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Structural Convergence of the National Economies of Europe

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Abstract

Analysis of convergence has centered on movement of indices such as per capita incomes or welfare for countries or regions within countries. In this paper, the analysis focuses on the structure of economies in terms of the distribution of production across sectors and explores the implications of convergence of structure for a subset of EU countries. To assist in the exploration, some new methodology is introduced, based on the notion of a field of influence of change. A set of sensitivity indices and an associated importance matrix are constructed for a set of intercountry input-output tables. The results find that sectors at the European level are become more similar than the national economies as a whole.

1. Introduction

Traditional economic theory is rather clear on how economies specialize when they become more integrated. Trade theory suggests that economies specialize according to their comparative advantages due to technology (Ricardo) or factor endowments (Hecksher-Ohlin). However, these basic theories do not provide explanation for the concentration of activities nor the increasing intra-industry trade, at the expense of inter-industry trade, , that takes place between very similar economies, such as those of the European Union members. As an alternative to traditional theory, Marshall (1890) and Perroux (1950) introduced the logic of agglomeration. They consider that concentration of activity in one place increases the incentive for other firms to locate there so that they benefit from the external economies (mainly technological externalities) associated with agglomeration.

New economic geography theories propose that the location of production depends on the relative strength of centrifugal forces (congestion costs, factor price differences, among others) and centripetal/agglomeration forces: as transaction costs increase with distance, firms concentrate in a region with a larger market and close to supply of production factors and intermediary goods. Hence, concentrated firms benefit from greater pecuniary externalities, technological externalities and increasing returns to a greater extent than isolated firms (Krugman, 1991; Krugman and Venables, 1995; Venables, 1996; Fujita *et al*., 1999). As soon as an agglomeration (such as a metropolitan-centered region) becomes important, centripetal forces are self-sustained above a certain threshold. According to this approach, increasing returns and decreasing transportation costs are the key elements at the origin of uneven spatial distribution of activity and development.

In the European case, greater integration has reduced transaction costs and intensified trade relationships. Therefore, a shock that would hit a certain region or country will be passed on to all other regions and countries much more quickly than before because of increasing backward and forward trade linkages. This could contribute to a synchronisation of regional business cycles within EMU (Krieger-Boden, 2002; Frankel and Rose, 1998).

In addition, the production structure of isEU member countries is becoming more similar, reflected by a growing dominance of intraindustry trade (indicating diversification) as opposed to interindustry trade (specialization). Jones and Kiezkowski (1990, 2001) would argue that this phenomenon is a result of the fragmentation of production, whereby the value chain of production is broken down into a larger set of tasks, many of which are sequentially performed in different locations. A general framework for analyzing fragmentation was presented for the first time by Jones and Kierzkowski (1990), in which they state that production blocks can be connected by service links. Arndt and Kierzkowski (2000) further noted that fragmented production need not be performed in close spatial proximity, while Jones and Kierzkowski (2001) suggest that the process of fragmentation is emerging as one of the dominant new patterns of production process in the world economy. Hummels and Levinsohn (1993) and Hummels *et al* (1998) formalized these processes into the notion of vertical specialization of production whereby different stages in the commodity chain of production would be performed in different locations, in many cases different countries. Hence, interregional trade is increasingly based on an intra-industry trade with vertical differentiation (by quality) at the expense of horizontal differentiation (by variety) of products (Maurel *et al.*, 1999). Differences in goods quality result from differences in factor composition and from comparative advantages due to previous investments in human capital and R&D, to regional size and limited technological externalities over space. These comparative advantages are dynamic. The rich countries/regions tend to specialize in high quality goods, because their higher development and income allow them greater efforts in human capital, R&D and technological externalities, whereas peripheral and poor countries/regions tend to specialize in lower quality goods.

In this paper, the focus will be on the development of a framework to explore the role of national structural changes in the promotion of convergence tendencies within the EU. The framework thus focuses on structural interdependencies in a way that prior analysis has not. The next section is devoted to exploring changes in the production structure of the European economies. The model we use to evaluate the structural convergence process is described in section 3. The forth section presents empirical evidence whilst in section 5 there are some concluding remarks.

2. Exploratory analysis of structural change in the EU economies

This section aims at providing some insights into the evolution of the productive structure of the European economies. We focus on 5 countries (Germany, France, Italy, The Netherlands, and Belgium) since the I/O tables that will be used in the rest of the analysis concern these countries only. In this section, we use data from the Cambridge Econometrics database; they cover the 1975-2002 period and 5 sectors (Agriculture, Energy and Manufacturing, Construction, Non-market services, Market services) which are slightly different from the ones used in the following sections. Indeed, in section 4, energy and manufacturing are two different sectors.

To examine the extent to which the production structure has become more similar across countries, we introduce an index of inequality in productive structure based on the one of Cuadrado-Roura *et al*. (1999) as follows:

(1) $$I=\sum_{i=1}^{5}\left[\left(WA_{it}-WA_{t}\right)^{2}+\left(WEM_{it}-WEM_{t}\right)^{2}+\left(WC_{it}-WC_{t}\right)^{2}+\left(WENMS_{it}-WENMS_{t}\right)^{2}+\left(WMS_{it}-WMS_{t}\right)^{2}\right]$$

where $WA_{it}, WEM_{it}, WC_{it}, WNMS_{it}, WMS_{it}$ denote, respectively, the weight of agriculture, energy&manufacturing, construction, non-market services and market services in total Gross Value

Added in country i at time t; and $WA_t, WEM_t, WS_t, WNMS_t, WMS_t$ are the corresponding sectoral weights at the European level (EU-5). The value of this index would be zero if the productive structures were the same across all the countries.

