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New aspects on the industrial concentration patterns of the European Union

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Abstract

The analysis of concentration patterns at both the national and the regional levels in the European Union (EU) reveals initially contradictory results of concentration and deconcentration trends. However, these industrial concentration trends in the two spatial dimensions are, in essence, complementary, as further analysis indicates that industrial activities continue to move towards the most dynamic countries but not towards the same powerful regions. This outcome is verified by an econometric approach, which by studying the EU-15 and new EU member states aims to reveal the characteristics of two deviated productive systems and two different levels of maturity. The empirical analysis gives rise to the existence of a non-monotonic relation between concentration and integration.

Key words: *industrial concentration, econometric model, EU-15, New EU Member States*

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Introduction

Agglomeration economies and concentration dynamics have attracted much interest in both the theoretical and the empirical literature. This interest stems from the globalization and integration processes that have been taking place since the second half of the 20th century, which have fundamentally changed global spatial patterns and the ways of industrial organization. In the context of these dynamics, the European Union (EU) and its economic environment have been affected by a complex framework of procedures, which include open economy mechanisms, the transition of East Europe from the former socialist system to the free market and global competition, the increasing integration through the gradual enlargement of the EU, and the introduction of the single market. Under these conditions, the area is experiencing a marked shift with regard to industrial activities and their tendency for translocation with the intention to exploit the increasing returns that stem from externalities and economies of scale. Furthermore, the choice of the location of industrial units is related to the centripetal or centrifugal character of the market forces and their benefits.

In this framework of review and re-determination of spatial asymmetries and industrial dynamics, a series of basic issues is established in relation to the effects of economic integration and market openness. In particular, it has been questioned whether the effects of the decline of trade costs and the exploitation of the benefits of agglomeration lead, at the spatial level, to further spatial asymmetry in favour of the already dynamic regions, or whether they cause dispersion trends. At the sectoral level, the degree to which the location decisions of economic activities are based on the cumulative mechanisms of development is also being questioned, thus leading to a further concentration increase in specific industries.

Empirical studies have been conducted in an effort to study industrial concentration patterns, but they have yielded mixed results, depending on the geographical scale and the industries considered (Barrios and Strobl 2004; Combes and Overman 2003). Thus, the concentration patterns and degrees differ between countries (Combes and Overman 2003; Aiginger and Davies 2004) and between industries (Brülhart 1998; Midelfart-Knarvik et al. 2002). Various studies have underlined these differences; at the macro-regional level, US regions are more specialised and concentrated than EU regions (Krugman 1991), which cultivates expectations for a concentration rise in the EU that is parallel to its increasing integration (a 'United Europe' would be much more like the United States; Brülhart and Torstensson 1996). On the other hand, when the whole of Europe is examined, countries characterised by considerable concentrations of industrial activity have been assessed to be of a large market size, with good geographic access, and with the existence of externalities (Tsiapa 2008). Furthermore, recent data attest that the most technologically and productively advanced branches of

manufacturing, that is, the most capital-intensive branches, present the most significant increase in concentration, whereas the high-return service sectors, that is, real estate and financial services, present higher concentrations but have declining trends (Tsiapa 2010). Finally, there is a part of the literature that supports the existence of a non-monotonic relation between the concentration and integration degree emanating from the interaction of the centripetal agglomeration forces with the centrifugal factor-cost considerations, where the former dominate the latter only during the early stages of integration (Brülhart and Torstensson 1996; Hanson 1996).

As a consequence of this reasoning, there is a broad array of literature that studies the location trends of industrial activities within the EU at *either* the country level (Aiginger 2000; Aiginger and Pfaffermayr 2004; Amiti 1998, 1999; Brülhart 1995) *or* the regional level (Molle 1997; Brülhart and Traeger 2005; Ezcurra et al. 2006). This has created the need to study the trends of concentration, taking into account *both the national and the regional levels,* so as to compose and then assess an integrated picture of the concentration patterns.

To this end, this paper analyses first the stylised facts in the concentration patterns at the national and the regional levels, with the intention to disentangle the concentration trends that exist at both levels. Thus, the concentration trends of different spatial scales are analysed with the aim of revealing the characteristics of the concentration pattern in each spatial level, and, particularly at the country level, by the national concentrations, and at the regional level, by the regional agglomerations. Additionally, the concentration trends will give information on the form and the dynamics of the core-periphery pattern within the EU formed at both the country and the regional levels. Ultimately, the results of the concentration trends in the two spatial dimensions are observed to be complementary: trends of both concentration and deconcentration are observed, indicating that industrial activities continue to move towards the most dynamic countries, but not towards the same typical powerful regions.

Secondly, this paper intends to verify this hypothesis by detecting the determinants of the regional concentration pattern and by investigating the existence of any non-monotonic relation between integration and agglomeration. For this issue, different concentration trends are emerging in the areas [or the 'large-scale regions' as Krugman (1993) has described them] of the advanced EU-15 and the least developed new member states (NMS-10). These distinct concentration patterns (deconcentration in the EU-15 and concentration in the NMS-10) are elucidated through an econometric approach that assigns different determinant factors of a spatial and industrial nature, reflecting virtually the existence of different productive systems, and levels of transformation and maturity.

Furthermore, this paper is in line with the outcomes of a series of studies that allege that any ambiguity in the results regarding the determinants of agglomeration is grounded on analysing different regions, sectors, or time periods (de Groot et al. 2009; Melo et al.

2009). Thus, the analysis, by distinguishing, firstly, different economies and productive systems and, secondly, different sectors in the manufacturing activity aims to capture, discriminate, and elucidate the (initially contradictory) trends that influence different regions and industries.

This paper is structured as follows. Section 1 gives the pertinent theoretical framework with respect to industrial concentration. Section 2 describes some methodological issues pertaining to this study. Section 3 analyses some stylised facts on the concentration patterns at the national and regional levels. Section 4 econometrically detects the determinants of the concentration levels and the concentration changes in both the EU-25 and its subgroups. Finally, the last section offers the concluding remarks.

1. A concise theoretical analysis

In the literature, the concentration patterns generally are related to increasing trends under different assumptions and factors of influence. In conventional neoclassical theory, production is characterised by perfect competition, homogenous products, and constant returns to scale. The comparative advantage of each country is formed by the inherited and lumpy spatial distribution of natural endowments and factors of production. Therefore, activities concentrate on reaping the static gains in those countries that are *relatively* abundant in the factors they use intensively, and the concentration patterns follow the exogenously determined comparative advantage patterns of the economies.

A new economic school has been derived from more recent research. It is composed of both the New Trade Theory and the New Economic Geography (NEG). The models by Krugman (1980) and Helpman and Krugman (1985), which underpin the New Trade Theory, were the first to formally show that scale economies, product differentiation (a greater variety of products), and trade costs could be the basis for international trade and aggregate welfare gains. The location of the firms is predicted to be in regions with good market access. As trade costs are reduced, the separation of production from consumption is facilitated and a larger degree of concentration occurs. Nevertheless, in the case of the trade cost being trivially small, the differences in these costs are considered as unimportant, and thus, the factor cost considerations of the neoclassical model become more important. This theoretical base was confirmed retroactively in the case of the United States, where, after the First World War, regional integration contributed to the decline in its specialisation levels. On the contrary, the results in the EU are mixed; whereas the income disparities between the central and the peripheral countries are getting smaller, the internal regional inequalities of countries are getting larger (Venables 1998). This intensifies the need to study concentration and integration on both of the spatial scales.

A more advanced theoretical context developed along with the models that make up the 'new economic geography' (Krugman 1991; Fujita et al. 1999). These models consider location as an endogenous process and relate it to the geographical advantages that stem from two things: first, from agglomeration economies, in which the proximity of industries generate externalities based on the diffusion of knowledge or the spillovers of labour market pooling effects, and second, from input-output linkages among industries, through which benefits from the proximity between buyers and sellers are generated. These factors, which constitute the 'home market effect', create a circular process of causation, and thus are determined endogenously. The gradual integration induces the activation of centrifugal forces and the diffusion of a part of industries toward the periphery, a phenomenon denoted by Baldwin and Martin (2004) as 'catastrophic agglomeration'. Therefore, the cumulative causation forces and the integration levels are related by an inverted U-type curve (Ottaviano 2002). For high trade costs, the industries are located in different areas for the supplying markets; for intermediate values, firms and workers cluster together for the exploitation of agglomeration advantages; for low values, the firms give weight to the costs of the factors and to the immobile factors being dispersed over the space. Brülhart and Tosrtensson (1996) found some support for the inverted U-shaped relationship between the degree of regional integration and spatial agglomeration in the EU, as in the 1980s the concentration in the core had fallen slightly.

