014	0.009	-1.51	0.131
United Kingdom	aRS_i	-0.017	0.010	-1.74	0.083	-0.045	0.010	-4.56	0.000
	aRS_i^w	-0.012	0.009	-1.44	0.150	-0.031	0.007	-4.35	0.000
	T_i^b	-0.004	0.005	-0.81	0.418	-0.013	0.006	-2.34	0.019

Table A7. 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	-1.2	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	-2.2	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	-0.5	0.617
Paper	T_k	-0.010	0.010	-1.09	0.28	-0.004	0.011	-0.33	0.74
	T_k^w	-0.004	0.008	-0.5	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	0.12
Chemicals	T_k	-0.008	0.011	-0.72	0.47	-0.012	0.015	-0.82	0.41
	T_k^w	-0.005	0.010	-0.52	0.6	-0.024	0.009	-2.52	0.012
	T_k^b	-0.003	0.007	-0.4	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	-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
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	-1.6	0.11
	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	-0.026	0.008	-3.5	0
	T_k^w	-0.041	0.010	-4.18	0	-0.029	0.006	-4.9	0
	T_k^b	-0.017	0.010	-1.62	0.11	0.002	0.006	0.39	0.7
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	0.61
	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	-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	0.25
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	-0.071	0.027	-2.65	0.008
	T_k^w	-0.016	0.013	-1.27	0.2	-0.025	0.012	-2.05	0.04
	T_k^b	-0.038	0.015	-2.55	0.01	-0.047	0.021	-2.2	0.027

Table A8. Industry location quotients, by country

	Germany		**France**		**Italy**	
	1985	2001	1985	2001	1985	2001
Food	0.61	0.75	1.00	1.33	0.78	0.79
Textiles	0.63	0.39	1.11	0.78	1.58	1.78
Wood	0.95	0.64	0.23	0.89	0.60	1.42
Paper	0.70	0.82	1.05	1.00	0.79	0.68
Chemicals	1.11	1.17	1.01	1.03	0.94	0.71
Rubber and plastic prod.	1.01	1.07	1.09	1.12	1.02	0.83
No-metal products	0.85	0.84	0.88	0.80	1.31	1.18

Basic metals and metal products	1.02	0.92	1.02	1.02	0.93	1.19
Machinery	1.39	1.38	0.67	0.74	1.00	1.13
Electrical and optical equipment	1.21	1.22	1.05	1.09	0.90	0.84
Transport equipment	1.10	1.48	1.21	0.98	0.93	0.61
Manufacturing nec	1.22	0.69	1.07	0.95	1.08	1.29

	United Kingdom		**Belgium-Lux.**		**Netherlands**	
	1985	2001	1985	2001	1985	2001
Food	1.26	0.98	1.57	1.27	1.36	1.42
Textiles	1.04	1.15	0.94	1.07	0.43	0.44
Wood	1.52	0.80	2.41	0.82	0.55	0.90
Paper	1.39	1.37	1.37	0.99	1.41	1.70
Chemicals	0.85	1.00	1.49	1.60	1.25	1.24
Rubber and plastic prod.	1.01	1.15	0.98	0.88	0.62	0.75
No-metal products	0.95	0.80	1.40	1.24	0.65	0.83
Basic metals and metal products	0.82	0.85	0.99	1.13	2.02	0.98
Machinery	0.98	0.83	0.76	0.59	0.77	0.91
Electrical and optical equipment	1.04	1.09	0.87	0.69	0.83	0.94
Transport equipment	1.02	0.97	0.25	0.91	0.52	0.62
Manufacturing nec	0.27	1.02	0.45	0.93	0.62	1.03