<<Figure 1>>

This index is represented in figure 1 above and shows that, in terms of GVA, the productive structure of the studied countries has become more uniform over time. This index can be divided into the sum of inequalities in productive structure by sector as follows:

(2) $$IDA = \sum_{i=1}^{5} \left(WA_{it} - WA_t \right)^2$$

(3) $$IDEM = \sum_{i=1}^{5} \left(WEM_{it} - WEM_t \right)^2$$

(4) $$IDC = \sum_{i=1}^{5} \left(WC_{it} - WC_t \right)^2$$

(5) $$IDNMS = \sum_{i=1}^{5} \left(WNMS_{it} - WNMS_t \right)^2$$

(6) $$IDMS = \sum_{i=1}^{5} \left(WMS_{it} - WMS_t \right)^2$$

<<Figure 2>>

These indices are represented in figure 2. It shows that the reason for the greater homogeneity in productive structures comes mainly from an harmonization of market services and energy&manufacturing structures among countries. However, the homogenization process acts in opposite directions in both sectors. Countries that had a high weight of the energy&manufacturing

sector in total GVA at the initial period (Germany, France, the Netherlands) have experienced a decrease of this sector's weight (respectively by 24%, 21% and 20%) . Indeed, there has been a transfer of resources from this sector towards more productive sectors that has been more marked in these countries than in others. The more productive sector that has increased its weight in total GVA is the market services sector. Its weight has increased in all the studied countries (France:21.2%, Belgium:3.3%, Holland:18.9%, Italy:16.7%), but mostly in Germany (+40%). Germany and France were the two countries with the smallest initial weight of this sector in their economy (respectively 38 and 44%).

Changes in the productive structure do not seem to come from the non-market services, agricultural or construction sector, of which index of inequality is small and pretty flat over the whole period.

3. Analyzing structural change through key sectors identification

In the present paper we analyze the well-known static Leontief input-output model defined as:

$$\mathbf{x} = \mathbf{Ax} + \mathbf{f} \tag{7}$$

where **x** is the output vector, **A** the matrix of input coefficients representing technology, and **f** is the endogenous final demand vector. The expression in (7) can be rewritten as:

$$\mathbf{x} = (\mathbf{I}\text{-}\mathbf{A})^{-1}\mathbf{f} = \mathbf{Bf} \tag{8}$$

where **B** is the Leontief inverse. As in the present paper we are interested in using the EC intercountry input-output tables, it should be noted that the matrix **A** in the case of *n* regions is

$$\mathbf{A} = \begin{bmatrix} A_{11} & A_{12} & \cdots & A_{1n} \\ A_{21} & A_{22} & & \vdots \\ \vdots & & & \vdots \\ A_{n1} & A_{n2} & \cdots & A_{nn} \end{bmatrix}$$

and the corresponding Leontief inverse is

$$\mathbf{B} = \begin{bmatrix} B_{11}^{n} & B_{12}^{n} & \cdots & B_{1n}^{n} \\ B_{21}^{n} & & & \vdots \\ \vdots & & & \vdots \\ B_{n1}^{n} & B_{n2}^{n} & \cdots & B_{nn}^{n} \end{bmatrix}$$

One of the main tasks in recent years has been the attempt to capture the influence of changes in technology through the methodology of *field of influence*, developed in order to guide the updating procedure of I-O tables (Sonis and Hewings, 1989) and to identify the key sectors of the economy (Cuello *et al*., 1992; Sonis and Hewings, 1992; Sonis *et al*., 1999). The field of influence can be considered as a mapping of a specific change into its system-wide impact, where the system can be a single economy or, in the case of the EU, a set of interdependent economies.

In particular, if a change e occurs in the element a_{ij} of the matrix **A**, then the components of the new Leontief-inverse matrix $\mathbf{B}(\mathrm{e}) = \left\| b_{ij}(e) \right\|$ can be calculated through the Sherman-Morrison (1959) formula:

(9) $$b_{ij}(e) = b_{ij} + \frac{b_{ii_0} b_{jj_0} e}{1 - b_{j_0 j_0} e}$$

Following Sonis and Hewings (1989), the direct field of influence $\mathbf{F}[i, j]$ of e_{ij} can be calculated as:

$$\mathbf{F}[i,j] = \begin{bmatrix} b_{1i} \\ b_{2i} \\ \vdots \\ b_{ni} \end{bmatrix} \begin{bmatrix} b_{j1} & b_{j2} & \dots & b_{jn} \end{bmatrix} \tag{10}$$

The previous formula states that if the Leontief inverse reflects the economic landscapes of links between industries, then equation (10) provides a landscape generated by change in one or more elements of the original matrix **A**. Then, equation (9) can be rewritten as:

$$\mathbf{B}(e) = \mathbf{B} + \frac{e}{1 - b_{ji}e}\mathbf{F}[i, j]$$

The matrix $\mathbf{F}[i, j]$ should be interpreted as the sensitivity of the Leontief inverse to a point technological change.[1]

Next, drawing on the use of Monte Carlo simulation in exploring uncertainty in input-output systems, we use an alternative procedure to run sensitivity analysis, as proposed in Percoco (2003). Let us write (7) as

$$\mathbf{x} = f(b_{1i}, ..., b_{ij}, ..., b_{nn})$$

[1] In Sonis and Hewings (1995) an extension to the technological change in one sector is presented and the column field of influence as well. In addition, van der Linden et al. (2000) provide an application of the methodology to the EU Intercountry I-O tables.

where the generic elements b_{ij} is supposed to be affected by uncertainty[2]. If we fix $b_{ij} = \bar{b}_{ij}$, then the variance of sector x_i is:

(11)
$$V\left(x_i \middle| b_{ij} = \bar{b}_{ij}\right) = \int \ldots \int \left[f(b_{i1},\ldots,\bar{b}_{ij},\ldots b_{in}) - E\left(x_i \middle| b_{ij} = \bar{b}_{ij}\right)\right]^2 \prod_{i \neq j} p_i(b_i) db_i =$$
$$= \int \ldots \int f\left(b_{i1},\ldots,b_{in}\right) \prod_{i \neq j} p_i(b_i) db_i - E\left[x_i \middle| b_{ij} = \bar{b}_{ij}\right]^2$$