A similar inverted U-shaped relationship has been revealed between the level of regional disparities and the development level of a country. More analytically, in less developed countries economic activities (the time period is different for each country) start to concentrate in a few places in order to take advantage of the scale and agglomeration economies and their externalities, resulting in a widening of regional disparities. At later stages when gradual integration takes place (by a decline in trade cost), economic activities orientate towards more peripheral areas in order to eventually avoid price competition effects, high land prices, or pure external diseconomies, resulting in a decline in regional disparities (Williamson 1965; Henderson et al. 2001).

2. The methodological approach of the analysis

The theoretical and the empirical parts of the literature have supported mixed concentration and deconcentration trends. This could depend on the development and integration level of the economies under study, the structure of their production systems, or the spatial scale (of aggregation units) that is analysed. By giving special weight to these factors, this paper attempts to analyse the concentration patterns in the EU. Thus, its goal is, first, to investigate the concentration trends in the EU-25 (EU-27 apart from

Cyprus and Malta due to lack of data) by displaying some stylised facts on the concentration pattern for different spatial levels.

Second, by focusing on the regional level (as the employment movement is more intense and flexible at the inter-regional level than it is at the inter-country level), the research attempts to detect the determinants of the concentration pattern by an econometric approach through two directions. First, it demonstrates the characteristics of the leading dynamics of the pattern by identifying the driving forces of the *high concentration levels*. Second, it demonstrates the characteristics of the revealing trends of the pattern by identifying the driving forces of the significant positive *concentration change*. Furthermore, the econometric analysis examines the EU-25 as a whole as well as the subgroups of the EU-15 and the NMS-10. This distinction is necessary, as these two macro-regions (following the denomination of Dunford for large areas with common economic and political traits) have developed different economic, political, and institutional systems that have affected their evolution fundamentally and in different ways.

The industrial concentration is based on the calculation of the entropy index of topographic concentration of Brülhart–Traeger–Theil (Theil 1967)[1]. The topographic Theil index is as follows:

$$T_i = \sum_{j=1}^{J} a_j(i) \ln\left(\frac{a_j(i)}{\alpha_j}\right),\ 0 \leq T_i \leq \ln(1/\alpha_j^*),$$

where $a_j(i)$ denotes the share of region j in the total regions as concerns the sector i, α_j denotes the share of region *j* in the total regions in terms of the area, and α_j^* denotes the minimum value of the total range of values of α_j. The topographic concentration measures the degree to which sectors are concentrated *relative to the physical space* (Brülhart and Traeger 2005), reflecting the density of their economic activity or employment.

The study of concentration trends is based on employment data (rather than on value added data, as a more integrated time series database is available from Eurostat). Finally, the estimation of the concentration index is based on the ISIC2 categorization of manufacturing, according to which the 26 branches are, for the better attribution of

[1] In the present paper, it is concluded that the form of concentration that should be utilised is the topographic form because the bulk of the study is based on the following: (1) the detection of the employment distribution, which is evaluated not in absolute terms but on a weighted basis to highlight all the countries that, independently of their size, show a dynamic presence through a considerable attraction of means; (2) the regional level, in which the determination of concentration trends indicates that the size of each region is related to the administrative divisions of each country and does not strictly represent a market size or potential (and, therefore, there is no need to measure its size in absolute terms); and (3) the accomplishment of the comparative analysis of the concentration trends on both spatial levels (national and regional) on a common basis, which should be the topographic concentration index.

results, grouped into three sectors: the consumer, intermediate, and capital sectors[2] (Petrakos and Tsiapa 2000).

Table 1. Description of the 3-digit branches of manufacturing (ISIC2) and their categorisation

Categorisation according to their use in the productive process	
Sector	NACE (ISIC2)
Consumer	311–314, 321–324, 331–332, 341–342, 390
Intermediate	351–356, 361–362, 369, 371, 372, 381
Capital	382–385

NACE (ISIC2)	Name
311, 313, 314	Food, beverages and tobacco
321, 322	Textiles, wearing apparel (except footwear)
323, 324	Leather products and footwear (except rubber or plastic)
331, 332	Wood products (except furniture), furniture (except metal)
341, 342	Paper and products, printing and publishing
351–354	Chemicals, petroleum
355, 356	Rubber and plastic products
361, 362, 369	Mineral products (non-metallic)
371, 372	Iron and steel, non-ferrous metals
381	Fabricated metal products
382, 385	Machinery (except electrical), professional and scientific equipment
383	Machinery electrical
384	Transport equipment
390	Other manufactured products

Source: Petrakos and Tsiapa (2000)

3. Stylised facts of the concentration pattern

A. Industrial concentration trends at country level

For the analysis and the evaluation of the topographic concentration patterns in the EU-25 and the sub-areas of the EU-15 and the NMS-10 at the *national level*, the decomposability property of the Theil index is used with the intention of comparing the concentration within areas of the EU-15 and the NMS-10 (cross-country analysis for each area) to the concentration patterns between areas of the EU-15 and the NMS-10, in a conceptually rigorous fashion.

[2] The consumer sector consists of products that apply to the demand market, which has been characterised as 'light industry', and its industries are both labour- and resource-intensive. The intermediate sector consists of products that are used as inputs for the production of other goods, and its industries are resource-intensive (from, e.g., the production of minerals or fuel) and scale-intensive (from, e.g., the production of iron or plastic). Finally, the capital sector consists of the most technologically advanced industries, and it is considered to be a sector of capital intensity and of high productivity and returns.

The problem of measurement errors in databases with employment or value added is taken into consideration by accounting the stochastic component to the measures (Brülhart and Traeger 2005), by assessing the statistical significance of the observed concentration patterns, and by using inferential methods. Therefore, to evaluate the significance of the changes in the concentrations over time, a bootstrap test, particularly the BDS test (developed by Brock et al. 1987), is applied. From the results obtained, the null hypothesis of independent and identical distribution (iid) of residuals for any case is not rejected (Table 2). Consequently, the statistical significance of the concentration trends is assured.

From the analysis, the following points should be highlighted: First, higher values of concentration are observed in the capital sector in the EU-25 as well as in its sub-areas (EU-15 and NMS-10). Second, the capital sector is the only one that displays a statistically significant increase in the concentration index *within* all the (sub)areas, confirming its further reinforcement[3]. Third, a more unbalanced and 'lumpy' pattern of concentration is displayed *internally* in each area (and mostly inside of the EU-15) rather than among the EU-15 and the NMS-10, as the 'within' component of the concentration index in manufacturing results is in higher values (0.247) than the 'between' component (0.002).

Table 2. Topographic concentration of manufacturing and of its sub-sectors in the EU-25 countries, 1995 and 2006 by the total (EU-25), between (NMS-10 and EU-15) and within (NMS-10, EU-15) components of the Theil index

	manufacturing		consumer		intermediate		capital	
	1995	*2006*	*1995*	*2006*	*1995*	*2006*	*1995*	*2006*
total	0.267	0.249	0.226	0.193	0.322	0.283	0.352	**0.376**
BDS	0.016 (0.59)		0.080 (0.05)		0.052 (0.23)		0.080 (0.06)	
between	0.0001	0.002	0.007	0.003	0.001	0.006	0.005	0.010
BDS	0.080 (0.08)		0.012 (0.010)		0.081 (0.08)		0.129 (0.016)	
within	0.267	0.247	0.218	0.191	0.321	0.277	0.347	**0.366**
BDS	0.024 (0.51)		0.052 (0.22)		0.09 (0.04)		0.049 (0.23)	
- NMS-10	0.078	0.071	0.060	0.030	0.133	0.145	0.102	0.174
BDS	-0.041 (0.48)		0.002 (0.54)		0.007 (0.73)		0.044 (0.29)	
- EU-15	0.331	0.300	0.287	0.253	0.380	0.311	0.410	0.419
BDS	0.079 (0.07)		0.044 (0.24)		0.140 (0.011)		-0.022 (0.79)	

Source: Own estimations from Eurostat (2011)
Note: the values in parenthesis are the probabilities of the bootstrap test

Overall, important distinctions and fundamental changes are displayed in the concentration patterns in the NMS-10 as well as in the EU-15 area, revealing different characteristics and maturity levels between their productive systems. More specifically,

[3] It is claimed that higher returns of scale through the agglomeration economies and their externalities are assured, mainly in capital-intensive industries (Krugman 1991). This happens as the net benefits of industrial concentration are disproportionately accrued by technology-intensive and innovative sectors (Henderson et al. 2001).

the market of the NMS-10 is in the incipient levels of being restructured based on deconcentration of the consumer sector and on the positive change of the concentration in the intermediate and especially the capital sector (that is higher than the corresponding value of the EU-15), which reveals a process of structural and spatial upheavals. On the contrary, due to the higher concentration values, the market and its manufacturing activity in the EU-15 are at a more mature level; they have benefited more from the agglomeration economies in all the manufacturing sectors and have reaped larger increasing returns of scale, especially in high-productivity industries. This outcome receives a larger weight under the study of Feldman (1999), which alleges that industries characterised by a high degree of concentration in an economy are likely to be the mature industries.