	Spain		**Greece**		**Finland**	
	1985	2001	1985	2001	1985	2001
Food	1.71	1.23	2.00	1.92	1.23	0.81
Textiles	1.25	1.31	2.97	2.26	0.83	0.45
Wood	1.58	1.57	0.80	0.77	2.97	2.16
Paper	0.85	0.97	0.91	1.30	3.08	2.08
Chemicals	0.79	0.84	0.80	0.99	0.59	0.70
Rubber and plastic prod.	0.97	0.86	0.79	0.79	0.86	0.91
No-metal products	1.38	1.64	1.48	1.55	1.06	0.88
Basic metals and metal products	1.07	1.09	0.68	0.74	0.55	0.76
Machinery	0.47	0.65	0.17	0.45	1.15	1.24
Electrical and optical equipment	0.45	0.57	0.32	0.37	0.60	1.25
Transport equipment	0.85	0.83	0.54	0.56	0.73	0.64
Manufacturing nec	1.88	1.34	0.69	0.69	0.94	0.78

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TABLES in the text

Table 1. Robustness of results to the choice of the basic geographic unit of analysis, spatial aggregation, sectoral aggregation, same geographical benchmark

Basic unit (R)	Intermediate level	Industry aggregation		ΔL	ΔL^w	ΔL^b
NUTS2 (145)	country	one-digit, NACE rev. 1	1985–1993	-0.028***	-0.019***	-0.009**
				(0.005)	*(0.003)*	*(0.003)*
			1993–2001	-0.014**	-0.016***	**0.002**
				(0.006)	*(0.004)*	*(0.004)*
NUTS1 (60)	country	one-digit, NACE rev. 1	1985–1993	-0.023***	-0.013***	-0.009**
				(0.005)	*(0.003)*	*(0.003)*
			1993–2001	-0.009*	-0.011***	**0.002**
				(0.005)	*(0.002)*	*(0.005)*
NUTS2 (145)	Northern/ Southern Europe	high-tech/low-tech dichotomy	1985–1993	-0.005***	-0.004**	-0.001
				(0.002)	*(0.002)*	*(0.001)*
			1993–2001	0.000	-0.001	**0.001**
				(0.004)	*(0.003)*	*(0.002)*
NUTS2 (145)	NUTS1	one-digit, NACE rev. 1	1985–1993	-0.029***	-0.006***	-0.023***
				(0.005)	*(0.002)*	*(0.005)*
			1993–2001	-0.014**	-0.005**	-0.009*
				(0.007)	*(0.002)*	*(0.006)*

Notes: *weighted relative Theil, bootstrap standard error in parentheses, based on 10,000 replications, positive changes over time are in bold*

Table 2. Relative concentration of manufacturing industries across EU regions

			Absolute change	
	Taxonomy[a]	**Average 1985-2001**	**1985-2001[b]**	**1980-95[c]**

Textiles and wearing apparel	LT	0.26	0.034	0.165 **
Wood	LT	0.22	-0.130 **	--
Non-metallic mineral products	LT	0.18	-0.032	0.017
Chemicals	HT	0.17	-0.020	0.000
Manufacturing nec	HT	0.16	-0.125 ***	-0.004
Transport equipment	HT	0.15	0.021	0.020
Food	LT	0.14	-0.054 ***	0.011
Paper, publishing and printing	LT	0.13	-0.014	0.010
Electrical and optical equipment	HT	0.10	-0.046 ***	-0.006
Basic metals and fabricated metal products	LT	0.11	-0.083 ***	-0.056
Machinery	HT	0.10	-0.025	-0.006
Rubber and plastic products	LT	0.10	-0.056 **	--

Notes: [a] *OECD technology classification: L= low-tech, M-L= medium to low-tech; M-H= medium to high-tech*

[b] */**/*** denotes rejection of the null hypothesis that ΔTk=0 at the 90%, 95% or 99% significance level.*

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

Table 3. Specialisation indices and components, 1985-2001

(average values and differences)