In order to carry out sensitivity analysis, we are interested in integrating V over the probability density function of $\bar{b}_{ij}$:

(12)
$$E\left[V\left(x \middle| b_{ij}\right)\right] = \int \ldots \int \left[b_{i1},\ldots,b_{ij},\ldots,b_{in}\right]^2 \prod_i p_i(b_i) db_i - \int \left[E\left(x_i \middle| b_{ij} = \bar{b}_{ij}\right)\right] p_j(\bar{b}_{ij}) d\bar{b}_{ij}$$

Let us define the variance of x_i as:

(13)
$$V\left(x_i\right) = \int \ldots \int \left[f(b_{i1},\ldots,b_{ij},\ldots b_{in})\right]^2 \prod_i p_i(b_i) db_i - \left[E(x_i)\right]^2$$

By subtracting (12) from (13) we have:

(14)
$$V(x_i) - E\left[V\left(x_i \middle| b_{ij}\right)\right] = \int \left[E\left(x_i \middle| b_{ij} = \bar{b}_{ij}\right)\right]^2 p_j(\bar{b}_{ij}) d\bar{b}_{ij} - \left[E(x_i)\right]$$

[2] For a review of the arguments of the different tyoes of uncertainty in I-O model, see Bullard and Sebald (1977), Jackson (1987) and Jackson and West (1989).

By adopting the classical ANOVA decomposition $V(x_i) - E\left[V\left(x_i \middle| b_{ij}\right)\right] = V\left[E\left(x_i \middle| b_{ij}\right)\right]$ and dividing it by the unconditional variance, we have the what may be termed the *Sensitivity Index* of the ij^{th} element of the Leontief inverse:

$$(15) \qquad S_{ij} = \frac{V\left[E\left(x_i \middle| b_{ij}\right)\right]}{V(x_i)}$$

with $S_{ij} \in [0,1]$.

Following Percoco (2003), the ordered set of the sensitivity indices are defined as the *Importance Matrix* $\mathbf{S}_{nxn}$. This matrix measures the importance of technical coefficients in order to explain the variance of the output of the economy. In particular, the reacting sectors (i.e. the ones affected by a change in the technical coefficient b_{ij}) are on the columns, whilst the activating sectors (i.e. the ones whose technological change is meant to generate volatility of the reacting sectors) are on the rows. The generic element S_{ij} = $[s]_{ij} \in \mathbf{S}$ measures the effect on the output of the economy of the sector *I* of a change in the technology of sector *j*. The methodology will now be applied to the EU countries to explore a new perspective on convergence.

4. Convergence in EU countries through I-O models

The convergence process in Europe has resulted in a reduction of income disparities between nations over the time. Three of the four cohesion countries (i.e. capita with GNP was below 90% of the EU average), Ireland, Spain and Portugal, have succeeded in converging to the European average since the date of their membership; only Greece is not converging (Dall'erba and Hewings, 2003). However, the results are less optimistic at the regional level; for more than two decades, numerous poor regions, with a per capita GDP below 75% of the European average (objective 1 regions) and mostly located in periphery, did not succeed in catching-up the core and rich regions (Le Gallo and Ertur, 2003 ; Le Gallo and Dall'erba, 2003). In addition, various studies indicate that regional disparities within countries have tended to increase (Esteban, 1994; Neven and Gouyette, 1995; Quah, 1996; Martin, 1999). For instance, the catching-up of Spain mainly benefited its two richest regions (Madrid and Cataluña) but at the expense of increasing the gap with the other regions within the country; in contrast, the growth in its two poorest regions (Extremadura and Andalusia) has been low. The increase in regional inequalities is not a phenomenon specific to the poorer countries. Regional disparities have increased in almost all the European countries, but at different rates. Italy is the country where they are the greatest; the Mezzogiorno has failed to catch up with the dynamic and developed regions of the north-eastern part of the country. In France, Ile-de-France maintains its great distance from the other French regions. In the UK, regional inequalities seem to have declined, but this result is due to the decline of manufacturing industry in almost all the regions of the country. Regional disparities have decreased only in Germany, the Netherlands and Belgium.

The aim of this section is to use the model described in the previous section to demonstrate that even if we do not have convincing empirical evidence of convergence among EU members, another kind of convergence have risen in the past decades. We refer to it as *structural convergence*, implying that the economies become more similar in terms of response to an unpredictable technological shocks. In particular, we will focus on both the impact of a generalized productivity change in a country and the effect of a change occurring in one sector of the European economies.

The data we use to analyze the importance matrices in the context of the European Union are intercountry input-output tables for the period 1965-1985[3]. In particular, we consider the same 5 countries as section 2 (Germany, France, Italy, The Netherlands, and Belgium) and, following van der

[3] Further details on the tables are in van der Linden and Oosterhaven (1995) and Oosterhaven (1995).

Linden *et al*. (2000), an aggregation of 6 sectors (Private sercives, Energy, Building, Market Services, Agriculture and Manufacturing)[4].

The Importance Matrices $\mathbf{S}_t$ (where the subscript denotes the time period so that t= 1965, 1970, 1975, 1980, 1985) are computed by running a Monte Carlo simulation under the assumption that all the coefficients of the Leontief inverse **B** are distributed as a log-normal probability function with a 99.7% confidence interval (Bullard and Sebald, 1977; 1988) with the expected value equal to the observed coefficient.

In tables 1-3, we present the result of an experiment numbering 2000 runs for the year 1985. In order to interpret the results, its two marginal indices have been constructed: the *index of absolute importance* $S_i \sum_j S_{ij}$, measures the absolute importance of sector/country j for the economy, and the *index of absolute sensitivity* $S_j = \sum_i S_{ij}$ provides a quantitative measure of the reactivity of the economy.