B. Industrial concentration trends at regional level

Table 3 shows the concentration index and its components (within and between) for the EU-15 and the NMS-10 at the *regional level* (in NUTSII regions) in the three broad manufacturing sectors covering the period 1995-2006. First, the values of concentration at the regional level are at higher levels than those at the country level (Table 2). This indicates greater employment mobility and, ultimately, a greater concentration of manufacturing activities in the space. Second, the sectors follow the same order by the size of their concentration index at the regional level, as well as at the country level. This implies that higher values of concentration can be found in the capital sector and lower values can be found in the consumer sector. Consequently, it seems that at both spatial scales, the capital-intensive industries are those that benefit more from the agglomeration economies, as they meet the criterion of concentration in their location. On the contrary, this criterion does not play a crucial role in the location of the labour-intensive industries, as their nature is characterised by low returns and small technological corporations, and thus does not imply the pay-off of a large scale of externalities' benefits.

Third, with regard to the evolution of the concentration index for the period 1995-2006, a decreasing route in all sectors is noted, implying a total deconcentration trend in all the categories of industries during the studied period. Fourth, the idiosyncratic nature of the EU-15 and the NMS-10 is verified by their two distinct concentration patterns. In the EU-15, the concentration index has been reduced in the manufacturing sector as a consequence of the corresponding decline in all the sub-sectors. Thus, although the capital-intensive industries display an augmented concentration trend at the national level, they reflect a propensity of deconcentration at the regional level.

As can be seen in Figure 1, the areas that obtain dynamism from the increase in the concentration of the capital sector are *perimetrical* of the traditional centre. In particular, the regions with a considerable concentration rise do not necessarily display high concentration levels, but they belong to countries with high concentration levels (south

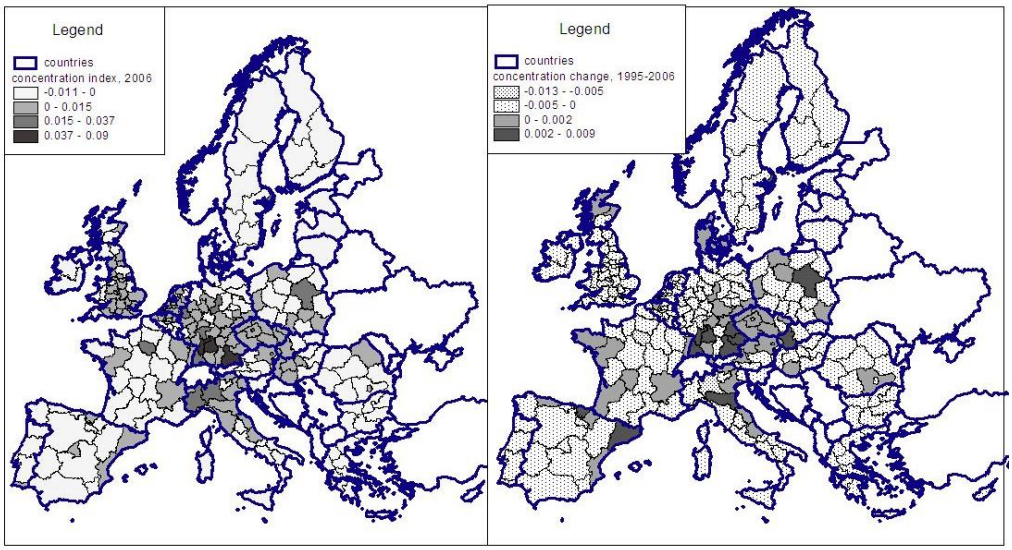
Germany, northeast Italy, west and east France, north United Kingdom). To a lesser degree, regions with a significant change of concentration are parts of countries with a non-significant level of concentration (northeast Spain). On the contrary, the NMS-10 experienced an increase in the concentration of capital-intensive industries, which was directed mainly toward the Czech Republic, Poland, Slovakia, and Slovenia[4].

Table 3. Topographic concentration of manufacturing and of its sub-sectors in the NUTSII regions of EU-25, 1995 and 2006 by the total (EU-25), between (NMS-10 and EU-15) and within (NMS-10, EU-15) components of the Theil index

	manufacturing		consumer		intermediate		capital	
	1995	*2006*	*1995*	*2006*	*1995*	*2006*	*1995*	*2006*
total	0.643	0.587	0.589	0.489	0.764	0.640	0.807	0.741
BDS	0.104 (0.02)		0.080 (0.05)		0.044 (0.26)		-0.130 (0.08)	
between	0.0001	0.002	0.007	0.003	0.001	0.006	0.005	0.010
BDS	0.080 (0.08)		0.101 (0.09)		0.081 (0.08)		0.129 (0.016)	
within	0.643	0.586	0.582	0.486	0.763	0.634	0.802	0.731
BDS	0.117 (0.014)		0.080 (0.06)		0.044 (0.25)		-0.09 (0.16)	
- NMS-10	0.266	0.246	0.210	0.199	0.364	0.343	0.436	0.453
BDS	-0.021 (0.79)		-0.081 (0.18)		-0.096 (0.13)		0.147 (0.03)	
- EU-15	0.765	0.701	0.751	0.606	0.865	0.708	0.890	0.807
BDS	0.122 (0.012)		0.098 (0.02)		0.053 (0.20)		-0.04 (0.53)	

Source: Own estimations from Eurostat (2011)
Note: the values in parenthesis are the probabilities of the bootstrap test

Figure 1. Concentration index (2006) and its change (1995-2006) of the capital sector in NUTSII regions of EU-25



Source: Own estimations from Eurostat (2011)

[4] The concentration change pattern is consistent with the study of Petrakos (2009), in which the analysis is based on a similar time period (1995-2005) and a similar regional level (NUTSII regions), and supports the increase of internal regional disparities within countries for all the NMS, while a decrease for a part of the EU15 (Germany, Italy, Spain, Portugal, Austria and Ireland).

Concisely, a salient inference of the analysis is the differentiated concentration patterns of the EU-15 and the NMS-10, which reflect an unequal degree of the evolution and the levels of maturity of their productive systems. On the one hand, the EU-15 economy is in a mature productive stage, as it has developed an advanced, capital-intensive productive system in which its industrial activities approach high levels of concentration and polarization. It also displays trends of deconcentration as a sign of an integrated economy. On the other hand, the concentration pattern in the NMS-10, although once influenced by the location behaviour of the consumer sector, seems to be now fundamentally formed by the behaviour of the capital sector, which increases its concentration at both the national and the regional levels while exhibiting a pure selective spatial behaviour toward central and more developed regions. Additionally, this form of productive restructuring that is realised in industries of increasing returns is assessed as the incipient stage of productive evolution and organization, whereas it is characterised more by a spatial dimension than by significant inter-industrial associations.

4. Determination of the concentration patterns and trends

A. The econometric specification

The preceding analysis showed the peculiarities of the industrial concentration patterns in the EU-15 and the NMS-10. These peculiarities include mixed trends of concentration and deconcentration reflecting their two different productive systems and levels of evolution and providing a strong motivation for further study. Within this line of thought, this section elaborates the concentration patterns by detecting the determinants of the industrial concentration and its change in the regions (NUTSII level) of the EU-25.

