Dimitrios Tsagdis, Stilianos Alexiadis*

EU27 leading regions in labour productivity growth in agriculture, industry, and services: A methodology and a research agenda

Address for correspondence: Dr Dimitrios Tsagdis, University of Hull, Business School, Filey Road, Scarborough, YO11 3AZ, UK; e-mail: d.tsagdis@hull.ac.uk

*Ministry of Rural Development and Foods, Department of Agricultural Policy and Documentation, Room 501, 5 Acharnon Street, 101 76, Athens, Greece; e-mail: ax5u010@minagric.gr. The findings, interpretations and conclusions are those entirely of the authors and do not necessarily represent the official position, policies or views of the Ministry of Rural Development and Foods and/or the Greek Government.

Abstract

Based on the premise that, labour productivity growth is the only way to sustainable wealth creation, a methodology is proposed for identifying leading (/lagging) regions. Leading (/lagging) is operationalised in this context as convergence above (/below) the EU27-average-labour-productivity-growth in agriculture, industry, and services. The methodology unfolds over a sequence of six steps. The first two steps utilise regressions; first to offer a rough indication that leading regions are not to be found outside the EU12, and second to delineate the EU12 regions leading in one or two of the above three sectors. It is to be made explicit that there is no leading region in all three sectors. The third step utilises Venn diagrams to provide an overview of the sectoral-convergence-clubs of the regions. The fourth step transforms the Venn diagram of the leading regions into a geographical depiction, so that during the fifth step spatial econometrics can be used to identify autonomous and spillover-leaders. As a final step some finer filtering takes place, e.g. flagging capital leading regions. The methodology allows the delineation of valuable samples of leading (/lagging) regions for testing hypotheses on the (endogenous) factors of such growth (e.g. technology diffusion, infrastructure, education, economic activity mix, policy); some of which are tested as examples in the paper. Finally, the paper aims to stimulate interest in this research agenda for the further study (e.g. comparative case based on primary data) of such factors in the delineated sample of EU27 leading and lagging regions.

I. Introduction

There is a growing body of empirical studies investigating leading/lagging regions in terms of a number of indicators (e.g. un/employment rates, wages, innovation, productivity, GDP growth, foreign direct investment) in a variety of industries and territories. Such studies, although insightful in their own terms, have not been particularly helpful in delineating a set of common factors underpinning the emergence of leading regions in general and in Europe in particular. Besides such an agenda lying outside the scope of most such studies, their focus on a small set of indicators, industries, regions, years, etc. often results in one region appearing as leading in some set of indicators, sectors, time periods, etc. but as lagging in others (see for example TERLUIN and POST, 2000, p. 12).

This paper aims to rectify the above by developing a methodology and demonstrating its use in the EU27 regions as a proof of concept. Ideally the proposed methodology would utilise total factor productivity growth as the indicator *par excellence* for identifying leading regions. Due to data limitations however, in the proof of concept labour productivity growth is used instead as a proxy. Nonetheless, this still allows most indicators encountered in the aforementioned studies to be construed as testable hypotheses of the factors underpinning the emergence of such leading regions. This is often neglected by other studies whose end point is the identification of leading/lagging regions in a given territory in terms of a set of indicators. Whereas for the purposes of this paper this is only a starting point; i.e. we wish to identify leading regions so that a subsequent series of steps with respective sets of analyses can be performed to identify any common underlying factors.

Moreover, most of the aforementioned studies, regardless of their set of indicators, treat leadership in absolute terms and not as *stochastic convergence*. This is not the case with the proposed methodology; which thus does not merely identify leading/lagging regions but regions that converge above (*leading*), below (*lagging*) as well as towards a territory's average. This allows the drawing of sufficiently differentiated samples so to test some of the aforementioned hypotheses.

Finally, the methodology proposed in this paper does not accept such groups of converging regions at face value, but tries to further distinguish between those whose convergence may be due to spillovers from adjacent regions.

As it may be surmised from the above, the methodology is structured as a series of steps. The first step utilises regressions to delineate regions that converge above, below and towards a territory's average in any sector and/or combination thereof. The second step utilises Venn diagrams to provide an overview of the sectoral overlaps of such convergence clubs. The third step transforms the Venn diagram of the leading regions into a geographical depiction, so that during a fourth step spatial correlations can be used in an attempt to identify spillover-effects among the groups of leading regions and thus spillover vs. autonomous leaders. As a final step some finer filtering can take place, e.g. flagging capital leading regions, or border lagging ones. The proof of concept follows the same sequence of steps utilising a EU27 NUTS2 EUROSTAT data set for the 1995-2005 period.

The presentation of the above in the remainder of the paper is structured in the following manner. The next section provides the theoretical underpinning of the methodology in the areas of converge and spatial econometrics; whereas the penultimate one presents the empirical findings from its application in the EU27. The paper concludes with respective recommendations and areas for further research.

II. The Case for Convergence

The seeds of the notion can be found in the so called convergence-hypothesis; i.e. that all economies will converge in the long run, traced to classical economists such as Ricardo, Marx, and Malthus.[1] Moreover, several economic historians (e.g. GERSCHENKRON, 1952; GOMULKA, 1971) argued that backward economies tend to grow faster than rich ones, advocating a process of long-run convergence. Contrary to the above, there has been an equally impressive body of literature (e.g. MYRDAL, 1957; KALDOR, 1970) supporting an alternative hypothesis; viz. that divergence occurs, and in particular that rich economies grow at the expense of poor ones, perpetuating a centre-periphery pattern.

This question of convergence or divergence has been one of the most debated topics in economics during the last twenty years (for a review see DE LA FUENTE, 1997; ISLAM 2003). However, the contributions to this debate, much like the phenomena studied, have not followed a uniform path.

The first empirical test of the convergence-hypothesis can be found in BAUMOL (1986), who placed emphasis on the dictum that convergence is identical with a negative relation between initial level and growth rate of per-capita output. A central tenet of Baumol's thesis is that convergence is feasible if 'poor' economies exhibit a tendency to grow faster than 'rich' economies.

A substantial, and continuously growing, empirical literature (e.g. BUTTON and PENTECOST, 1995; NEVEN and GOUYETTE, 1995; FAGERBERG and VERSPAGEN, 1996; SALA-I-MARTIN, 1996) has developed that examined regional convergence during the various EU facets (e.g. EEC, EU12, EU14). These studies assessed convergence mainly in terms of per-capita income, while fewer studies concerned particular sectors (e.g. for manufacturing see PASCUAL and WESTERMANN, 2002; GUGLER and PFAFFERMAYR, 2004). Both kinds of studies however suggested that European regions either diverge or exhibit a slow rate of convergence (less than 2% annually). Several criticisms have been raised against such conclusions, due to their underpinnings in several simplifying assumptions (MCCOMBIE and THIRLWALL, 1994). This has led to the development of a new concept of convergence, that of *club-convergence*, which acknowledges the possibility of a variety of convergence patterns due to differences in initial conditions. For instance, regions starting from a low position may get locked-in low evolutionary-paths, whereas high evolutionary-paths may be the result of high initial positions. Such possibilities are also suggestive of *cumulative* mechanisms that perpetuate initial differences. The club-convergence notion carries the implication that it is legitimate to assume that convergence across *all* regions is difficult to occur, at least in the short-medium run. It is more reasonable to assume that overall convergence is followed by an initial stage of club-convergence, i.e. a restriction of the property of convergence within a given set of regions. Treating all regions as a single set might mask this process, resulting to misleading conclusions. The important point to grasp, from a policy perspective, is that detecting groups with common convergence trends helps to reflect on existing policies and to shape future courses of action that may be better suited to each group.

Detecting such different groupings has led to a fast growing literature that applies time-series techniques (for an introduction see BERNARD and DURLAUF, 1995). However, most such empirical studies are concerned with national economies (e.g. BEN-DAVID, 1996; OXLEY and GREASLEY, 1999) with fewer focused on regions (e.g. MCGUINESS and SHEEHAN, 1998; ALEXIADIS and TOMKINS, 2004). Regardless of their varied territorial extensions, their central question remains the same, viz. whether the long-run forecasts of labour productivity for two regions are equal at a fixed time. Although two kinds of tests for time-series convergence can be identified in this literature, viz. the Augmented Dickey-Fuller (ADF) and the one developed by NAHAR and INDER (2002)[2] only the latter is suitable to this study.[3] That is, because it identifies groups that move towards a common level of labour productivity, approximated by the *average* productivity of all economies included in the set. The intuition behind this argument should be relatively easy to discern, viz. convergence occurs when a region's deviation from the average productivity ($y_i - \bar{y}$) approaches zero in the long-run, i.e. $(y_i - \bar{y})_t \to 0$, as $t \to \infty$. Expressing this in terms of a regression equation yields:

$$w_{i,t} = \theta_0 + \theta_1 r + \theta_2 r^2 + \ldots + \theta_{k-1} r^{k-1} + \theta_k r^k + u_{i,t} \qquad (1)$$

where $w_{i,t} = (y_i - \bar{y})_t^2$, r is a time trend, and θ_i are parameters. For a given set of regions, equation (1) can be written in a matrix form as follows:

$$\mathbf{W_{i,t}} = \boldsymbol{\theta}_\mathbf{i}\mathbf{r} + \mathbf{u} \qquad (2)$$

Convergence towards the average is thus signified if $\boldsymbol{\theta}_\mathbf{i} < 0$ while $\boldsymbol{\theta}_\mathbf{i} \geq 0$ indicates deviation from the average. In the latter case two possibilities can be identified: positive deviation (i.e. above the average) and negative deviation (i.e. below the average). Having introduced the type of convergence at stake, in the following section its econometric application is discussed.