Table 1 shows the geographical dimension of the linkages within the European economy and the results show that Italy and France are the countries with the highest potential for initiating structural changes. It is also interesting to notice that Italy has one of the highest values of S_j (2.982). Table 2 examines which sector production multipliers are the most affected by a structural change in any other sector. The results confirms our conclusion from section 2 since they reveal that Market Services and Manufacturing are the most important sectors as well as the most sensitive ones while public services are unlikely to be driving structural change. Table 3 provides information not only on which sectors' technological changes would have the strongest impact upon the Leontief-inverse, but also information about which member countries would exert the greatest influence. Somewhat surprisingly, Italy is the

[4] The aggregation procedure was carried out by using the PyIO Module (Nazara, Guo and Hewings, 2003).

most likely to enhance changer in the EU economy, whilst Market Services and Agriculture are the most affected by those changes.

<< Tables 1,2,3>>

Using the orders of the importance and sensitivity indices for countries and sectors, it is possible to design Figures 3a-3c as probabilistic economic landscapes. Notice that in Figure 3a, a clear hierarchy among countries does not seem to be confirmed, meaning a great similarity of the economies and thus a clear path towards greater equality in the structure of countries.

<< Figures 3a, 3b, 3c>>

The simulation for the 1985 has been carried out over the whole period 1965-1985 and the results are presented in Figures 4a-4d. There has been a constant decline in the importance of Belgium and Germany and a rise in the importance of France and Italy. Focusing on the sectors, it can be seen that the increase in the importance of the manufacturing sector coincides with the decline of agriculture. Market services became both important and sensitive starting from the 1970s.

<<Figures 4a, 4b, 4c, 4d>>

By analyzing the path of the trace function of the importance matrices, it is possible to show the pattern of *hollowing out* among the sectors and the economies (the latter implying an increasing international interdependence). The higher is the trace value, the higher is the intra-sectoral or national trade, and in this case the less is the specialization of the country. Figure 5 shows a constant decline in the trace function over the period 1965-1985, but it is interesting to notice that the value fell by 33% for sectors but only by 12% for countries. This means that there is a growing path of inter-sectoral linkages, implying growing complementarities among sectors (this is also a proof of the rising importance of the Market Services as ancillary to industrial and agricultural production). On the other hand, even though the hollowing out process is present for the national economies, it should be stated that it is slower than in the case of integration between sectors. This can be explained by at least two factors. First, our data set covers just the period 1965-1985, thus it ignores the impact of the European Monetary Union and the integration effects of the single currency. Secondly, we consider just five countries, so that we do not have any evidence of the increasing or decreasing interdependence between, for instance, France and Spain of between Italy and Austria.

<<Figure 5>>

Thus, Figure 5 should be interpreted in the sense that the increasing complexity of production is much more rapid than the internationalization of the member economies. To make a further step into the analysis of the structural convergence, let us consider the importance matrix of total intensity defined as:

(16) $$I = \sum_i \sum_j S_{ij}$$

and the relative variance. In figure 6, the temporal pattern of this indicator is drawn. It is interesting to notice that the intensities at both national and sectoral level are decreasing, implying a decreasing sensitivity of the European economy as a whole to sector and international shocks. However, what is more interesting is the fact that the rate of change of the intensities over the period 1965-1985 equals the rate of change of the trace function over the same time period, i.e. the intensity of the importance matrix by sector declines by about 33% and the one of the spatial matrix of about 12%. This finding implies first that even though the EU economies are more sensitive to international shocks (in 1985, the intensity of the spatial matrix is still higher than the one of the importance matrix by sectors), they will be decreasingly affected by technological shocks. Secondly, the increasing complexity in the production process is likely to be driving a diversification path among the economies (this could also explain the decreasing sensitivity to international structural changes).

Previous results can be interpreted by considering the fact that the Single Market has not led to a strong specialization of European economies, but rather to a possible specialization of regional economies within countries, depending on the geographic position of the region at the European scale, and their level of investment in technology and human capital. Fatas (1997) demonstrates that specialization in technology and quality is more obvious between EU regions than between EU countries. In addition, it seems that agglomeration forces are limited to the country where they take place; lower transaction costs and higher factor mobility within countries than between countries (due to cultural, linguistic differences) can maintain regional dynamics in the form of increasing polarization/specialization. As regions within a country become less similar over time, we may expect that region-specific fluctuations increase within countries, whereas the smaller specialization of the national economies makes them less sensitive to specific shock. In other words, better opportunities for the exploitation of scale economies (via localized knowledge spillovers) tend to foster the spatial concentration of industries and increase the likelihood that a given shock will have asymmetric effects on different regions because of the growing differences in regional production structures. In essence, the degree of regional specialization influences the degree of shock susceptibility: the more specialized the region, the more sensitive to shock and vice versa. The problem accounts for the lack of adjustment mechanisms when a region is hit by adverse region-specific shocks. In the absence of labor mobility or wage flexibility within a country, two alternatives remain: increased subsidies through regional development policies or an increase in unemployment in the region hit by adverse shocks.

<< Figures 6, 7>>

Finally, by analyzing figure 7, it is possible to verify the path of structural convergence among the European economies and sectors in terms of sensitivity. The graph depicts the temporal pattern of the variance for the spatial and sectoral matrices and it shows a constant decline of both functions. This means that both sectors and economies are becoming more similar in responding to technological shocks. In addition, it should be noticed that this figure seems to confirm the fact that sectors at the European level are becoming more similar than the national economies as a whole. This result means that, in terms of technology, sectors are converging faster than countries.