More specifically, the analysis will follow two directions: first, toward the detection of the determinants of the topographic concentration levels, so as to estimate the factors that play a significant role in the frontier regions having a high concentration, and second, toward the detection of the determinants of the topographic concentration change, so as to investigate the factors that contribute to high concentration increase. Furthermore, two points are highlighted for the detection of the driving forces of the concentration levels and changes. First, the degree of contribution of different factors will be investigated, with a focus on the concentration patterns espoused by the different (traditional and modern) trade theories. Second, the variables included in the econometric model define both industrial and spatial characteristics, with the intent of elucidating the nature of the patterns of concentration levels and changes. The hypothesis expected to be confirmed is that the concentration trends at the incipient levels of regional integration tend to be reinforced by capital and technologically driven forces and by pecuniary or technological externalities. On the contrary, the

concentration trends at high levels of integration tend to be weaker and/or to be partly reversed into diffusion tendencies.

The spatial level on which the concentration patterns will be analysed is the NUTSII level of the EU-25, whereas the time series of the database covers the period between 1995 and 2006. All data are sourced from Eurostat, except where otherwise indicated. Thus, the econometric model is based on panel data and is applied on the EU-25 (271 NUTSII regions for 11 years) as well as separately on the macro-regions of the EU-15 (215 NUTSII regions) and the NMS-10 (56 NUTSII regions), so as to reveal and then assess the different natures and evolutions of their productive systems. The necessity of identifying and analysing the concentration trends in the manufacturing sector separately to the areas of the EU-15 and the NMS is verified by the Chow test (1960). This determines whether a single regression is more efficient than two separate regressions that split the data into two sub-samples by testing whether all coefficients of each subgroup in the econometric model are jointly the same. The null hypothesis (that the coefficients for the two subgroups are equal) is rejected by the p-values[5].

The econometric model has the following form:

$$Y_{it} = \alpha_o + \sum_{j=1}^{n} (\alpha_j X_{jit}) + \varepsilon_{it},$$

where Y_{it} is the dependent variable of concentration, α_0 is the constant term, $\sum_{j=1}^{n} X_{jit}$ is a set of determinants, $\sum_{j=1}^{n} a_j$ is a set of estimators of determinants, $\varepsilon_{it} \sim N(0,\sigma^2)$ is the disturbance term (with a mean of 0 and constant variance), *i* denotes the regions in question, *j* denotes the independent variables 1-*n,* and *t* is the time period under study. Analytically, the econometric model for determining the concentration index takes the following form, with the consequent hypothetical predictions:

$$Y_{it}=a_0 + b_1CAPINT_{it} + b_2LABINT_{it} + b_3SCALE_{it} + b_4MAR_{it} + b_5PORTER_{it} + b_6JACOBS_{it} + b_7INV_{it} + b_8WAGE + b_9GRAV_{it} + b_{10}GDPCAP_{it} + b_{11}BORDER_{it} + e_{it} \quad (1)$$

The dependent variable for the first case (of detecting the determinants of the topographic concentration levels) takes the form of the *concentration level* estimated by the topographic Theil concentration index. For the second case (of detecting the determinants of the topographic concentration change), it takes the form of the *concentration change* estimated by the change in the topographic Theil concentration index (the definition and the merits of the Theil index are analysed in section 2).

[5] The results of the Chow test for the econometric model of concentration levels are F(11,2967): 2.012, p-value: 0.05. For the econometric model of concentration change the results are F(10,2961): 4.039, p-value: 0.00.

The independent variables are as follows:

The *capital-intensive industries* are represented by the variable CAPINT, which is estimated on the basis of the deviation of factor intensity in a region from the mean (Amiti 1997):

$$CAPINT_j = \left| \frac{\sum_i E_{ij}}{\sum_i VA_{ij}} - \frac{\sum_i \sum_j E_{ij}}{\sum_i \sum_j VA_{ij}} \right|,$$

where *j* denotes the region, *i* denotes the capital sector, *E* denotes employment, and VA denotes the value added. The consolidation of a globalised system contributed to a reinforced role of capital and technology (Rosecrance 1996), generating increasing returns that constitute the frontrunners of any economic transformation. Based on the preceding analysis, the concentration pattern is formed by forces that are driven by capital industries which are characterised by important increasing returns and an innovative nature. For this reason, the relation of the capital-intensive industries with the concentration index, as well as with the concentration change, is considered to be positive.

The *labour-intensive industries* have also been entered into the econometric model by the variable LABINT, which is estimated by the following equation:

$$LABINT_j = \left| \frac{\sum_i E_{ij}}{\sum_i VA_{ij}} - \frac{\sum_i \sum_j E_{ij}}{\sum_i \sum_j VA_{ij}} \right|,$$

where *j* denotes the region, *i* denotes the labour-intensive sector, *E* denotes employment, and VA denotes the value added. This variable is used with the intent to evaluate the allegation of the neoclassical theory on concentration trends in labour-intensive areas for the case of Europe. The high values of concentration in the consumer sector in the NMS-10 vis-à-vis the EU-15 specified in the analysis generate expectations for a positive correlation of the variable with the concentration for this area. Concerning the correlation of the variable with the concentration change, it is investigated whether the concentration change in a region is demonstrated by the movement of labour-intensive industries toward it. The preceding analysis underlined the fundamental changes in the NMS-10, which occurred through a considerable increase in concentration in the capital sector. Thus, a negative correlation between the concentration change and the labour-intensive industries for the NMS-10, as well as for the whole studied areas, is expected.

The *economies of scale* have received significant attention for their role in economic growth, first from Marshall (under perfect competition) and then from Krugman and the NEG theory (under non-perfect competition). This factor is included in the econometric model using the SCALE variable, which is the average firm size, and it is estimated using the ratio of employment to the number of enterprises (Amiti 1999):

$$SCALE_i = \frac{\sum_j E_{ij}}{\sum_j NF_{ij}},$$

where *i* is the country, *j* is the branch, *E* is employment, and *NF* is the number of units. In the econometric model, the existence of increasing returns to scale under the hypothesis of non-perfect competition is examined. In general, in the literature economies of scale are positively related to economic or productivity growth[6] (Fingleton and McCombie 1998), and thus their correlation with the concentration level is expected to be positive. Concerning the correlation of the variable with the concentration change, the sign of the estimator of the variable will indicate the participation of the scale economies to the rise in the concentration. The economies of scale seem to be oriented toward the core areas of the EU (Brülhart and Torstensson 1996), arguably because the nature of the variable is related to market size. This sets up the need to examine whether the deconcentration trend, that is, the concentration increase toward other regions, is conducted *inter alia* from economies of scale, and this would be reflected by a negative sign of the correlation.

The next three variables capture the dynamic externalities in an attempt to infer their contribution to the concentration trends. More specifically, using the terminology of Glaeser et al. (1992), there are three types of dynamic externalities: (a) the Marshall-Arrow-Romer (MAR) externalities that concern knowledge spillovers in an industry and indicate the degree of the partial specialisation of the region[7]; (b) the Porter externalities that indicate the degree of local competition in an industry; and (c) the Jacobs externalities that lie within the region and indicate the diversity of the industries in the region. The first two types of externalities are part of intra-industrial economies, underlining the benefits of specialised industries. The third type of externality is part of inter-industrial economies, supporting the fact that industries reap advantage through a highly industrially diversified area. Following Dekle (2002), the following variables have been introduced in the econometric model. The MAR variable is estimated using the following equation:

$$MAR = \frac{l_{ir} / l_r}{l_i / l},$$

[6] However, a smaller degree of contribution of this type of economy of scale (of internal economies of scale in relation to external economies of scale) to economic development has been detected (Brandt 2002).

[7] The notion of Marshallian externalities and the extent of sector-specific concentrations are conceptually distinctive with that of topographic concentration (dependent variable), as the first one reflects the uneven distribution of employment in sectors proportionally to the total employment, while the second one reflects the uneven distribution of employment in sectors in physical space (Brülhart and Traeger 2005). Therefore, a sector could have zero topographic concentration but positive relative concentration in the case that is perfectly evenly spread in physical space, or conversely zero relative concentration and positive topographic concentration in the case that is spread exactly proportionally to total employment/output.

where *i* denotes the sector, *r* denotes the region, l_{ir} denotes the employment share of sector *i* in region *r*, l_r denotes the employment share of total manufacturing in region *r*, l_l denotes the employment share of sector *i* in the whole area, and *l* denotes the total employment in the whole area. It has been widely acknowledged that knowledge is predominantly industry-specific and that these types of spillovers are known as 'specialisation' externalities. The Porter externalities variable (PORTER) is estimated by

$$PORTER = \frac{l_r / n_{ir}}{l / n_i},$$

where n_{ir} is the number of firms in sector *i* and region *r*, and n_i is the number of firms in sector *i* in the whole area. The Jacobs externalities variable (JACOBS) is estimated by the Herfindahl-Hirschman index:

$$JACOBS = \sum s_i^2 ,$$

where s_i is the employment share of sector *i* in manufacturing in a specific region. The Jacobs externalities are based on the diffusion of knowledge across different industries supporting the increasing returns of a diversified local production. This type of externality is characterised as a 'diversification' externality.