	aRS_i			aRS_i^w			T_i^b		
	Average value	$\Delta_{1985-2001}$	**Sign.**	**Average value**	$\Delta_{1985-2001}$	**Sign.**	**Average value**	$\Delta_{1985-2001}$	**Sign.**
Greece	0.39	*-0.13*	***	0.15	*0.02*		0.24	*-0.14*	***
Belgium and Luxembourg	0.22	*-0.13*	***	0.16	*-0.06*	***	0.06	*-0.07*	***
Spain	0.20	*-0.08*	***	0.13	*-0.04*	**	0.07	*-0.04*	*
Finland	0.19	*-0.08*		0.05	*-0.01*	**	0.14	*-0.07*	
United Kingdom	0.16	*-0.06*		0.14	*-0.04*		0.02	*-0.02*	
Netherland	0.14	*-0.09*		0.05	*-0.02*		0.08	*-0.07*	
Italy	0.14	*-0.01*		0.10	*-0.04*	**	0.04	***0.02***	
France	0.10	*-0.01*		0.09	*-0.01*		0.01	*0.00*	
Germany (only Western G.)	0.12	*-0.02*		0.08	*-0.03*	***	0.04	***0.02***	
Overall localisation	0.14	*-0.04*	***	0.10	*-0.04*	***	0.04	*-0.01*	

Table 4. Relative specialisation -A comparison of the pre- and post-Single Market periods

pre-Single Market	**post-Single Market**

	ΔT_i^b		aRS_i^w		ΔT_i^b		aRS_i^w	
Belgium and Luxembourg	-0.070	**	-0.041		**0.001**		-0.022	
Finland	-0.003		-0.008	**	-0.066		-0.001	
France	-0.011		**0.015**		**0.009**		-0.024	**
Greece	-0.053		**0.035**	**	-0.089	*	-0.018	
Italy	**0.008**		-0.009		**0.017**		-0.030	*
Netherlands	-0.058	**	-0.013		-0.014		-0.009	
Spain	-0.005		-0.030	*	-0.036	*	-0.008	
United Kingdom	-0.004		-0.012		-0.013	**	-0.031	**
Western Germany	-0.004		-0.027	**	**0.022**	*	-0.008	
Overall localisation	-0.009	**	-0.019	***	**0.002**		-0.016	***

Notes: Absolute changes for pre-Single Market refers to the period 1985-1993 while for post-Single Market the period considered is 1993-2001, positive changes are in bold

Table 5. Relative concentration -A comparison of the pre- and post-Single Market periods

	pre-Single Market		**post-Single Market**	
	ΔT_k^b	ΔT_k^w	ΔT_k^b	ΔT_k^w

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	***
Overall localisation	-0.009	**	-0.019	***	**0.002**	-0.016	***

Notes: Absolute changes for pre-Single Market refers to the period 1985-1993 while for post-Single Market the period considered is 1993-2001, positive changes are in bold

FIGURES in the text

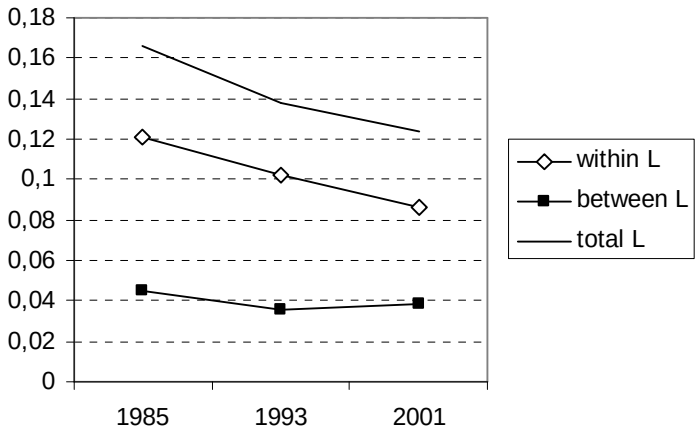

Fig. 1. Evolution of EU-wide localisation within and across countries, entropy index of overall localisation (L-index), 1985-2001

Source: SBS-region database employment by manufacturing sectors

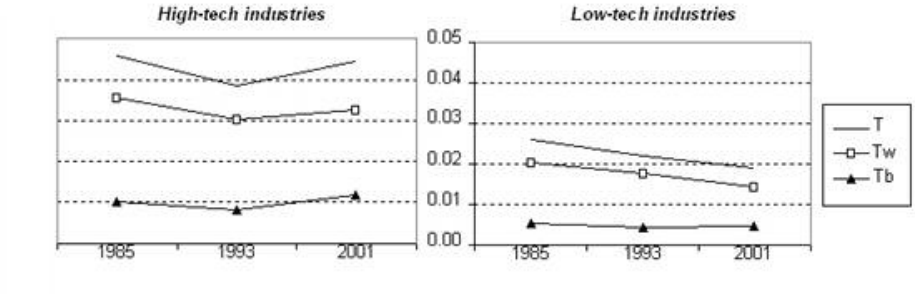

Fig. 2. Relative concentration of high-tech and low-tech manufacturing industries over the North-South divide