5. Concluding remarks and some perspectives on European transport infrastructure policy

In the literature on convergence, attention has been focused on the progress of measures such as per capita income or other measures of welfare. The analysis explored in this paper examines a complementary part of the process – the structure of the economy. However, no attempt was been made to explore the contribution that the economic structure plays in promoting or retarding convergence properties defined in welfare terms. The results indicate that the greater harmonization of their productive structures comes mainly from the market services and energy&manufacturing sectors that are becoming more similar over time. While the weight of the first one is increasing, the weight of the second one is decreasing, motsly because it is not as productive as the market services sector in France and Germany. Using the measures of sensitivity and associated importance matrix, we highlight next that convergence in economic structure seems to be dominated by convergence of technological similarities at the sector level rather than at the country level. However, the analysis needs to be extended over a long period to chart the degree to which the country convergence eventually begins to mirror the developments at the sectoral level.

Infrastructure investments is a building bloc in the making of European cohesion policies through Structural Funds. For the past programming period 1994-1999 the total Operational Program for Transport for all countries amounted to 40.6 billion Euros, of which about 80% devoted to roads and railways. The report "Thematic Evaluation of the Impact of Structural Funds on Transport Infrastructures" by European Commission (2000) state that the employment impact of that spending can be estimated in 2.307.979 job units, but what is more interesting to notice is that no mention is done of transportation effect of those investment both in terms of accessibility and transport cost variation.

In particular, as reported in Glaeser and Kohlhase (2004), starting from the Forties, a constant decline in transport cost has occurred. It can be argued that this figure was mainly due to technological innovations in the first thirty years and to deregulation in transportation industries in the last decades. This pattern is likely to be driving changes in the spatial structure of production by reducing the friction of distance and broadening the spatial extent of the market for input and the market for outputs (Parr *et al.*, 2002). Thus, European infrastructure policies, by linking in a more efficient way regions (especially the ones in the cohesion countries) soundly affect the economic structure by enhancing economic development and altering the allocation of productive factors.

As argued by Vickerman (1996), infrastructures themselves should be considered only as a necessary, rather than sufficient, condition to encourage development in under-developed regions. Other economic-environmental factors should be objects of simultaneous *ad hoc* policies in order to overwhelm the risk of economic implosion of backward systems. In fact, a number of scholars[5] have

[5] See, among others, Krugman (1991) and Martin and Rogers (1995).

shown that in a dualistic economic system with two sets of developed and under-developed regions, a decrease in transport cost will result in a change in the economic structure and in a widening of regional disparities.

In this paper we have shown how sectors are converging in technological terms faster than countries. This means that infrastructure investment changing transport costs and accessibility of regions are able to wide, *ceteris paribus*, economic disparities in Europe. In absence of constant coordination among all sectoral policies, European cohesion actions might result in strengthening yet stronger regions by broadening the spatial extent of their markets.

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Table 1 *Geographical Importance Matrix (1985)*

	DE	FR	IT	NL	BE	Sj
DE	0.252	0.412	0.506	0.388	0.72	2.278
FR	0.448	0.874	0.546	0.644	0.76	3.272
IT	0.78	0.9	0.876	0.31	0.55	3.416
NL	0.592	0.322	0.74	0.588	0.78	3.022
BE	0.17	0.108	0.314	0.228	0.89	1.71
Si	2.242	2.616	2.982	2.158	3.7	

Table 2 *Sectoral Importance Matrix (1985)*

	Public Services	Energy	Building	Mkt Services	Agriculture	Manufacturing	Sj
Public Services	0.013	0.111	0.0117	0.0481	0.1326	0.0962	0.41
Energy	0.3003	0.164	0.2678	0.3289	0.2522	0.3692	1.68
Building	0.3731	0.291	0.5681	0.3549	0.4186	0.4355	2.44
Mkt Services	0.533	0.507	0.585	0.5694	0.6565	0.611	3.46
Agriculture	0.3588	0.385	0.2093	0.481	0.3822	0.3536	2.17
Manufacturing	0.5564	0.538	0.5226	0.533	0.3068	0.5031	2.96
Si	2.1346	1.996	2.1645	2.3153	2.1489	2.3686	

Table 3 *Country-by-Sector Importance Matrix (1985)*

	Public Services	Energy	Building	Mkt Services	Agriculture	Manufacturing	Sj
DE	0.231	0.126	0.206	0.253	0.194	0.284	1.294
FR	0.287	0.224	0.437	0.273	0.322	0.335	1.878
IT	0.410	0.390	0.450	0.438	0.505	0.470	2.663
NL	0.276	0.296	0.161	0.370	0.294	0.272	1.669
BE	0.165	0.085	0.054	0.157	0.114	0.045	0.620
Si	1.369	1.121	1.308	1.491	1.429	1.406	