With regard to the 'specialisation' externalities, the benefits of a local monopoly with respect to Marshall externalities depend on the internalization of externalities, whereas in Porter externalities, the benefits of local competition are based on the boost of imitation and innovation. In that context, it seems that Porter externalities will be less developed in the NMS-10, as the countries in this group are in the initial stages of productive evolution. Therefore, the conditions of competitiveness do not seem to be well defined. On the contrary, the process of learning and knowledge diffusion among industries into agglomeration economies of any development level seems to be very important. As for Jacobs externalities, they are based on well-defined cooperation networks, a component that characterises markets that are not in the first stage of integration. Indeed, it has been empirically proven that diversification externalities are more pronounced for high-technology industries and metropolitan environments (Paci and Usai 1999), or are mostly closed with innovation in manufacturing (van der Panne 2004). Under this reasoning, Marshall externalities are expected to be more important and highly correlated with the concentration levels and changes in the NMS-10, whereas the benefits accrued on both the specialisation and the diversification externalities are expected to influence the EU-15.

The variable of *accumulated investments per employee in the manufacturing sector* (INV) is used in the econometric model with the intent of capturing the transformation degree of the manufacturing sector and its relation to the rise in concentration. More specifically, capital formation and accumulation contributes to non-capital resources, as

technology, labour, land, and the environment are gradually but surely transformed into new forms of capital. Thus, the capital accumulation generated by investments leads to the transformation of potential productive resources into capital of some kind[8] (Mayer 1996). In any case, the potential of capital accumulation is correlated positively with the concentration index and its change.

The variable of *wages* (WAGE) is introduced into the model to capture any (de)concentration trends that accrue because of the benefits of a low wage cost. It has been demonstrated in the literature that low labour cost could be a motive for the diffusion of industries under the precondition of low labour mobility, resulting in a non-monotonic relationship between the agglomeration economies and their integration (Puga 1999). Thus, areas that experience the deconcentration process (EU-15) are investigated to see whether they are motivated by a cheaper labour force (expecting a negative correlation), whereas areas that display a concentration trend (NMS-10) are expected to be correlated with high wage levels.

The *geographical position* also plays an important role in determining and defining spatial and productive dynamics that designate the patterns of firms' locations. This factor is represented by the geographic gravity index (GRAV) and is estimated using the following equation:

$$GRAV_i = \sum_{j=1}^{J} \left(\frac{GDP_j}{d_{ij}}\right) + GDP_i ,$$

where *i* denotes the region, *j* denotes the rest of the regions, GDP denotes the gross domestic product of the region in question, and *d* denotes the distance between regions *i* and *j*. This variable is an index of the centrality and accessibility of the space (Petrakos 2000), because it defines the position of each country according to geographical and economic considerations. In general, market accessibility is related positively to the concentration levels. However, the mixed concentration trends in the EU-25 (deconcentration in the EU-15 and concentration increase in the NMS-10) could allow for a different type of correlation with geography.

The relation of the *development level,* in particular the GDP per capita (GDPCAP), to the concentration was estimated. The correlation of the development index and the concentration levels is expected to be positive in all cases, as the development level and the level of concentration are considered as a cumulative and reinforced process (Krugman 1999). The correlation of the development index to the concentration increase is expected to be negative in those cases where a deconcentration process lies in regions of a lower development level (EU-15) and positive at the opposite end of the spectrum.

[8] Labour in one period becomes machinery in the next; skills are converted into human capital; inventions are copyrighted and privatised; new knowledge becomes intellectual property.

Moreover, whether the (de)concentration trends are correlated with the movement of activities from the metropolitan regions to the border regions is investigated. Borders, in particular, have been put in a state of flux because the re-allocation of activities, opportunities, and threats has changed the significance of the role of borders in the (European) socioeconomic map. For this reason, the dummy variable of *border regions* (BORDER) (the classification is by ESPON 2006) is included in the econometric model to determine whether these areas are affected by the eastward concentration trends or the westward deconcentration trends.

The relation between border areas and concentration levels is expected to be negative as a result of the initially spatial selective process towards the European core. However, studies (Hanson 1996) have suggested that integration contributes to the expansion of a border economy by a mobility of foreign firms toward the border areas. The EU-15 is characterised by a higher level of integration. Thus, border areas are expected to participate more in the economic expansion process, as they are significant receivers of economic activities, and therefore, correlate positively with the dependent variable. On the contrary, the productive systems in the NMS-10 have begun a process of 'exploration and exploitation' of new economic potentials, causing the metropolitan regions to be poles of attraction in economic activities – activities in which the border areas do not significantly participate.

B. The results of the econometric model

The model is estimated under the period weights estimation method, which is a variant of the panel corrected standard errors (PCSE) estimation method. The errors of any regression model may be non-spherical, a problem that is much more acute for time-series-cross-section (TSCS) models (Beck and Katz 1995). For this reason, a superior way to handle TSCS data is to estimate the ordinary least squares coefficients and to compute the PCSE (Petrakos et al. 2006). Moreover, it is likely that some independent variables and the concentration are to be jointly determined. For this reason, whether there is a correlation between the explanatory variables (X_{jit}) and the error term (ε_{it}) is examined, whereas the standard approach to testing each variable for non-stationarity over time is to be estimated by an augmented Dickey-Fuller regression (ADF). The conventional single-equation ADF test is based on the following regression equation:

$$\Delta X_{it} = \alpha_i + \beta_i X_{i,t-1} + \sum_{j=1}^{k} \theta_{ij} \Delta X_{i,t-j} + \varepsilon_{it},$$

where Δ is the first difference of the variable X_{it}, *i* is the country, *t* is the year, *k* is the number of lagged first differences, ε_{it} is a white-noise disturbance with a variance of σ^2, and *t* = 1, 2,…., T indexes time. The null hypothesis of $\beta_i = 0$ is based on the existence

of a unit root, whereas the alternative hypothesis of $\beta_i < 0$, if validated, will indicate that X_{it} is stationary. For the unit root test, the Levin-Lin-Chu (LLC) test, which is widely used for this purpose in the literature (Li and Liu, 2004), is conducted. Table 4 shows the results of the LLC test, based on which the null hypothesis of non-stationarity is not rejected for the independent variable of scale economies (SCALE). Moreover, the correlation of the variable with the residuals draws to the conclusion that the applied method is considered non-consistent and the results biased. For this reason a two-stage least squares method is employed with the selection of the instrumental variable of productivity in manufacturing (PROD), defined as the ratio of value added to employment in manufacturing. The instrumental variable is exogenous (uncorrelated with the error term), and it is correlated with the endogenous variable (SCALE) (Tables 5 and 6).

Table 4. Results based on the Levin, Lin and Chu test for pool regression models

	dependant: topographic concentration levels	*dependant:* topographic concentration change
Time-variant variables		
CAPINT	-6.58***	-6.27***
LABINT	-32.78***	-28.95***
SCALE	**3.66**	**3.74**
MAR	-15.12***	-10.13***
PORTER	-4.55***	-4.35***
JACOBS	-37.76***	-35.91***
INV	-36.17***	-43.32***
WAGE	-5.71***	-5.41***
GRAV	-17.41***	-14.82***
GDPCAP	-39.48***	-38.51***

**** statistically significant at the 1% level,*
*** statistically significant at the 5% level,*
** statistically significant at the 10% level*

I. The detection of the determinants of the concentration levels

The compilation and assessment of the econometric model on concentration levels leads to the following important inferences for the EU-25 (Table 5). First, both types of economies of scale (internal and external) as well as both specialisation (Marshall and Porter) and diversification (Jacobs) externalities generated by the external economies of scale appear as important factors of concentration. At this point it should be mentioned that the considerable influence of both diversity and specialisation on concentration does not constitute contradictory results; the two can coexist in an aggregated level of regions or industries. A series of meta-studies (Beaudry and Schiffauerova 2009; Melo et al. 2009) indicates that there has not been a clear picture of the contribution of each type of externality due to the levels of industrial and geographical aggregation or the

choice of the performance measures. This analysis confirms that the positive relation of both specialisation and diversification externalities to concentration is not an ambiguous result, as it is diversified when it is studied at different (disaggregated) macro-regions and production systems.