III. Empirical Application, Analysis, and Discussion

As introduced in the previous section regional growth may be convergent or divergent, while convergence/divergence may also be an exclusive property of a specific set of regional economies. An assessment is thus made in this section, whether convergence is apparent across the EU27 267 NUTS2 regions[4] or whether it only applies to a select club. The exercise covers the 1995-2005 period, due to the unavailability of data for all EU27 territorial units outside the boundary years.

Although most of the empirical literature in regional convergence[5] is confined to the use of total labour productivity, in this paper convergence is examined for each sector separately, viz. agriculture, industry, and services. The reason for this sectoral delineation of labour productivity is that different growth characteristics are attached to each sector of an economy, which thus affect the developmental trajectory of a region.

Running a regression of equation (2) for each EU27 NUTS2 region and for each of the three sectors produces some interesting patterns. In particular, regions might converge (diverge) towards (above/below) the average labour productivity either in terms of a single sector or in a more than one sectors, e.g. in the case of two sectors exhibiting dual-sector convergence. Therefore, based on the statistical significance of the results[6], three Venn diagrams are constructed so to capture all patterns of convergence towards, above, and below the average labour productivity of each sector in Figures 1a-c respectively; whereas Table 1 summarises these results.

A number of observations become apparent from the above:

1) The EU27 NUTS2 regions follow substantially differentiated convergence patterns and there are a small number of regions (13%) that follows no statistically significant pattern.
2) The number of regions converging towards (36%) and above the average (39%) is almost evenly split. Regions converging below the average are a minority (13%). These observations could be interpreted as rather good news as leading regions occupy the lion's share.
3) Dual-sector convergence is prominent across the regions converging above (29%) the average. Single-sector convergence is more pronounced in regions converging towards (19%) and below the average (12%) with the largest single-sector for both clubs being agriculture (at 8.6% each). For the dual-sectors leaders the most frequently encountered sectors are industry and services (21%). This could be interpreted as suggesting that this combination constitutes a rather stable regional leadership rule and that regions with other profiles are less likely to be leading; especially as only 4% of the regions with industry-services stable convergence characteristics are not in the leaders' club. The bulk of the subsequent analysis will therefore focus on this industry-services leaders' club.
4) It is worthy reporting, finally, that there is no region with similar convergence patterns across all of its three sectors.

The geographical distribution of the leading club of regions is mapped in Figure 2. It is interesting to note that the majority of the regions in this group belong to EU12 countries with fewer regions from EU15 countries and none from the new EU27 member states. In actual fact most regions from the new member states follow unstable convergence patterns or at best converge towards the EU27 average. It could thus be argued, that the notion of stochastic convergence above the average is constrained exclusively within the EU12 context.

In order to further corroborate this argument the empirical analysis is extended by applying equation (2) using data only for the EU12 NUTS2 regions. Given that for the EU12 regions there is a more extensive data set, i.e. covering a longer time-period (1977-2005), thus the application of time-series techniques can be used to provide more robust results. In this case convergence is redefined in terms of the EU12 average and the empirical application reveals a similar geographical pattern, as shown in Figure 3. It is also worthy to highlight here that the vast majority of industry-services leading regions are located in EU12 central; i.e. in an area that includes regions from Belgium, Luxemburg, and western Germany.

In this context it is reasonable to assume that the regions which follow a similar pattern in their sectoral convergence are located in close proximity. Table 2a details single and dual-sector leading regions located in close proximity.

Table 2a, in conjunction with the previous maps and tables, suggests that there are only few cases (less than 2% of the EU27 regions and about 10% of the leading ones) of neighbouring leading regions across national borders. For example, regions es43 and pt18, located in Spain and Portugal, respectively, follow a pattern of single-sector convergence above the average in agriculture. Austrian region at31 bordering the German region de21, both converge above the average in industry and services. Moreover, two French regions converging above the average in agriculture and industry fr22 and fr21 are bordering with the Belgian regions be34 and be35, which converge above the average in services and industry. This could be interpreted as an indication that a leading performance is concentrated within the borders of national economies, while it could be argued that spillover-effects are weaker across national borders, when compared to regional ones.

In an attempt to provide an approximation of the spillover-effects the annual labour productivity growth rate of a leading region, adjusted by the distance from its surrounding leading regions, is correlated with the level of labour productivity of its surrounding leading regions. The correlations for 72 neighbouring[7]-leading-regions are reported in Tables 3a-c. A positive correlation coefficient can be taken as an indication of spillovers between regions; a condition that characterises 41 of these neighbouring-leading-regions. There are though some 23 neihbouring leading regions in which the correlation coefficient is negative, indicating an absence of spillovers from their neighbouring-leading-regions. If to these 23 autonomous leading regions the 39 isolated ones (that are leading but are not neighbouring with other leading regions, see Table 2b) are added, then it could be argued that the vast majority of leading regions (60%) is not due to spillovers.

An obvious implication of the analysis insofar is that not all European regions are converging towards a common equilibrium and that in addition they are not always doing so on their own right. This suggests multiple equilibria in the labour-productivity-growth-performance of EU27 regions, e.g. different ones for leaders in agriculture, industry, services, their combinations (qua dual leaders), autonomous vs.

spillover leaders, for regions converging towards or below the average and so on. Such an outcome seems to 'fragment' the predictions of Endogenous Growth Theory (EGT) and New Economic Geography (NEG) models.[8]

It may thus be instructive to examine how some of the externalities (e.g. technological and spatial) popularised by the above literatures measure up against such findings. To accomplish this, i.e. approximate these externalities, three proxies are chosen: i) patents per-capita, ii) employment in high technology sectors, and iii) population density (inhabitants per square kilometre). The first two proxies are used to reflect technological externalities, while the third one is a standard measure of externalities due to agglomeration effects. These proxies refer to the initial year of the analysis (1995) and are obtained from EUROSTAT.

Focusing such an analysis on the industry-services-leaders club (N=55) and as can be seen from Table 3, in 1995 the technological externalities of most of these regions were above the club's average.[9] However, this is reversed for population density; i.e. agglomeration externalities. The large numbers of regions at either end suggest that their present leadership positions cannot be accounted for by such characteristics/externalities, or in other words, that it may be still possible for regions lacking in such characteristics to enter leadership convergence paths. It is thus particularly noteworthy that there are twelve (indicated with bold in Table 3) of these 55 regions exhibiting all three characteristics above the average, and five (indicated with bold underline) below the average. Most encouragingly, three of these five regions (viz. itd1, itd2, itf1) are autonomous leaders (indicated in square brackets). Looking at the other end of the spectrum four of the aforementioned twelve regions (viz. ukf1, ukg3, ukj2, ukd3) are autonomous leaders (indicated by square brackets). Suggesting that extensive presence or absence of all three such characteristics does not seem related to autonomous leadership.

Further inspection of these proxies shows that they are all positively correlated (during the 1995-2005 period) with the levels of labour productivity (as listed in Table 4). However, upon closer inspection of Table 4, there appears to be two particular sets of observations worthy of discussion:

a) according to the EGT/NEG kind of models, one would expect increasingly stronger correlations between the externalities as one ascents labour-productivity-growth paths; i.e. for regions converging below, towards, and above the average. Although the externalities/correlations follow such a pattern in general, there are some noteworthy exceptions for employment in high technology sectors, and population density (grey shaded cells in Table 4). Both of which follow a different pattern in regions with services, and agriculture-industry sectoral convergence; in addition population density externalities also follow a different pattern in regions with agricultural-sector convergence.

b) The strongest correlations (i.e. in the vicinity of 0.7 or above, bold-underlined cells in Table 4) are to be found mainly in services and industry (and their combinations) leading regions and especially so for patents per capita where the strongest correlations are only to be found in leading regions.

The above observations are suggestive of some further variation in the patterns of regional labour productivity growth and convergence due to these structural characteristics. Examining this hypothesis more formally, a standard spatial version of the cross-section test for β-convergence is applied. This test is enhanced by introducing as explanatory variable the three aforementioned structural characteristics. Thus, the test takes the following form:

$$g_i = a + b_1 y_{i,0} + b_2 PT_{i,0} + b_3 HT_{i,0} + b_4 PD_{i,0} + (\mathbf{I} - \zeta \mathbf{W})^{-1} u_i \qquad (3)$$

where $PT_{i,0}$ measures the patents per-capita, $HT_{i,0}$ refers to the employment in high technology sectors, $PD_{i,0}$ is the population density and **W** is the a spatial matrix with its elements defined as $w_{ij} = \frac{1/d_{ij}}{\sum_j 1/d_{ij}}$, where d_{ij} denotes the distance between two regions i and j, as measured by the distance between the major urban centres where the majority of economic activities are located. The denominator is the sum of the (inverse) distances from all regions surrounding region i. Following BARRO and SALA-I-MARTIN (1992) the convergence coefficient b may be expressed as $b = -(1 - e^{-\beta T})$ where T is the number of years included in the period of analysis. The term for $\beta = -\frac{\ln(b+1)}{T}$ indicates the speed at which economies approach the steady-state value of output per worker over the given time period, i.e. the average rate of convergence.