Figure 1 Total index of inequality in productive structure

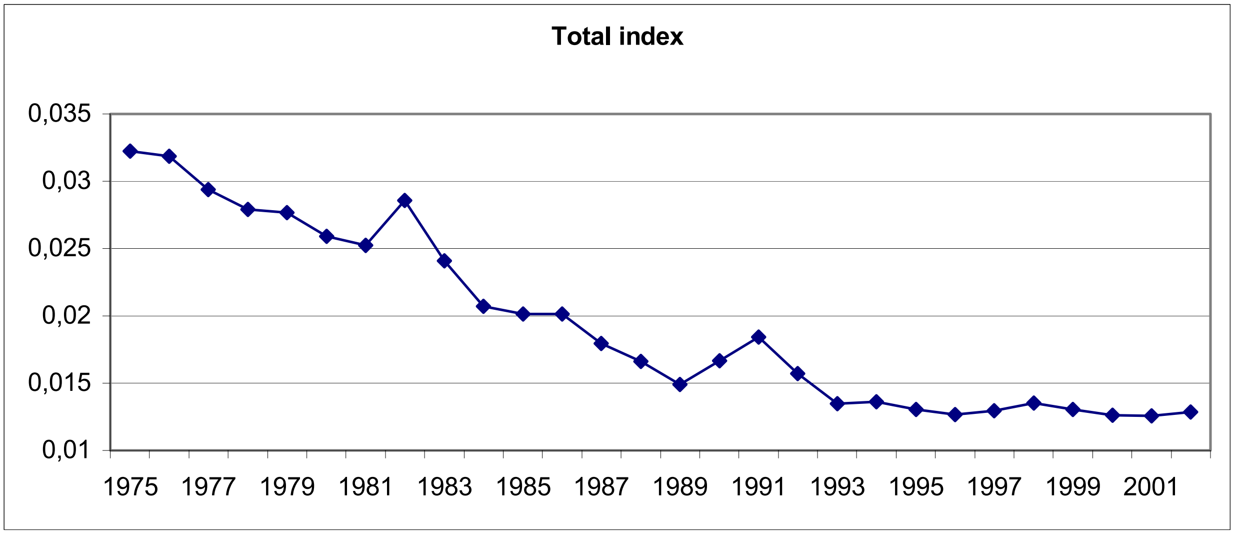

Figure 2 Index of inequality in productive structure by sector

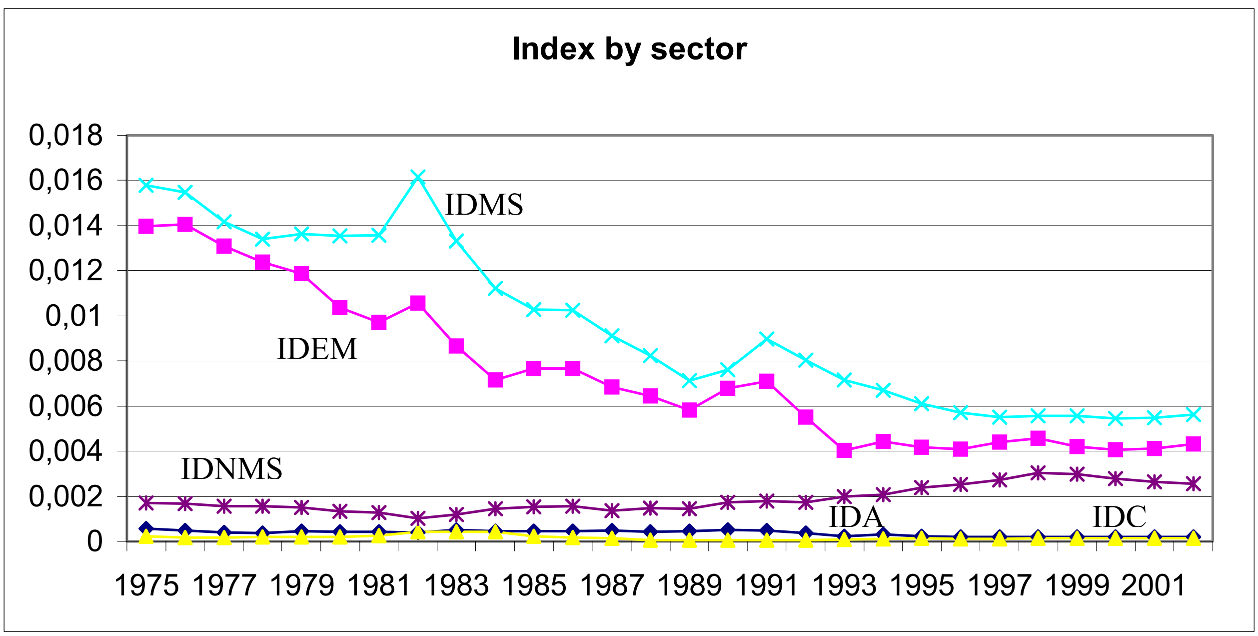

Figure 3a Probabilistic economic landscapes of the EU economy (country-by-country)

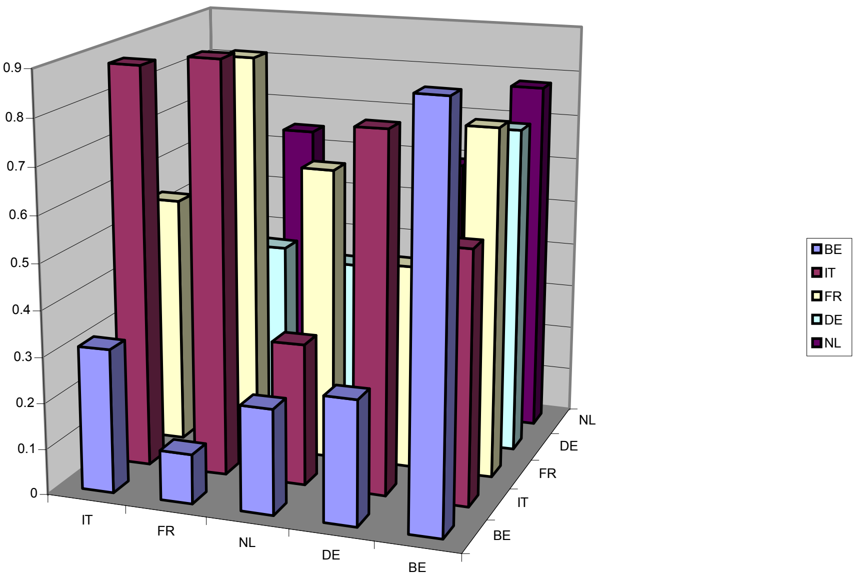

Figure 3b *Probabilistic economic landscapes of the EU economy (sector-by-sector)*