Second, the concentration is characterised as a capital-driven process, as there is evidence of a positive (negative) correlation of capital-intensive (labour-intensive) industries with the dependent variable. Third, factors of both the neoclassical theory (accumulation of investment) and the modern trade theory (scale economies, geography) seem to have a pivotal role in the concentration pattern. Finally, concerning the spatial dimension of the concentration pattern, a cumulation of manufacturing activity that favours central and more developed regions is revealed.

In an attempt to further elucidate the results of the econometric model an analysis is applied based on a more spatially disaggregated level. Within this line of thought and regarding the NMS-10, first, the internal economies of scale correlate negatively to the concentration, indicating the insignificance of their contribution to the concentration pattern. Second, benefits accrue from both the specialisation and diversification externalities generated by the diffusion of information (of Marshal and Jacobs externalities[9]), rather than by the competitiveness (Porter externalities). Third, the positive correlation of both the capital- and labour-intensive industries with the concentration levels is in concordance with the neoclassical theory, thus supporting the notion that the concentration pattern in the NMS-10 has been formed by an internal division of labour, in which high concentration values are found in regions of labour-intensive as well as capital-intensive industries. Additionally, weight is given to the assumptions of the neoclassical theory as regards the positive contribution of capital accumulation (through investments) to concentration. Finally, the spatial pattern of concentration seems to favour the central and developed regions, as the concentration level is correlated positively with the geographical gravity and the development level, and negatively with border regions.

Concerning the area of the EU-15, it seems that internal economies of scale and all types of dynamic externalities in the agglomeration economies are related to high concentration levels. The process is clearly capital-driven (a positive correlation of concentration to the capital-intensive industries and a negative one to the labour-intensive industries) and supported by investment capital. The spatial dimension of the concentration pattern is formulated by a core-periphery pattern (positive correlation of concentration to the development level and the gravity, and negative to the borders).

[9] However, during the last years of the period (namely 2004-06) the Jacobs' externalities are more important to the industrial concentration of the NMS-10, while the Marshall externalities are more important to the industrial concentration of the EU-15.

II. The detection of the determinants of concentration change

The detection of the determinants of concentration change is expected to reveal the characteristics of (de)concentration trends in relation to a series of factors of different nature and to different areas of dissimilar economic and productive systems. Additionally, the econometric analysis attempts to investigate whether the concentration change occurs in countries with high concentration levels (by the introduction of the dummy of national effect, NATEF, which takes the value of 1 for regions that belong to countries with high concentration levels and 0 in the opposite case). For the EU-25 (Table 6), the following points are emphasised: First, it seems that economies of scale do not participate in the process of concentration increase as they are correlated negatively with concentration change. On the contrary, the concentration increase seems to be triggered by the generated externalities of specialisation, the low wage levels, the significant presence of capital-intensive industries, and the capital accumulation emanating from investments. The spatial pattern of deconcentration seems to favour the borders, as a higher concentration rise is correlated positively with border regions and negatively with the gravity index. Furthermore, based on the positive relation of NATEF with the dependent variable, high concentration changes take place in those countries with already high concentration levels.

For the NMS-10 area, we conclude the following: First, the internal economies of scale do not have any positive contribution to the concentration process. Second, the externalities that have a significant role in industries' concentration seem to be those of specialisation (Marshall). The concentration increase is purely a capital-driven process. Thus, a drift in the intensity of the employment concentration from labour and capital toward only capital is observed. Therefore, the neoclassical assumption about a concentration's rise according to the abundant resources of each region seems to lose its ascendancy. Investment capital constitutes an important factor in concentration change. The wage does not seem to play any considerable role in the concentration trend. Eventually, as Krugman and Venables (1996) have suggested, part of the labour force may experience lower real wages during the adjustment process as the relocation of industry occurs. Furthermore, the concentration change pattern displays a more spatially selective behaviour as concentration change is related positively (negatively) with central (border) regions, while it is related in a U-curve form with the development level of the regions. Finally, any positive change in concentration seems to occur mainly in countries with initially higher concentration levels.

Table 5. TSLS estimates of the concentration levels, 1995-2006

Independents	Dependant: topographic concentration levels											
	EU-25				*NMS-10*				*EU-15*			
	(1)		(2)		(3)		(4)		(5)		(6)	
CAPINT			$1.40 \cdot 10^{-5}$	***			$8.14 \cdot 10^{-5}$	**			$2.17 \cdot 10^{-5}$	***
LABINT	-0.002	***	-0.007	***	0.007	***	0.012	***	-0.001	***	-0.0009	***
SCALE	$2.36 \cdot 10^{-6}$	*	$2.60 \cdot 10^{-5}$	***	$-1.64 \cdot 10^{-5}$	***	$-1.72 \cdot 10^{-5}$	***	$3.26 \cdot 10^{-6}$	**	$1.28 \cdot 10^{-5}$	**
MAR	0.0001	***	0.001	***	0.001		0.004	***	0.002	***	0.002	***
PORTER	0.0005	***	0.0003	***	-0.002		-0.0004	***	0.0005	***	0.0004	***
JACOBS	0.015	***	0.003	***	0.002	***	0.002	*	0.01	***	0.005	***
INV			$1.60 \cdot 10^{-11}$	***			$3.68 \cdot 10^{-12}$	**			$9.62 \cdot 10^{-12}$	***
WAGE	$1.36 \cdot 10^{-6}$	***			$4.77 \cdot 10^{-7}$	**		***	$1.04 \cdot 10^{-6}$	***		
GRAV	$8.89 \cdot 10^{-6}$	***	$9.49 \cdot 10^{-6}$	***	$6.88 \cdot 10^{-10}$	***	$3.32 \cdot 10^{-10}$	***	$9.61 \cdot 10^{-11}$	***	$3.63 \cdot 10^{-10}$	***
GDPCAP		***	$5.51 \cdot 10^{-5}$	***			$3.11 \cdot 10^{-6}$	***		***	$1.12 \cdot 10^{-6}$	*
BORDER	-0.001	***	-0.0007	***	-0.0003	***	-0.011	***	-0.001	***	-0.0001	***
R^2_{adj}	0.87		0.67		0.66		0.66		0.81		0.81	
F	2318.7		545.4		121.4		91.31		1065.7		946.9	
N	2978		2851		555		526		2411		2313	

**** statistically significant at the 1% level,*
*** statistically significant at the 5% level,*
** statistically significant at the 10% level*