Applying equation (3) for all EU27 regions produces the results reported in Table 5. It is important to note that the estimated coefficients of the structural variables, i.e.

$PT_{i,0}$, $HT_{i,0}$ and $PD_{i,0}$, are positive. This is an indication that the structural characteristics have positive effects on the labour productivity growth rate of a region regardless of its convergence characteristics (e.g. leaders and laggers alike). Still, the estimated coefficient on $PT_{i,0}$ is statistically insignificant for the EU27 and the leading regions, despite the fact that the remaining estimations are not. One plausible interpretation, at least according to ALEXIADIS and TSAGDIS (2009), may be that it is the adoption —rather than the intentional creation— of technology that is the key in shaping EU27 regional levels of technology and thus patterns of convergence. The results though suggest that technology creation is significant for regions converging below or towards the EU27 average (at 90% confidence) although its impact is rather negligible (i.e. a 1% increase, inducing a 1% increase in labour productivity levels.

The estimated coefficient of the $HT_{i,0}$ variable indicates that its effects are pretty strong, but much stronger for the regions converging towards the average were a 1% increase in high technology employment will induce a 4.4% increase in a region's labour productivity growth rate. Finally, Population Density seems to be most important for the industry-services leading regions, since the implied impact is 5.5%, while for all EU27 regions is only 1.3% and far less so for those converging below the average. In the light of the above, it could be argued that patents and employment in high technology sectors are of less importance for the industry-services leading regions, since they are already at their peak and that the only of the three factor that has some impact is agglomeration so as to increase their capabilities.

It could also be argued, that regions converging either below or towards the EU27 average would need to improve the aforementioned characteristics in order to move towards a convergence path above the average.

Finally, the implied rate of convergence for all EU27 regions is about 3% while for the selected leading regions is almost four times high (8.8%). As expected the regions converging towards the average exhibit a smaller rate (2.6%) while, the regions converging below the average an even smaller one (0.7%). This difference in the rates of convergence adds further corroboration to the earlier multiple-equilibria arguments as they indicate that the EU27 regions follow multiple and sufficiently differentiated patterns of convergence.

IV. Conclusions, policy implications, and areas of further research

In this paper an attempt was made to develop and demonstrate a superior methodology for creating samples of regional groups (based on their convergence characteristics) for testing a range of hypotheses (e.g. spillover, externality, capital-city effects). In that sense the paper fills an important gap as, although an increasing number of empirical studies have paid attention to issues of economic convergence, the empirical assessment of stochastic convergence has not so far received due attention. The methodology should thus prove useful for policy makers and economists alike interested in managing, evaluating, or producing differentiated policies and instruments that are appropriate for regions with different convergence characteristics.

Moreover, its proof of concept application produced several findings that should also prove interesting from a policy perspective.

Firstly, the convergence characteristics of the EU27 regions were identified which should help focus attention to those converging below and towards the average as well as those not following a statistically significant convergence pattern. This should help the overarching EU goals of regional cohesion, development policies, and administrations of respective funds.

Secondly, the paper identified particular sectoral convergence characteristics indicating that there are possibilities for regions with any combination of sectors, even solely based on agriculture, to be leaders in labour productivity growth. This should inform Common Agricultural Policy reforms and other EU, national, etc. sector-specific policies, help in policy learning from the leading to the lagging regions and the diffusion of best practices.

Thirdly, the paper highlighted the lack of cross-national-border spillover effects identifying the importance of another major EU policy area, viz. of cross-border collaboration, for achieving convergence and disseminating best practices in labour productivity improvements.

Fourthly, the analysis investigated three structural characteristics related to labour productivity growth; suggesting that not all are equally relevant to regions belonging in different convergence clubs. This is highly instructive for policy purposes as one-cure-for-all policies are only too often promoted (e.g. attract/create high technology employment); when they may be suboptimal for a particular region. Obviously, more characteristics could be included by introducing more conditional variables in the model, e.g. sectoral composition/economic activity mix, intra- and inter-regional firm linkages, education/presence of HEIs, the role of clusters and their governance (BORRÁS and TSAGDIS, 2009), the presence/relevance of policy (MCDONALD ET AL, 2007) and so forth.

Thus, the paper offers a complementary set of methodological and policy lessons as well as a number of serious empirical results. However, its main contribution should be seen as opening up a research agenda, developing a language for talking about regional leadership (e.g. dual-sector, autonomous, isolated leaders), and attracting interest for further research in this area; especially collaboration for the development of comparative case studies and the collection of primary data for the study of region-specific mechanisms and in depth hypotheses testing.

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Fig. 1a *Regions converging towards the average in a statistically significant manner*

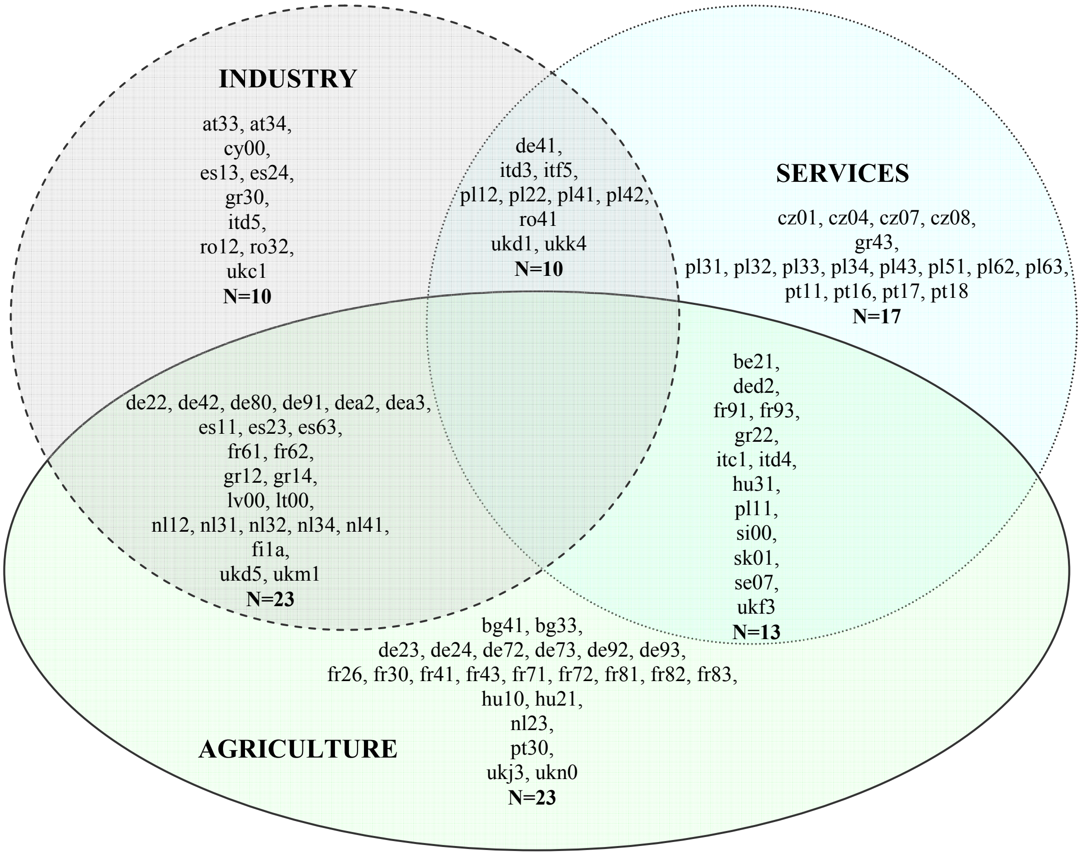

Fig. 1b *Regions converging above the average in a statistically significant manner*