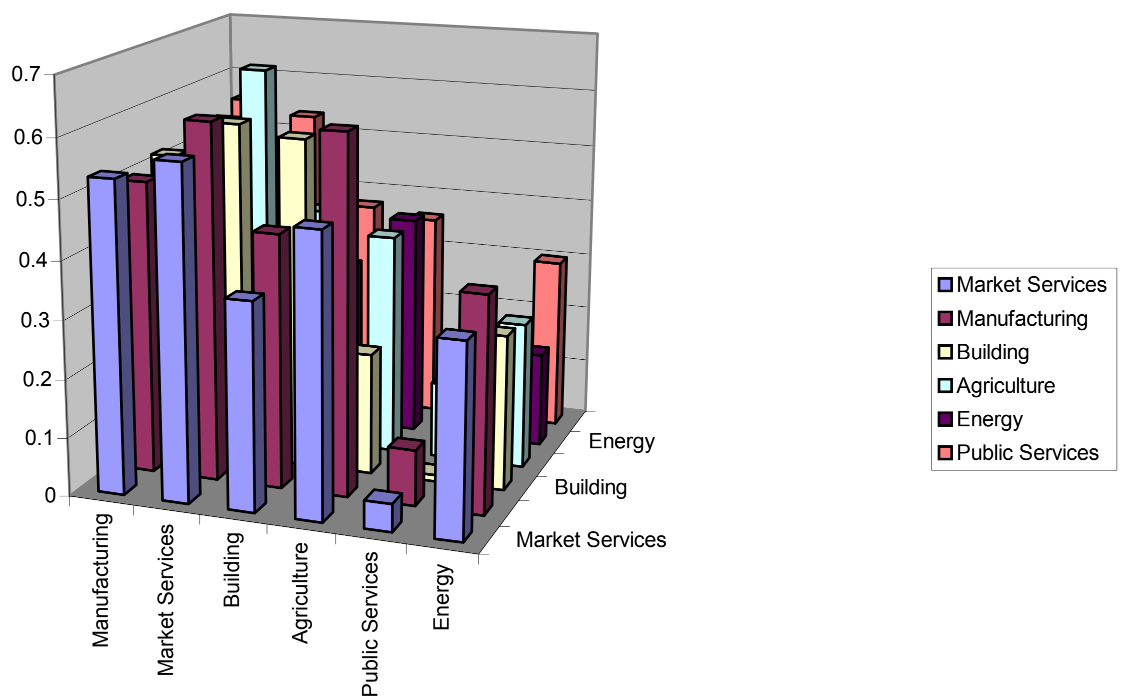

Figure 3c *Probabilistic economic landscapes of the EU economy (country-by-sector)*

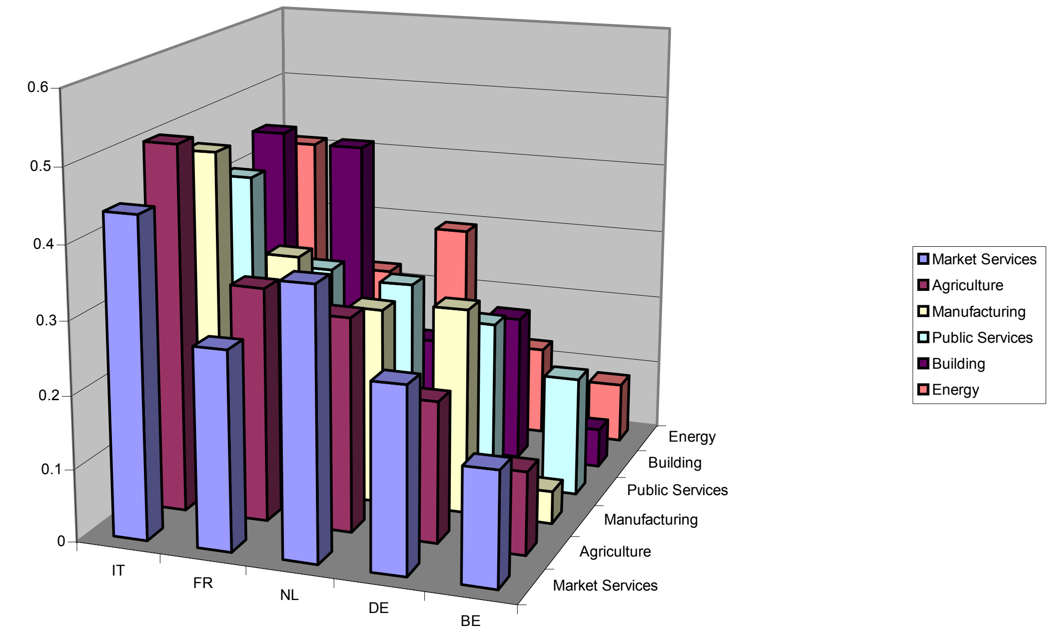

Figure 4a *Absolute Importance Hierarchy by Sector 1965-1985*

Rank	1965	1970	1975	1980	1985
1	3	6	6	6	6
2	6	3	3	3	4
3	5	5	4	4	3
4	2	4	5	5	5
5	1	2	2	1	1
6	4	1	1	2	2

Figure 4b *Absolute Sensitivity Hierarchy by Sector 1965-1985*

Rank	1965	1970	1975	1980	1985
1	6	3	6	4	4
2	3	6	4	6	6
3	4	4	3	3	3
4	1	1	1	5	5
5	2	5	2	2	2
6	5	2	5	1	1