Table 6. TSLS estimates of the concentration change, 1995-2006

Independents	Dependant: topographic concentration change											
	EU-25				*NMS-10*				*EU-15*			
	(1)		(2)		(3)		(4)		(5)		(6)	
CAPINT			$3.62 \cdot 10^{-7}$	*			$5.27 \cdot 10^{-5}$	***			$1.57 \cdot 10^{-6}$	***
LABINT	-0.0001	***	-0.0002	*	-0.001	***	-0.001	***	-0.0002	***	-0.0002	***
SCALE	$-1.50 \cdot 10^{-7}$	***	$-1.92 \cdot 10^{-7}$	***	$-3.67 \cdot 10^{-6}$	***	$-3.76 \cdot 10^{-6}$	***	$-1.63 \cdot 10^{-9}$		$-4.12 \cdot 10^{-7}$	
MAR	$8.94 \cdot 10^{-5}$	***	0.0001	***	0.0001	**	$8.34 \cdot 10^{-5}$	**	$9.05 \cdot 10^{-5}$	***	0.0001	***
PORTER	$2.58 \cdot 10^{-7}$		$3.14 \cdot 10^{-6}$		$-8.87 \cdot 10^{-5}$		$-2.48 \cdot 10^{-5}$		$1.86 \cdot 10^{-6}$		$6.96 \cdot 10^{-6}$	
JACOBS	$8.45 \cdot 10^{-5}$		$6.61 \cdot 10^{-5}$		-0.0004	***	-0.0005	***	$9.56 \cdot 10^{-5}$		$4.31 \cdot 10^{-5}$	
INV	$1.15 \cdot 10^{-8}$	*	$1.05 \cdot 10^{-7}$	**	$3.76 \cdot 10^{-7}$	***	$5.48 \cdot 10^{-7}$	***	$7.34 \cdot 10^{-8}$	***	$7.65 \cdot 10^{-8}$	
WAGE			-0.001	*			-0.04				-0.002	***
GRAV	$-7.86 \cdot 10^{-12}$	***			$1.06 \cdot 10^{-6}$	***			$-3.68 \cdot 10^{-12}$	***		
GDPCAP	$6.06 \cdot 10^{-6}$	***			$-4.40 \cdot 10^{-6}$	***			$7.29 \cdot 10^{-5}$	***		
$GDPCAP^2$	$-2.52 \cdot 10^{-8}$	***			$1.12 \cdot 10^{-8}$	*			$-2.61 \cdot 10^{-8}$	***		
BORDER	$3.65 \cdot 10^{-5}$	***	$3.14 \cdot 10^{-5}$	*	$-2.94 \cdot 10^{-5}$	*	$-3.00 \cdot 10^{-5}$	*	$4.39 \cdot 10^{-5}$	***	$2.82 \cdot 10^{-5}$	
NATEF	0.0001	***	0.0001	***	$5.61 \cdot 10^{-6}$	***	$2.93 \cdot 10^{-5}$	***	0.0001		$7.65 \cdot 10^{-8}$	
TIME	$-3.34 \cdot 10^{-5}$	**	$-7.27 \cdot 10^{-5}$	***	-0.0002	**	-0.0001	**	$5.26 \cdot 10^{-5}$		$3.98 \cdot 10^{-5}$	
R^2_{adj}	0.21		0.18		0.24		0.20		0.16		0.16	
F	46.5		35.8		18.24		12.04		39.5		40.7	
N	2756		2657		471		485		2172		2172	

**** statistically significant at the 1% level,*
*** statistically significant at the 5% level,*
** statistically significant at the 10% level*

In the EU-15, some significant distinctions are noticed between the patterns of concentration levels and concentration changes. First, the internal economies of scale are correlated negatively with the concentration change. This relation underpins the view about the deconcentration of activities from the traditional core, although its significance is not statistically important. All the kinds of dynamic externalities included in the econometric model (Marshall, Porter, and Jacobs) display a positive correlation with the concentration change, but only the Marshall type is statistically significant. The pattern of concentration change (similar to that of concentration levels) is a capital-driven process, as the concentration rise is magnified in regions with capital-intensive industries and important investment capital. However, it is triggered by the low labour cost. Finally, the spatial characteristics of the concentration change pattern verify the vigour of the deconcentration trend toward areas of a lower development level (by a negative relation of development level with the concentration change), and the reinforced role of border areas (by a positive relation with the concentration change). An equally important point is that any concentration increase takes place in countries with initially already high concentration levels.

Conclusions

The analysis and assessment of the concentration patterns in EU regions reveals contradictory elements in the two different economic systems of the EU-15 and the NMS-10. In the EU-15, a deconcentration process occurred, whereas in the NMS-10, the concentration process received a reinforced role. Both phenomena are characterised by a spatial dimension and a sectoral one, which econometric approaches studying the concentration levels and changes attempt to elucidate.

Therefore, further discourse concerning these concentration issues shows that the EU-15 is characterised by a more integrated economic system and a productive organization settled in a mature stage. This is corroborated by the concentration of manufacturing, and especially by the capital sector, which has reached a satisfactory level of reaping the benefits of internal and external economies of scale. The benefits that have been obtained by the agglomeration economies accrue to all types of dynamic externalities, namely, specialisation, competitiveness, and diversification as they concern different regions, sectors, or time periods. The spatial effects of this industrial distribution have formed a core-periphery pattern, with the most central, developed, and high-wage areas having concentrated high levels of manufacturing activity.

However, the trends illustrated by the concentration change reveal signs of a differentiated industrial pattern that weakens the centripetal forces. Thus, a deconcentration process is conducted, which is grounded on the relocation of high technology and increasing-returns industries to areas outside of the traditional core, to

regions with abundant low-cost labour, and to border regions. This tendency is concomitant with an adequate level of production integration and maturity, in which superior segments of manufacturing move inside the broader developed area, that is, towards the peripheral regions of leading countries, the 'central border' regions. The cause of the deconcentration process is assessed to be *inter alia* the low wage cost. The regions having cheaper labour and a low labour mobility seem to display a new dynamic profile. A second cause is seen in the contribution of specialisation-type externalities (Marshall and Porter) to the concentration change. It seems that knowledge spillovers based on know-how and innovation influence the concentration pattern by giving to recipient regions a competitive advantage. Finally, the significant role of border regions in the concentration rise indicates the agglomeration of industries with important buyer/supplier relationships. Thus, the diffusion of the activities from the core toward the periphery seems to be confirmed *internally* in dominant countries, as an economic mobility to the border and less developed regions has been observed.

The study of the concentration pattern of the NMS-10 separately from that of the EU-15 demonstrates the very different natures and levels of maturity in each economic and productive system. The industrial concentration in the NMS-10 is conducted by externalities of specialisation and diversification. High levels of concentration seem to have been generated by both labour- and capital-intensive industries. Stylised facts have underlined the deviated productive structure of the NMS-10, which seems to have followed the broader division of labour based, first, on a West-East EU division and, second, on an internal central-southwest division of capital- and labour-intensive manufacturing activity. The concentration levels are undoubtedly low, indicating the limited ability of these economies to reap the benefits of the generated externalities. Furthermore, clusters that denote the *spatial* correlation of agglomeration economies have been defined in this area, but only in the consumer sector, indicating the need of firms to develop intra-industry linkages in light industry. The spatial dimension of this concentration pattern favours the metropolitan, more developed, and higher-wage areas.

The trends revealed from the concentration change reinforce this pattern. The manufacturing sector and most of the capital sector display an augmented concentration change, indicating the predisposition of the economy of the NMS-10 to exploit the agglomeration economies and reap the generated benefits. However, this inclination is produced by specialisation-type externalities (Marshal), as the economic environment is not able yet to develop strong competitive or diversified productive structures. The spatial effects of the industrial mobility intensify the core-periphery pattern, which favours the central and most developed regions.

Briefly, the concentration trends configure the characteristics of two deviated productive systems and reveal two different levels of maturity, implying the existence of a non-monotonic relation between concentration and integration as the New Economic

Geography claims. The EU-15 constitutes a deeper integrated economy with a more mature productive system in which the more advanced countries display a tendency to damp spatial asymmetries with a deconcentration of economic activity towards peripheral regions. On the contrary, the NMS-10 experiences the incipient stages of the formation of a globalised concentration pattern, as it is at a lower maturity level of economic evolution and it is restructuring its productive and spatial organization by an intensification of the core-periphery pattern.

This kind of relation generates expectations for the existence of a similar (non-monotonic) relation between concentration and regional disparities according to the regional Kuznets Curve hypothesis implying the prospects for a decrease of regional inequalities in the EU-15 but an increase in the NMS. However, the integration process and the manufacturing transformation nowadays experience serious disruptions by the global economic crisis, which could lead to the reconfiguration of the manufacturing scene and the invalidation of any previous expectations.

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Bibliography

AIGINGER, K. (2000), Specialisation of European Manufacturing, *Austrian Economic Quarterly*, WIFO, vol. 5(2), pages 81-92.

AIGINGER, K. and DAVIES, S. (2004), Industrial specialization and geographic concentration: two sides of the same coin? Not for the European Union, *Journal of Applied Economics*, vol. 7, no. 2, pp. 231–248.

AIGINGER, K. and PFAFFERMAYR, M. (2004), The Single Market and Geographic Concentration, *Review of International Economics*, Vol. 12, pp. 1-11, February.

AMITI, M. (1997), Specialization patterns in Europe, *CEP Discussion paper*, No 363.

AMITI, M. (1998), New trade theories and industrial location in the EU: a survey of evidence, *Oxford Review of Economic Policy*, vol.14, No 2.

AMITI, M. (1999), Specialization patterns in Europe, *Review of World Economics*, pp.573-593.

ANSELIN, L. (1995), Local Indicators of Spatial Association – LISA, *Geographical Analysis* 27: 93-115.

ARBIA, G. (2001), The role of spatial effects in the empirical analysis of regional concentration, *Journal of Geographical Systems* 3: 271-281.