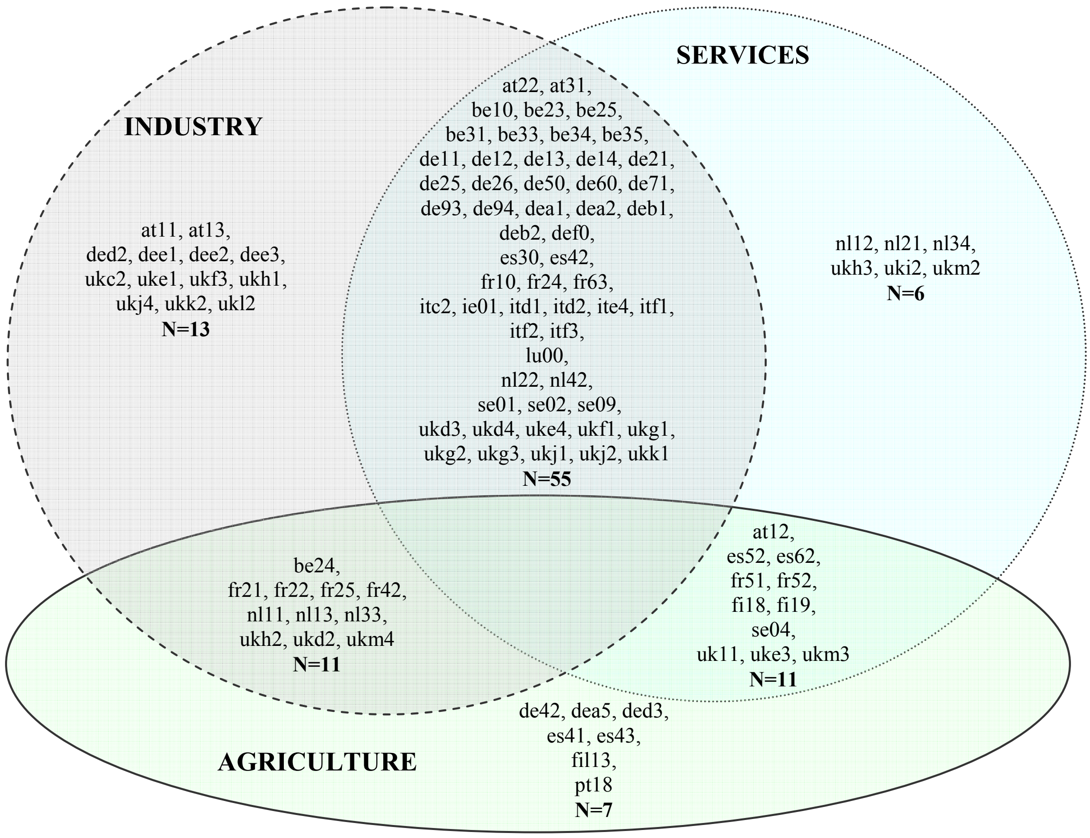

Fig. 1c *Regions converging below the average in a statistically significant manner*

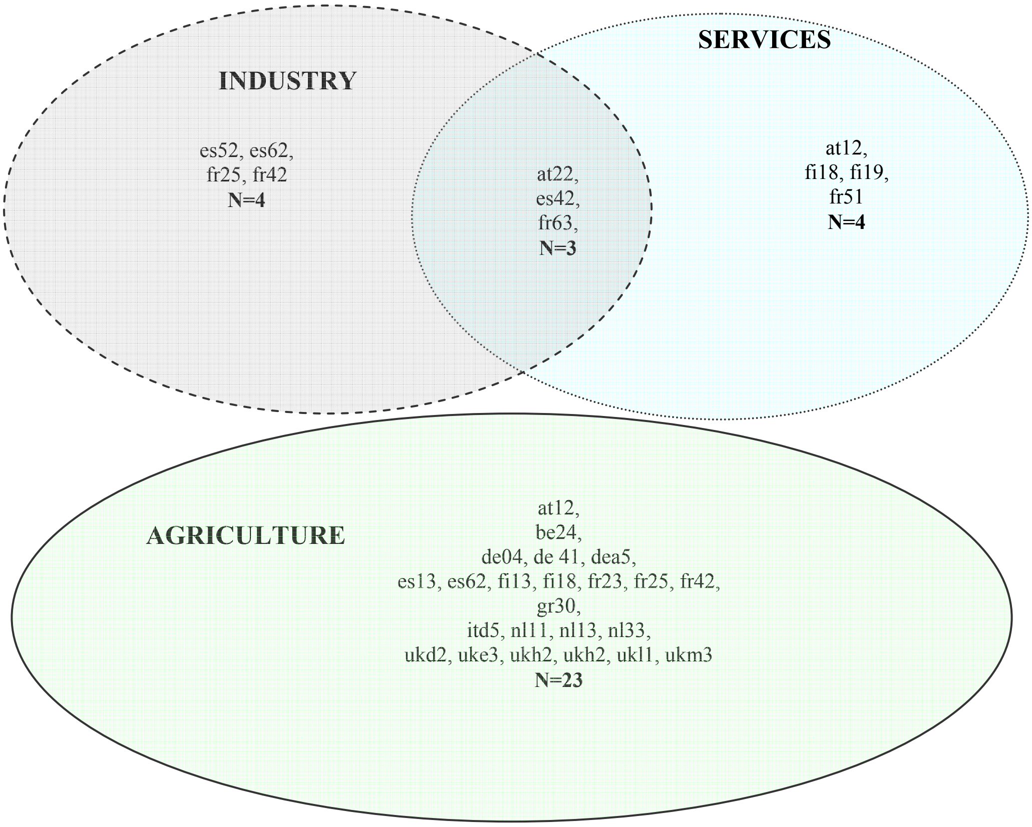

Fig. 2. The geographical distribution of regions converging above the EU27 average (1995-2005)

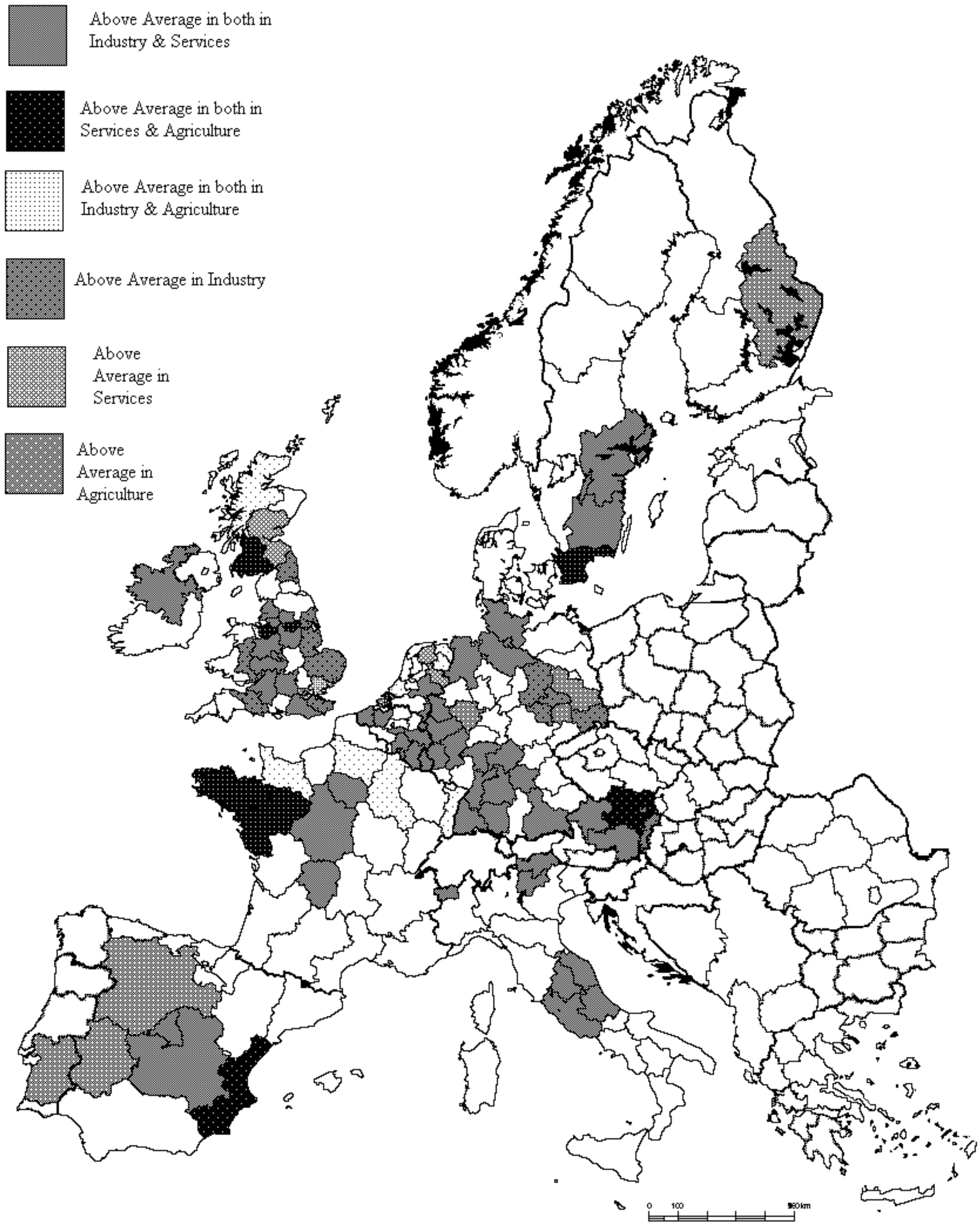

Fig. 3. *The geographical distribution of regions converging above the EU12 average (1977-2005)*