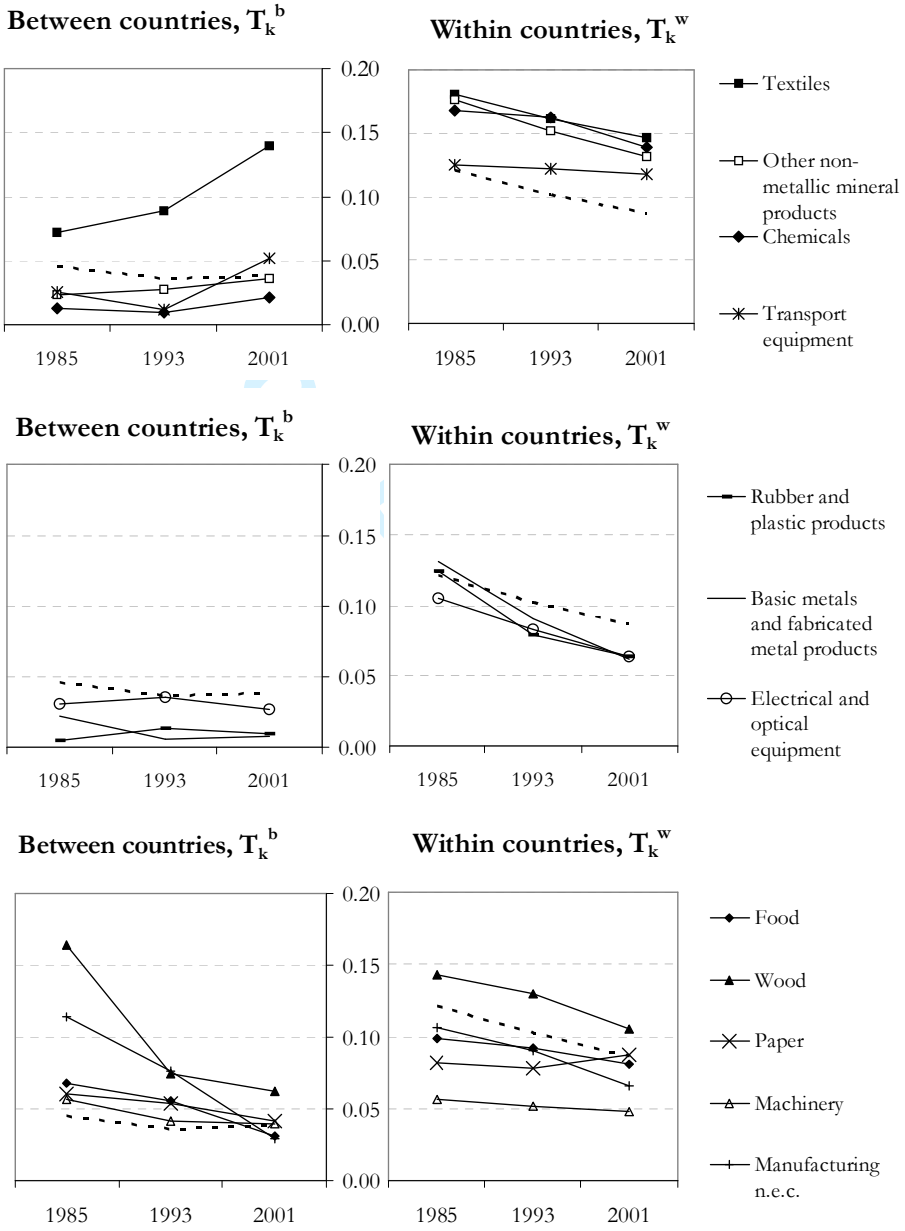

Fig. 3. Evolution of the two components of relative concentration

Notes: dotted lines are the respective components of the L-index: between-country in the left graphs, within-country in the right graphs