Figure 4c *Absolute Importance Hierarchy by Country 1965-1985*

Rank	1965	1970	1975	1980	1985
1	DE	DE	FR	FR	IT
2	FR	FR	DE	IT	FR
3	BE	BE	IT	DE	NL
4	IT	IT	NL	NL	DE
5	NL	NL	BE	BE	BE

Figure 4d *Absolute Sensitivity Hierarchy by Country 1965-1985*

Rank	1965	1970	1975	1980	1985
1	NL	IT	IT	IT	BE
2	IT	NL	NL	BE	IT
3	BE	BE	BE	FR	FR
4	DE	FR	FR	DE	DE
5	FR	DE	DE	NL	NL

Figure 5 *The Hollowing Out Process*

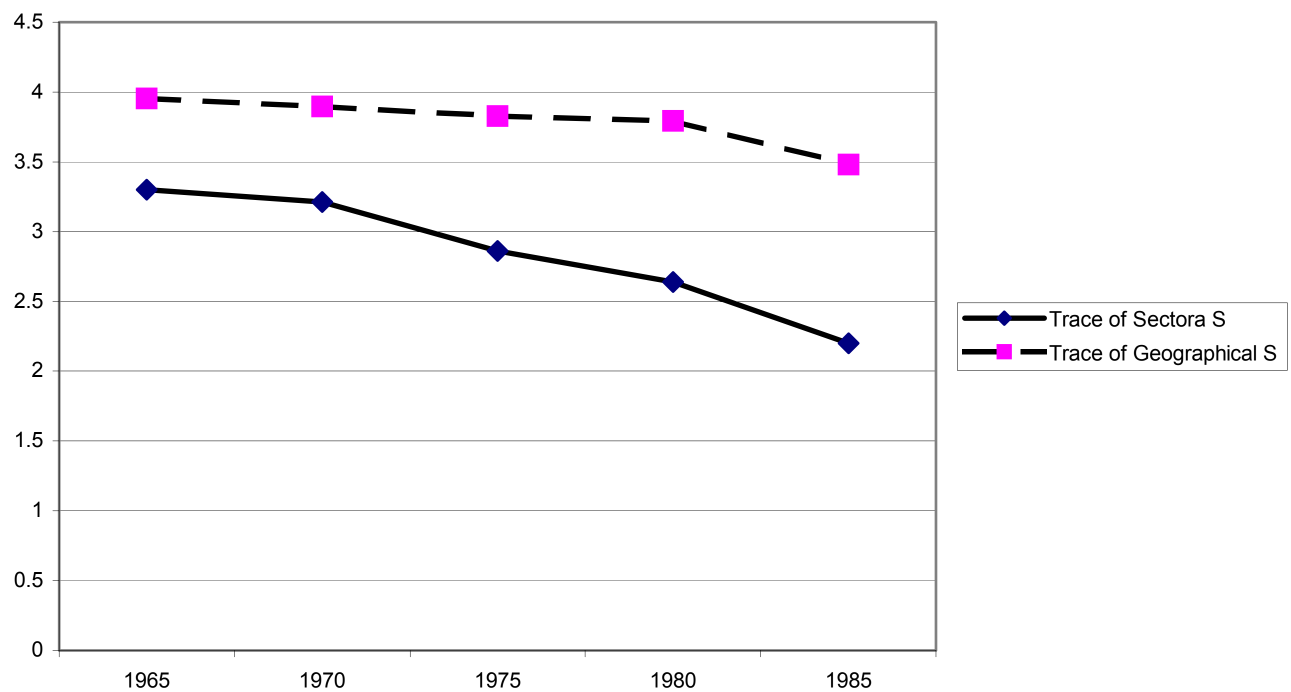

Figure 6 *Patterns of Importance Matrix Intensities*

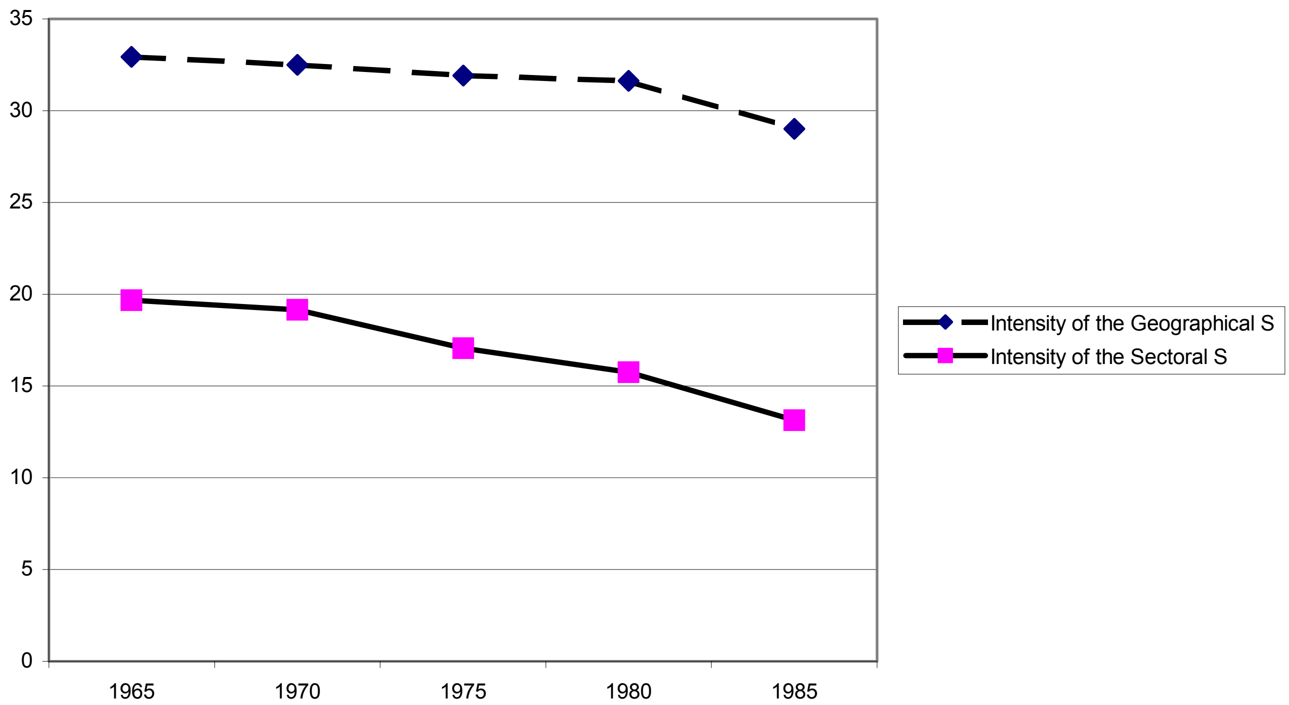

Figure 7 *Patterns of Importance Matrix Variances*