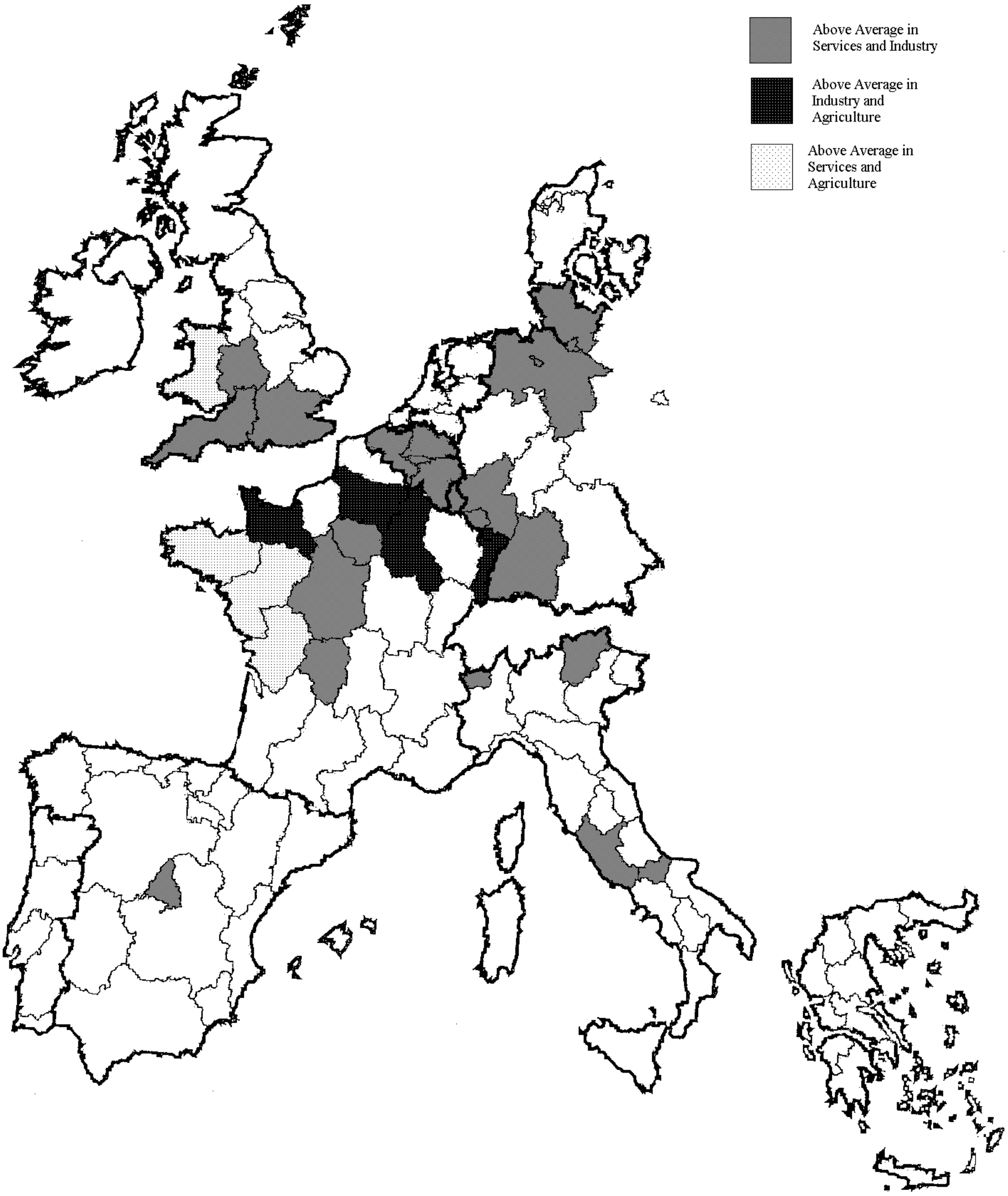

Table 1. *Summary of the 3 Venn diagrams (Fig. 1a-c)*

Convergence-clubs / Sector(s)	Below the Average		Towards the Average		Above the Average		Total	
	N	***%***	**N**	***%***	**N**	***%***	**N**	***%***
Agriculture	23	*8.6*	23	*8.6*	7	*2.6*	53	*20*
Industry	4	*1.5*	10	*3.7*	13	*4.9*	27	*10*
Services	4	*1.5*	17	*6.4*	6	*2.2*	27	*10*
Single-sector convergence Total	***31***	***12***	***50***	***19***	***26***	***9.7***	***107***	***40***
Agriculture & Industry	0	*0*	23	*8.6*	11	*4.1*	34	*13*
Agriculture & Services	0	*0*	13	*4.9*	11	*4.1*	24	*9*
Industry & Services	3	*1.1*	10	*3.7*	55	*21*	68	*25*
Dual-sector convergence Total	***3***	***1.1***	***46***	***17***	***77***	***29***	***126***	***47***
Convergence-club Total	**34**	***13***	**96**	***36***	**103**	***39***	**233**	***87***

Notes: There are 34 regions (13%) whose convergence patterns are not statistically significant.

Table 2a. *Spatial Proximity of EU27 leading regions (N=72)*

Sector / Country	Agriculture	Industry	Services	Agriculture & Industry	Agriculture & Services	Industry & Services
Austria						at22, at31
Belgium						**be10**, be31, be33, be34, be35
						be23, be25
France				fr21, fr22	fr51, fr52	**fr10**, fr24, fr63
Portugal	[pt18]					
Spain	es41, es43				[es52], es62	**[es30]**, es42
Sweden						**[se01]**, [se02], [se09]
Italy						[itd1], [itd2]
						[ite4], [itf1]
Luxemburg						**Lu00**
Germany	de42, ded3	dee3, [dee1], dee2				def0, de60, de50, de93, de94
						dea1, dea2, deb1, deb2, de11, de12, de13, de14, de21, de25, de26, de71
Netherlands			[nl12], nl21	nl11, [nl13]		
UK		[uke1], [ukf3], [ukh1]	ukh3, **[uki2]**			[ukd3], [ukd4], [uke4]
						[ukf1], ukg1, [ukg2], [ukg3], [ukj1], [ukj2], ukk1

Notes: Bold indicates regions in which capital cities are located (N=6), square brackets indicate autonomous leading regions (N=23). Leading regions in some countries (viz. Belgium, Italy, Germany, and the UK) appear as forming two clusters.

Table2b. Isolated Leaders, EU27 (N=39)

Sector / Country	Agriculture	Industry	Services	Agriculture & Industry	Agriculture & Services	Industry & Services
Austria		at11, at13			at12	at22
Belgium				be24		be35
Germany	dea5, ded3	ded2		de42		de93
Finland	fi13				fi18, fi19	
France				fr25	fr52	
Germany	dea5, ded3	ded2		de42		de93
Ireland						ie01
Italy						itd1, itd2, itc2, itf2, itf3
Netherlands		nl42	nl34	nl33		nl22
Sweden					se04	
UK		ukc2, ukj4, ukk2, ukl2	ukh3	ukd2, ukh2, ukm4	uke3, ukl1, ukm2, ukm3	

Notes: There are no regions in which capital cities are located in this group..

Table 3a. *Correlations between neighboring leading regions: Autonomous leading regions*

	dee1	**es30**	**es52**	**itd1**	**itd2**	**ite4**	**itf1**	**nl12**	**nl13**	**pt18**	**se01**	**se02**	**se09**	**ukd3**	**ukd4**	**uke1**	**uke4**	**ukf1**	**ukf3**	**ukg2**	**ukg3**	**ukh1**	**uki2**	**ukj1**	**ukj2**
de21									-0.05																
de94									-0.06																
dee2	-0.10																								
dee3	-0.06																								
es41		-0.04																							
es42		-0.08	-0.09																						
es43										-0.14															
itd1					-0.80																				
itd2				-0.66																					
ite4							-0.79																		
itf1						-0.61																			
nl11								-0.35																	
nl21								-0.19	-0.09																
se01												-0.44													
se02											-0.50		-0.64												
se09												-0.56													
ukd3															-0.50		-0.70	-0.42							
ukd4														-0.50			-0.70								
uke1																		-0.45	-0.49						
uke4														-0.49	-0.50										
ukf1														-0.48		-0.50					-0.60				
ukf3																-0.51		-0.46		-0.48		-0.49			
ukg1																				-0.46	-0.59			-0.55	
ukg2																		-0.45			-0.64				
ukg3																				-0.52					
ukh1																-0.47			-0.45						
ukh3																							-0.51		
uki2																						-0.51		-0.55	-0.42
ukj1																									-0.45
ukj2																							-0.58	-0.58	
ukk1																								-0.52	

Notes: *Autonomous leading regions are listed in header row (N=23).*

Table 3b. *Correlations between neighboring leading regions: Spillover leading regions (be10-es62)*

	be10	be23	be25	be31	be33	be34	de11	De12	de13	de14	de21	de25	de26	de50	de60	de71	de94	dea1	dea2	deb1	deb2	dee2	dee3	def0	es41	es42	es43	es62
be10				0.60																								
be23			0.51																									
be25		0.70																										
be31	0.60																											
be33						0.62															0.68							
be34					0.73																							
be35					0.72																							
de11								0.62		0.26			0.66															
de12							0.30		-0.03	-0.01			0.34			0.24												
de13										0.25																		
de14							0.47	0.65	0.27																			
de21												0.63																
de25											0.58		0.65															
de26																0.42												
de50																	0.04											
de60																								0.75				
de71								0.51					0.58					0.67		0.65								
de93														0.67														
de94														0.78														
dea1																			0.63		0.56							
dea2					-0.51													-0.62		-0.51	-0.40							
deb1																0.34			0.65		0.33							
deb2					0.51														0.57	0.33								
dee1																						0.15	0.18					
dee2																							0.16					
dee3																						0.16						
def0															0.09													
es30																									0.01	-0.03		
es41																											-0.15	
es42																											-0.17	0.13
es43																									0.16	0.14		
es52																										0.18		
es62																										0.23		
lu00					0.74	0.48															0.58							
nl11																	-0.11											
nl13																	-0.07											
at31												0.59																
pt18																											0.04	