Source: SBS-region database employment by manufacturing sectors

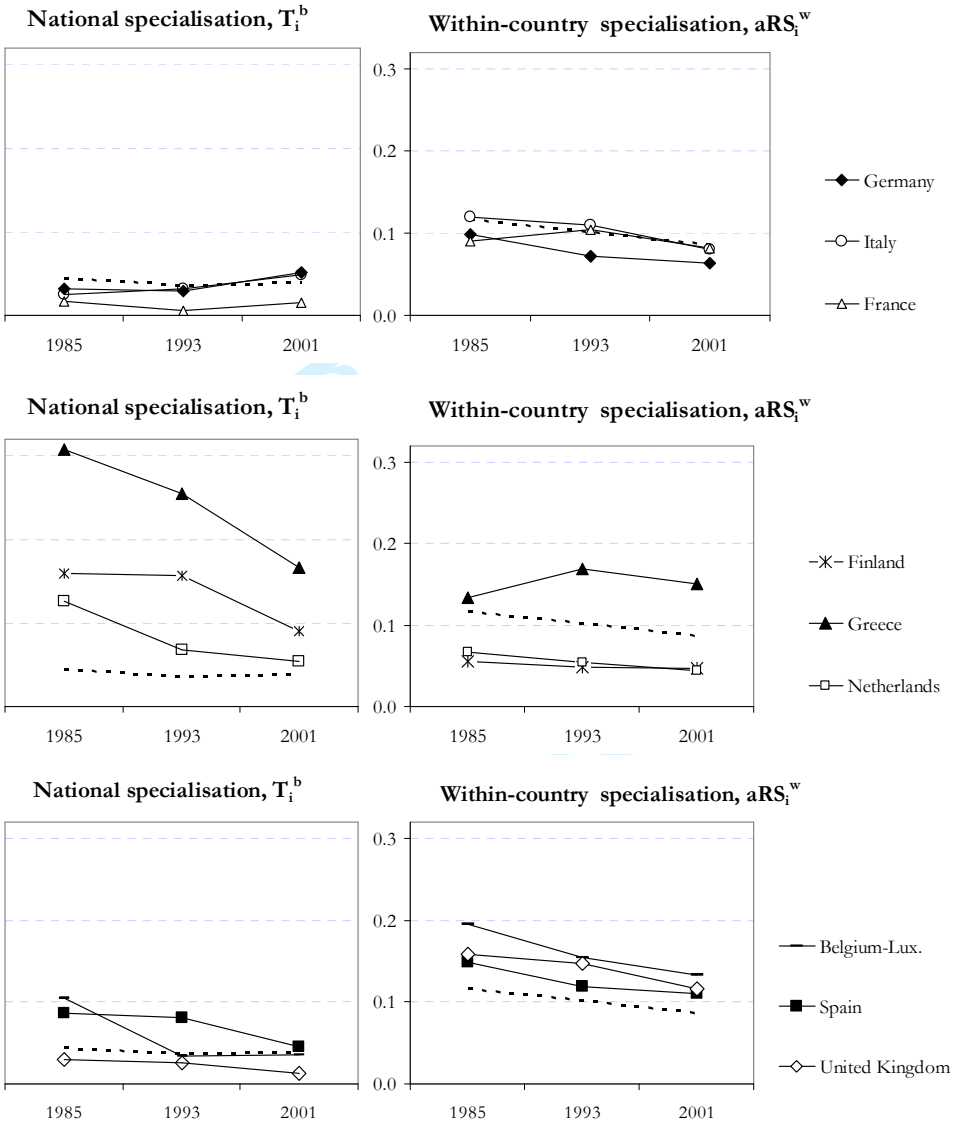

Fig. 4. Evolution of the two components of relative specialisation

Notes: dotted lines are the respective components of the L-index: between-country in the left graphs, within-country in the right graphs

Source: SBS-region database employment by manufacturing sectors