BALDWIN, R. and MARTIN, P. (2004), Agglomeration and regional growth, Handbook of Regional and Urban Economics, in J. V. HENDERSON & J. F. THISSE (eds), *Handbook of Regional and Urban Economics*, edition 1, vol. 4, chapter 60, Elsevier, pp. 2671-2711.

BARKER, R. (2010), *Corporate governance, competition and political parties*. Oxford University Press.

BARRIOS, S. and STROBL, E. (2004), Industry mobility and geographic concentration in the European Union, *Economics Letters*, 82, 71-75.

BEAUDRY, C. and SCHIFFAUEROVA, A. (2009), Who's right, Marshall or Jacobs? The localization versus urbanization debate, *Research Policy*, 38, 318-337.

BECK, N. and KATZ, J. (1995), What to do (and not to do) with time-series cross-section data, *The American Political Science Review*, vol. 89, No. 3, pp. 634-647.

BRANDT, N. (2002), Mark-Ups, Economies of Scale and the Role of Knowledge Spillovers in OECD Industries, *European Economic Review*, 2007.

BROCK, W.A., DECHERT W.D. and SCHEINKMAN J.A. (1987), A Test for Independence Based on the Correlation Dimension, *Journal of Econometrics*, 82, 157-192.

BRÜLHART, M. (1995), Industrial specialization in the European Union: a test of the new trade theory, *paper*, vol. 5, *Trinity Economic Paper Series*, Trinity College, Dublin.

BRÜLHART, M. (1998), Economic geography, industry location and trade: the evidence, *World Economy*, vol. 21.

BRÜLHART, M. and TORSTENSSON, J. (1996), Regional integration, scale economies and industry location in the European Union, *discussion paper*, CEPR, No 1435.

BRÜLHART, M. and TRAEGER, R. (2005), An account of geographic concentration patterns in Europe, *Regional Science and Urban Economics*, Elsevier, vol. 35(6), pages 597-624, November.

CHOW, G. (1960), Tests of Equality Between Sets of Coefficients in Two Linear Regressions, *Econometrica* 28 (3): 591–605.

COMBES, P. and OVERMAN, H. (2003), The spatial distribution of economic activities in the European Union, in HENDERSON and THISSE (eds), *Urban and Regional Economics*. vol. 4.

DE GROOT, H. L. F., J. POOT, J. and M.J. SMIT (2009), Agglomeration externalities, innovation and regional growth: theoretical perspectives and meta-analysis, in P. NIJKAMP and R. CAPELLO (eds), *Handbook of regional growth and development theories*, Edward Elgar, 256-281.

DECKLE, R. (2002), Industrial concentration and regional growth: evidence from the prefectures, *The Review of Economics and Statistics*, 84(2): 310-315.

ELLISON, G., GLAESER, E. L. (1997), Geographic Concentration in U.S. Manufacturing Industries: a Dartboard Approach, *Journal of Political Economy*, 105(3), pp. 889-928.

ESPON (2006), *ESPON project indicators*, Available http://www.espon.eu.

EUROSTAT (2011), *Statistics*. Available http://epp.eurostat.ec.europa.eu/

EZCURRA, R., PASCUAL, P. and RAPÚN, M. (2006), Regional specialization in the European Union, *Regional Studies*, vol. 40 , pp. 601-616.

FELDMAN, M. (1999), The New Economics of Innovation, Spillovers and agglomeration: A review of Empirical Studies, *Economics of Innovation and New Technology*, 8-1, pp.5-25.

FINGLETON, B and MCCOMBIE, L. (1998), Increasing Returns and Economic Growth: Some Evidence for Manufacturing from the European Union Regions, *Oxford Economic Papers*, vol. 50(1), pp. 89-105.

FUJITA, M., KRUGMAN, P. and VENABLES, A. (1999), *The spatial economy: cities, regions and international trade*, MIT Press.

GLAESER, E., KALLAL, H., SCHEINKMAN, J. and SHLEIFER, A. (1992), Growth in cities, *Journal of Political Economy*, 100(6), pp.1126-1152.

HANSON, G. (1996), Economic integration, intra-industry trade and frontier regions, *European Economic Review*, 40, pp. 941-949.

HELPMAN, E. and KRUGMAN, P. (1985), *Trade Policy and Market Structure*. MIT Press.

HENDERSON, V., SHALIZI, Z., VENABLES, A. (2001), Geography and development, *Journal of Economic Geography* 1(1), 81– 105.

KRUGMAN, P. (1980), Scale economies, product differentiation and the pattern of trade, *American Economic Review*, vol. 70, pp. 950–959.

KRUGMAN, P. (1991), *Geography and Trade*. Cambridge: MIT Press.

KRUGMAN, P. (1993), First nature, second nature, and metropolitan location, *Journal of Regional Science*, vol.33, No.2, pp.129-144.

KRUGMAN, P. (1999), The role of geography in development, *International Regional Science Review*, 22(2), pp. 142-161.

KRUGMAN, P. and VENABLES, A. (1996), Integration, specialization and adjustment, *European Economic Review*, vol. 40, pp. 959-967.

LI, X. and LIU, X. (2004), Foreign Direct Investment and economic growth: an increasingly endogenous relationship, *World Development*, 33(3), 393-407.

MAYER, J. (1996), Implications of new trade and endogenous growth theories for diversification policies of commodity-dependent countries, *discussion paper,* No 122, UNCTAD.

MIDELFART-KNARVIK, K.H., OVERMAN, H., REDDING, S. and VENABLES A. (2002), The location of European industry, In European Commission Office for Official Publications of the European Commission, *European Economy Special Report No2.* Brussels: European Commission, Directorate-General for Financial Affairs.

MELO, P., GRAHAM, D. J. and NOLAND R. B. (2009), A meta-analysis of estimates of urban agglomeration economies, *Regional Science and Urban Economics*, 39(3), pp. 332-342.

MOLLE, W. (1997), The economics of European integration: Theory, practice, policy, in: PESCHEL, K. (ed.) *Regional growth and regional policy within the framework of European integration*. Physica Verlag, Heidelberg, pp. 66-86.

OTTAVIANO, G. (2002), Regional policy in the global economy: insights from New Economic Geography, *discussion paper*, No 211, HWWA.

PACI, R. and USAI, S. (1999), Externalities, knowledge spillovers and the spatial distribution of innovation, *Geojournal*, 49: 381-390.

PETRAKOS, G. (2000), The new geography of development and the position of Balkans, in: G. PETRAKOS (ed), *The Development of Balkans*. Volos: University Press.

PETRAKOS, G. (2009), Regional growth and inequalities in the European Union, *discussion paper*, 15(2), pp. 23-44, University of Thessaly, Department of Planning and Regional Development.

PETRAKOS, G., FOTOPOULOS, G. and KALLIORAS, D. (2006), Peripherality and Integration: Industrial Growth and Decline in the Greek Regions, *paper presented in ERSA conference*.

PETRAKOS, G. and TSIAPA, M. (2000), The evolution and structure of industry, in: G. PETRAKOS (ed), *The Development of Balkans*. Volos: University Press.

PUGA, D. and VENABLES, A. (1996), The spread of industry: spatial agglomeration in economic development, *Journal of the Japanese and International Economies*, Vol 10, No 25, p. 440-464.

PUGA, D. (1999), The rise and fall of regional inequalities, *European Economic Review*, 43, pp. 303-334.

ROSECRANCE, R. (1996), The rise of virtual state, *Foreign Affairs*, 47(1), pp.45-61.

THEIL, H. (1967), *Economics and Information Theory: Studies in Mathematical and Managerial Economics*. Skokie: Rand McNally.

TSIAPA, M. (2008), Asymmetries, dynamics and perspectives of industrial and spatial development systems of European space and especially its south and east area, *PhD dissertation*, Department of Planning and Regional Development, University of Thessaly.

TSIAPA, M. (2010), Concentration patterns in different sectors of economic activity in regions of EU-27: signs of partial de-centralization?, *discussion paper*, 16(2), pp. 13-42, University of Thessaly, Department of Planning and Regional Development.

VAN DER PANNE, G. (2004), Agglomeration externalities: Marshall versus Jacobs, *Journal of Evolutionary Economics*, No 14, pp.593-604.

VENABLES, A. (1998), The assessment: trade and location, *Oxford Review of Economic Policy*, vol.14.

WILLIAMSON, G. (1965), 'Regional Inequality and the Process of National Development,' *Economic Development and Cultural Change*, 13, 3-45.