Notes: *Spillover leading regions are listed in header row (N=39).*

Table 3c. *Correlations between neighboring leading regions: Spillover leading regions (fr10-ukk1)*

	fr10	**fr21**	**fr22**	**fr24**	**fr51**	**lu00**	**nl11**	**nl21**	**at31**	**ukg1**	**ukk1**
be33						0.17					
be34						0.17					
de21									0.48		
de94							-0.17				
deb2						-0.14					
fr10		0.52	0.52	0.46							
fr21	0.24		0.44								
fr22	0.19	0.51									
fr24	0.17										
fr52					0.48						
nl12							0.22	0.11			
nl13								0.02			
ukf1										-0.47	
ukg1											-0.65
ukg2										-0.46	
ukg3										-0.47	
ukj1										-0.50	1.00
ukk1										0.99	

Notes: *Spillover leading regions are listed in header row (N=39).*

Table 4. Industry-services-leaders' characteristics in 1995

Region	Extend of Characteristics Above the Average of the Industry-Services-Leaders			Extend of Characteristics Below the Average of the Industry-Services-Leaders		
	Patents per Capita	**Employment in High Technology Sectors**	**Population Density**	**Patents per Capita**	**Employment in High Technology Sectors**	**Population Density**
at22	X				X	X
at31	X				X	X
be10	**X**	**X**	**X**			
be23		X	X	X		
be25		X		X		X
be31	X	X				X
be33		X		X		X
be34		X		X		X
be35		X		X		X
de11	X	X				X
de12	**X**	**X**	**X**			
de13	X	X				X
de14	X	X				X
de21	X	X				X
de25	X	X				X
de26	X	X				X
de50		X	X	X		
de60	**X**	**X**	**X**			
de71	**X**	**X**	**X**			
de93	X				X	X
<u>de94</u>				<u>X</u>	<u>X</u>	<u>X</u>
dea1	**X**	**X**	**X**			
dea2	**X**	**X**	**X**			
deb1	X	X				X
deb2	X	X				X
def0	X	X				X
ie01		X		X		X
[es30]		X	X	X		
<u>es42</u>				<u>X</u>	<u>X</u>	<u>X</u>
fr10	**X**	**X**	**X**			
fr24	X	X				X
fr63		X		X		X
itc2		X		X		X
<u>[itd1]</u>				<u>X</u>	<u>X</u>	<u>X</u>
<u>[itd2]</u>				<u>X</u>	<u>X</u>	<u>X</u>
[ite4]		X		X		X
<u>[itf1]</u>				<u>X</u>	<u>X</u>	<u>X</u>
itf2		X		X		X
itf3			X	X	X	
lu00	X				X	X
nl22	X		X		X	
nl42	**X**	**X**	**X**			
[se01]	X	X				X
[se02]	X	X				X
[se09]	X	X				X
[ukd3]	**X**	**X**	**X**			
[ukd4]			X	X	X	
[uke4]	X		X		X	
[ukf1]	**X**	**X**	**X**			
ukg1	X	X				X
[ukg2]		X		X		X
[ukg3]	**X**	**X**	**X**			
[ukj1]	X	X				X
[ukj2]	**X**	**X**	**X**			
ukk1		X		X		X
Col Total	34	42	19	21	13	36

Notes: X indicates whether a region is above or below the industry-services-leaders' average of each characteristic. Regions in bold (underline) indicate that all of their characteristics are above (below) average. Square brackets indicate autonomous leadership (N=16).

Table 4. Sectoral Convergence Clubs and Externalities' Correlations

Sector	Convergence club	Patents per-capita	Employment in High Technology Sectors	Population Density
Agriculture	Below Average	0.0001	0.0008	0.001
	Towards Average	0.002	0.0014	0.003
	Above Average	0.012	0.022	0.001
Industry	Below Average	0.4	0.51	0.65
	Towards Average	0.64	**0.74**	**0.72**
	Above Average	**0.71**	**0.82**	**0.76**
Services	Below Average	0.34	0.53	0.43
	Towards Average	0.52	**0.77**	0.60
	Above Average	**0.68**	**0.71**	0.53
Agriculture & Industry	Below Average	0.12	0.28	0.31
	Towards Average	0.17	0.15	0.17
	Above Average	0.24	0.47	0.33
Agriculture & Services	Below Average	0.08	0.11	0.12
	Towards Average	0.34	0.45	0.22
	Above Average	0.36	0.47	0.46
Industry & Services	Below Average	0.36	0.31	0.48
	Towards Average	0.58	0.47	0.61
	Above Average	**0.69**	0.64	0.57

Notes: bold and underline indicate the strongest correlations, grey-shaded cells indicate reversals in correlation rankings

Table 5. Tests for β-convergence between regional-groups

$$g_i = a + b_1 y_{i,0} + b_2 PT_{i,0} + b_3 HT_{i,0} + b_4 PD_{i,0} + (\mathbf{I} - \zeta \mathbf{W})^{-1} u_i$$

	EU27 Regions (N=267)	Regions converging below the average (N=34)	Regions converging towards the average (N=96)	Industry-Services Leaders (N=55)
a	1.0835**	1.0072**	1.1032**	4.2807**
b_1	-0.24688**	-0.0681**	-0.2287**	-0.5844**
b_2	0.01117	0.0131*	0.0107*	0.04819
b_3	0.0363**	0.0209**	0.0442**	0.01659*
b_4	0.01328**	0.0018**	0.0278**	0.0558**
ζ	0.4225**	0.1015**	0.3225**	0.7781**
Implied β	2.823**	0.704**	2.596**	8.770**

Notes: * Indicates significance at 90% level of confidence while ** indicates significance at 95% level of confidence.

Appendix

Table A1. *Average Slope Estimates, EU27 regions*

Estimated Equation: $w_{i,t} = \theta_0 + \theta_1 r + \theta_2 r^2 + \ldots + \theta_{k-1} r^{k-1} + \theta_k r^k + u_{i,t}$, OLS

Region	Agriculture		Industry		Services	
be10 Région de Bruxelles-Capitale	-0.0218802		0.0182035	**	0.0306834	**
be21 Prov. Antwerpen	-0.0337025		-0.0407695		-0.0268617	
be22 Prov. Limburg (B)	-0.0284227		-0.0266904		-0.0185315	
be23 Prov. Oost-Vlaanderen	-0.0175894		0.0224201	**	0.0169035	**
be24 Prov. Vlaams Brabant	0.0408076	**	0.0298999	**	-0.024279	
be25 Prov. West-Vlaanderen	-0.0262938		0.0368974	**	0.0163382	**
be31 Prov. Brabant Wallon	-0.0124991		0.0029599	**	0.021044	**
be32 Prov. Hainaut	-0.0105994		-0.0326041		-0.0189504	
be33 Prov. Liège	-0.0239477		0.0283463	**	0.0200842	**
be34 Prov. Luxembourg (B)	-0.015917		0.0357112	**	0.0163296	**
be35 Prov. Namur	-0.019728		0.0177543	**	0.016427	**
bg31 Severozapaden	-0.0237701		-0.0044465		-0.0285249	
bg32 Severen tsentralen	-0.0132615		-0.0036388		-0.0280717	
bg33 Severoiztochen	-0.022517	**	-0.0026462		-0.0353208	
bg34 Yugoiztochen	0.0342365		-0.0030404		-0.0277092	
bg41 Yugozapaden	-0.0199334	**	-0.0045944		-0.0190709	
bg42 Yuzhen tsentralen	0.0173326		-0.0020921		-0.0307266	
cz01 Praha	-0.0241165		-0.0177563		-0.0612163	**
cz02 Strední Cechy	-0.0129358		-0.0183206		-0.0810661	
cz03 Jihozápad	-0.0189548		-0.0184497		-0.066605	
cz04 Severozápad	-0.0100938		-0.0185448		-0.0364651	**
cz05 Severovýchod	-0.0190183		-0.0195355		-0.059975	
cz06 Jihovýchod	-0.0159324		-0.0190598		-0.0766822	
cz07 Strední Morava	-0.0179189		-0.0143994		-0.0411524	**
cz08 Moravskoslezsko	-0.0620611		-0.0175752		-0.088502	**
dk00 Denmark	-0.0371832		-0.0079037		-0.0155704	
de11 Stuttgart	-0.0186222		0.0245944	**	0.0418302	**
de12 Karlsruhe	-0.0294023		0.0267937	**	0.04451	**
de13 Freiburg	-0.0073885		0.0173408	**	0.0355839	**
de14 Tübingen	-0.0151582		0.0192983	**	0.0305637	**
de21 Oberbayern	-0.0018499	**	-0.0207253		-0.0357543	**
de22 Niederbayern	-0.0020322	**	-0.0168082	**	-0.0299602	
de23 Oberpfalz	-0.0041647	**	-0.0201923		-0.0237492	

de24 Oberfranken	-0.001448	**	-0.0135938		-0.033707	
de25 Mittelfranken	-0.0022194		0.0223254	**	0.0314547	**
de26 Unterfranken	-0.0174529		0.0192292	**	0.0281382	**
de27 Schwaben	0.0021465		-0.0205202		-0.0344121	
de30 Berlin	-0.0123191		-0.0184805		-0.0384156	
de41 Brandenburg - Nordost	0.0045936	**	-0.0028247	**	-0.0077318	**
de42 Brandenburg - Südwest	-0.0015168	**	-0.0048977	**	-0.0090447	
de50 Bremen	-0.0225877		0.0202567	**	0.0338593	**
de60 Hamburg	-0.0184329		0.0154732	**	0.0525146	
de71 Darmstadt	-0.017196		0.0168486	**	0.0579981	**
de72 Gießen	-0.0068006	**	-0.0230214		-0.0324443	
de73 Kassel	-0.0028426	**	-0.0151546		-0.0340018	
de80 Mecklenburg-Vorpommern	-0.0038839	**	-0.002947	**	-0.0120556	
de91 Braunschweig	-0.0203698	**	-0.0171912	**	-0.0339902	
de92 Hannover	-0.0033448	**	-0.0279002		-0.0429916	
de93 Lüneburg	-0.0277564	**	0.0014032	**	0.0360657	**
de94 Weser-Ems	0.0050716		0.0160603	**	0.0342208	**
dea1 Düsseldorf	-0.0260824		0.0353183	**	0.0459892	**
dea2 Köln	-0.0019868	**	-0.0291307	**	0.0605427	**
dea3 Münster	-0.0316657	**	-0.0185838	**	-0.0361157	
dea4 Detmold	-0.018503		-0.0287025		-0.0384436	
dea5 Arnsberg	0.0005606	**	-0.0285958		-0.0385734	
deb1 Koblenz	-0.0265748		0.0218109	**	0.0328689	**
deb2 Trier	-0.0367538		0.0220422	**	0.0314847	**
deb3 Rheinhessen-Pfalz	-0.0341235		-0.0390541		-0.0410586	
dec0 Saarland	-0.0197496		-0.0275011		-0.0359898	
ded1 Chemnitz	0.0010357		-0.0004232		-0.010574	
ded2 Dresden	-0.001314	**	0.0026864	**	-0.0107755	**
ded3 Leipzig	0.0033199	**	-0.0087508		-0.0154765	
dee1 Dessau	-0.0052406		0.0024767	**	-0.0084227	
dee2 Halle	-0.0097606		0.0122002	**	-0.0099495	
dee3 Magdeburg	-0.0266085		0.0003428	**	-0.0087596	
def0 Schleswig-Holstein	-0.0347715		0.0300828	**	0.0343521	**
deg0 Thüringen	-0.0002639		-0.00095		-0.0088388	
ee00 Estonia	-0.0216425		-0.0291063		-0.0214366	
ie01 Border, Midlands and Western	-0.0082029		0.0078911	**	0.0140533	**
ie02 Southern and Eastern	-0.0210696		0.0189088		0.0282575	

gr11 Anatoliki Makedonia, Thraki	-0.0366299		0.0053897		0.0014662	
gr12 Kentriki Makedonia	-0.0030681	**	-0.0032251	**	0.0002732	
gr13 Dytiki Makedonia	0.0211483		-0.0015572		0.0058044	
gr14 Thessalia	-0.0098376	**	-0.0004507	**	0.0006099	
gr21 Ipeiros	0.0462135		-0.039246		-0.0034806	
gr22 Ionia Nisia	-0.0109966	**	-0.0121456		-0.001335	**
gr23 Dytiki Ellada	0.0144343		0.0292081		-0.0087407	
gr24 Sterea Ellada	0.0050071		-0.0092239		-0.0330742	
gr25 Peloponnisos	0.0065286		0.0553852		-0.0048619	
gr30 Attiki	0.035653	**	-0.0090353	**	0.0089275	
gr41 Voreio Aigaio	0.0306573		-0.001398		-0.0064054	
gr42 Notio Aigaio	0.0360585		0.0290749		0.0117754	
gr43 Kriti	0.0467819		0.0012478		-0.0001633	**
es11 Galicia	-0.0320647	**	-0.0024087	**	-0.0027021	
es12 Principado de Asturias	-0.0161282		-0.0137198		-0.0058268	
es13 Cantabria	0.004274	**	-0.0070506	**	-0.0107851	
es21 Pais Vasco	-0.0326353		-0.0109895		-0.0125151	
es22 Comunidad Foral de Navarra	-0.0285951		-0.0147561		-0.0117091	
es23 La Rioja	-0.0298019	**	-0.0038456	**	-0.0085776	
es24 Aragón	0.0223745		-0.0089684	**	-0.0077866	
es30 Comunidad de Madrid	-0.0145527		0.014087	**	0.0139059	**
es41 Castilla y León	0.0059757		-0.0081992		-0.0034535	
es42 Castilla-la Mancha	-0.0225963		0.0002113	**	0.0028683	**
es43 Extremadura	0.0078407	**	0.0005996		0.0004339	
es51 Cataluña	0.0266571		-0.0114876		-0.0082472	
es52 Comunidad Valenciana	0.0317525	**	0.0014073	**	-0.0037389	
es61 Andalucia	-0.021562		-0.0045244		-0.0031992	
es62 Región de Murcia	0.0020917	**	0.0007428	**	-0.001336	
es63 Ciudad Autónoma de Ceuta (ES)	-0.0188397	**	-0.0075799	**	-0.0248041	
es64 Ciudad Autónoma de Melilla (ES)	0.0020349		-0.0166198		-0.0037306	
es70 Canarias (ES)	0.0023814		-0.0002081		-0.006222	
fr10 Île de France	0.0153969		0.0252319	**	0.0232372	**
fr21 Champagne-Ardenne	0.0007703	**	0.0148968	**	-0.0218229	
fr22 Picardie	0.0348207	**	0.0257127	**	-0.0246067	
fr23 Haute-Normandie	-0.0042719		-0.0244148		-0.024223	
fr24 Centre	-0.0366452		0.0182508	**	0.0226486	**
fr25 Basse-Normandie	0.0200313	**	0.0195009	**	-0.018251	

fr26 Bourgogne	-0.0545197	**	-0.0162199		-0.0211088	
fr30 Nord - Pas-de-Calais	-0.0265092	**	-0.0295494		-0.0221432	
fr41 Lorraine	-0.024953	**	-0.0184195		-0.0256128	
fr42 Alsace	0.0336998	**	0.0283047	**	-0.0312595	
fr43 Franche-Comté	-0.0141788	**	-0.0124951		-0.0202607	
fr51 Pays de la Loire	0.0103686	**	-0.0126033		0.020332	**
fr52 Bretagne	0.0094859	**	-0.0113298		0.0174642	**
fr53 Poitou-Charentes	-0.0203976		-0.0132689		-0.0203623	
fr61 Aquitaine	-0.0447176	**	-0.0115209	**	-0.0181282	
fr62 Midi-Pyrénées	-0.0176621	**	-0.0125739	**	-0.0193167	
fr63 Limousin	0.027736		0.0130099	**	0.0202964	**
fr71 Rhône-Alpes	-0.0168136	**	-0.0219842		-0.023917	
fr72 Auvergne	-0.0038007	**	-0.0146969		-0.0202275	
fr81 Languedoc-Roussillon	-0.0147614	**	-0.0168486		-0.0211915	
fr82 Provence-Alpes-Côte d'Azur	-0.0092883	**	-0.020561		-0.0280698	
fr83 Corse	-0.0005419	**	-0.0142331		-0.0207998	
fr91 Guadeloupe (FR)	-0.0069555	**	-0.0191258		-0.0030271	**
fr92 Martinique (FR)	0.0092101		-0.0101864		-0.0046384	
fr93 Guyane (FR)	-0.0097375	**	0.0142981		-0.0137382	**
fr94 Reunion (FR)	-0.0281		-0.0056772		-0.0087769	
itc1 Piemonte	-0.0154133	**	-0.014979		-0.0133101	**
itc2 Valle d'Aosta/Vallée d'Aoste	-0.0562779		0.0246099	**	0.0304661	**
itc3 Liguria	-0.0416		-0.0044887		-0.0101338	
itc4 Lombardia	-0.0487853		-0.0059613		-0.0048514	
itd1 Provincia Autonoma Bolzano-Bozen	0.0467698		0.026123	**	0.0269368	**
itd2 Provincia Autonoma Trento	0.0462295		0.0053658	**	0.0277137	**
itd3 Veneto	0.0049043		-0.0048173	**	-0.0091142	**
itd4 Friuli-Venezia Giulia	-0.0329476	**	-0.0109179		-0.0139588	**
itd5 Emilia-Romagna	0.0469415	**	-0.0069599	**	-0.0130938	
ite1 Toscana	-0.0326677		-0.001937		-0.0059135	
ite2 Umbria	-0.003681		-0.005944		-0.0136243	
ite3 Marche	-0.0158424		-0.0041334		-0.0107845	
ite4 Lazio	0.0057353		0.0033659	**	0.0019198	**
itf1 Abruzzo	-0.01411		0.0001547	**	0.0104628	**
itf2 Molise	-0.005829		0.0068796	**	0.0186402	**
itf3 Campania	0.0043532		0.0040673	**	0.0083513	**
itf4 Puglia	-0.0026907		-0.0012632		-0.002212	

itf5 Basilicata	0.0003202		-0.0119384	**	-0.0166889	**
itf6 Calabria	-0.0136579		-0.0026058		-0.0040831	
itg1 Sicilia	0.0133515		-0.0094093		-0.0089107	
itg2 Sardegna	0.004088		-0.011557		-0.0077933	
cy00 Cyprus	-0.0182202		-0.0022476	**	0.0005267	**
lv00 Latvia	-0.0303069	**	-0.0215064	**	-0.0296612	
lt00 Lithuania	-0.0215617		-0.0309103		-0.0303401	
lu00 Luxembourg (Grand-Duché)	0.0126871		0.0163044	**	0.0476823	
hu10 Közép-Magyarország	-0.035912	**	-0.0173069		-0.0526458	
hu21 Közép-Dunántúl	-0.0407605	**	-0.0179189		-0.1000244	
hu22 Nyugat-Dunántúl	-0.0492868		-0.0183785		-0.0195318	
hu23 Dél-Dunántúl	-0.0335494		-0.0195854		-0.0189877	
hu31 Észak-Magyarország	-0.0273177		-0.0121788		-0.0178602	
hu32 Észak-Alföld	-0.0422675		-0.0186849		-0.017076	
hu33 Dél-Alföld	-0.0347122		-0.0290998		-0.0183703	
mt00 Malta	-0.0216513		0.0211938		0.0144644	
nl11 Groningen	0.02604	**	0.0195363	**	0.0087704	
nl12 Friesland	-0.0190686	**	-0.016338	**	0.0119242	**
nl13 Drenthe	0.0330369	**	0.0136067	**	0.0074394	
nl21 Overijssel	-0.0199131		-0.0003086		0.0143335	**
nl22 Gelderland	-0.0045657		0.0170328	**	0.0104564	**
nl23 Flevoland	-0.0211967	**	0.0211011		0.0342922	
nl31 Utrecht	-0.04121	**	-0.0018805	**	0.0243614	
nl32 Noord-Holland	-0.0131338	**	-0.0190138	**	0.0172782	
nl33 Zuid-Holland	0.0199606	**	0.003466	**	0.007542	
nl34 Zeeland	-0.007471	**	-0.0100415	**	0.0005373	**
nl41 Noord-Brabant	-0.046855	**	-0.0015714	**	0.0195617	
nl42 Limburg (NL)	-0.0169196		0.0096351	**	0.0157325	
at11 Burgenland	-0.0399127		0.0013871	**	-0.0244656	
at12 Niederösterreich	0.0315545	**	-0.0273572		0.0019206	**
at13 Wien	-0.0050397		0.0007851	**	-0.0362954	
at21 Kärnten	0.0603014		-0.0179694		-0.0229945	
at22 Steiermark	0.0562046		0.0082461	**	0.0228059	**
at31 Oberösterreich	0.0393634		0.0157756	**	0.0273335	**
at32 Salzburg	0.067255		-0.0206565		-0.0302018	
at33 Tirol	0.0188723		-0.0135288	**	-0.0223299	
at34 Vorarlberg	0.0120342		-0.0034006	**	-0.0281266	

pl11 Lódzkie	-0.018223	**	-0.0127082		-0.0295352	**
pl12 Mazowieckie	0.0364798		-0.0330377	**	-0.0280753	**
pl21 Malopolskie	0.0212838		-0.0181444		-0.0310651	
pl22 Slaskie	0.042336		-0.000571	**	-0.0706881	**
pl31 Lubelskie	0.0245395		-0.0190647		-0.0688313	**
pl32 Podkarpackie	0.0552176		-0.0189757		-0.028088	**
pl33 Swietokrzyskie	0.0264915		-0.0126527		-0.0284188	**
pl34 Podlaskie	0.0555131		-0.0123572		-0.0673844	**
pl41 Wielkopolskie	0.0073307		-0.0101497	**	-0.0610915	**
pl42 Zachodniopomorskie	0.0688786		-0.0169532	**	-0.0679819	**
pl43 Lubuskie	0.0578098		-0.0141011		-0.0400206	**
pl51 Dolnoslaskie	0.015191		-0.0188196		-0.0713389	**
pl52 Opolskie	0.0166843		-0.0183462		-0.050496	**
pl61 Kujawsko-Pomorskie	0.0006131		-0.0085214		-0.0669574	
pl62 Warminsko-Mazurskie	0.0329361		-0.0129447		-0.0743356	**
pl63 Pomorskie	0.0582271		-0.0185915		-0.0697771	**
pt11 Norte	0.0200749		0.0263957		-0.0058279	**
pt15 Algarve	-0.0273503		0.0426602		0.0021199	
pt16 Centro (PT)	0.0328726		0.0231786		-0.0031344	**
pt17 Lisboa	0.0405856		0.0034688		-0.0015298	**
pt18 Alentejo	0.0084488	**	0.0067171		-0.0044213	**
pt20 Região Autónoma dos Açores (PT)	-0.018936		-0.0254696		-0.0033343	
pt30 Região Autónoma da Madeira (PT)	-0.011145	**	-0.0249706		0.0009028	
ro11 Nord-Vest	0.0282234		-0.0108738		-0.0296185	
ro12 Centru	0.0215266		-0.0258948	**	-0.0322409	
ro21 Nord-Est	-0.0047252		-0.0301612		-0.0267061	
ro22 Sud-Est	0.0089076		-0.0188686		-0.0192774	
ro31 Sud - Muntenia	0.0102148		-0.0307692		-0.0196361	
ro32 Bucuresti - Ilfov	0.0258313		-0.0129084	**	-0.015137	
ro41 Sud-Vest Oltenia	0.013893		-0.0040602	**	-0.0183942	**
ro42 Vest	0.0134151		-0.0267439		-0.0193375	
si00 Slovenia	-0.0201675	**	-0.0280601		-0.0004663	**
sk01 Bratislavský kraj	-0.0545198	**	-0.0171894		-0.0503287	**
sk02 Západné Slovensko	-0.0149983		-0.0182702		-0.06991	
sk03 Stredné Slovensko	-0.0168268		-0.0166542		-0.0687325	
sk04 Východné Slovensko	-0.0235288		-0.0137386		-0.0510841	
fi13 Itä-Suomi	0.0199947	**	-0.0257726		-0.0110869	

fi18 Etelä-Suomi	0.0186414	**	-0.0002473		0.0131676	**
fi19 Länsi-Suomi	0.0206075	**	-0.0114648		0.0101876	**
fi1a Pohjois-Suomi	-0.0070334	**	-0.0145421	**	-0.0135606	
fi20 Åland	-0.0296625		-0.0039041		-0.0011503	
se01 Stockholm	-0.0235703		0.0117098	**	0.0033012	**
se02 Östra Mellansverige	-0.0026386		-0.0256685		-0.0131114	
se04 Sydsverige	0.0085823	**	-0.0113139		0.0110545	**
se06 Norra Mellansverige	-0.0324395		-0.029146		-0.0131125	
se07 Mellersta Norrland	-0.0323816	**	-0.0379523		-0.0149848	**
se08 Övre Norrland	-0.0322704		-0.0200278		-0.0159996	
se09 Småland med öarna	-0.0277818		0.0233695	**	0.0142342	**
se0a Västsverige	-0.0082675		-0.0172297		-0.0130854	
ukc1 Tees Valley and Durham	0.0308896		-0.0013606	**	0.0007251	
ukc2 Northumberland, Tyne and Wear	-0.0151195		0.0173752	**	0.0029816	
ukd1 Cumbria	0.0268302		-0.0057304	**	-0.0015254	**
ukd2 Cheshire	0.0526977	**	0.0037589	**	0.0034355	
ukd3 Greater Manchester	-0.0029913		0.002572	**	0.0050311	**
ukd4 Lancashire	0.047057		0.0052907	**	0.0001355	**
ukd5 Merseyside	-0.041412	**	-0.0063327	**	0.0004427	
uke1 East Riding and North Lincolnshire	-0.0455819		0.0096649	**	0.0002439	
uke2 North Yorkshire	0.0091963		-0.0035687		0.0001189	
uke3 South Yorkshire	0.028778	**	0.0038882		0.0009774	**
uke4 West Yorkshire	0.0093916		0.0037027	**	0.0058617	**
ukf1 Derbyshire and Nottinghamshire	0.0144542		0.0058116	**	0.0063747	**
ukf2 Leicestershire, Rutland and Northants	-0.0405334		0.0141856		0.0093565	
ukf3 Lincolnshire	-0.0494454	**	0.0042526	**	-0.0004194	**
ukg1 Herefordshire, Worcestershire and Warks	0.0343924		0.014498		0.0048941	
ukg2 Shropshire and Staffordshire	0.035349		0.0050614	**	0.0059787	**
ukg3 West Midlands	-0.0005688		0.0068133	**	0.0066504	**
ukh1 East Anglia	-0.0287118		0.0050497	**	0.0042668	
ukh2 Bedfordshire, Hertfordshire	0.0066947	**	0.00134	**	0.0176765	
ukh3 Essex	-0.0210862		-0.0001702		0.0042108	**
uki1 Inner London	-0.0289796		0.0118686		0.0339749	
uki2 Outer London	0.0197179		-0.0056797		0.0118633	**
ukj1 Berkshire, Bucks and Oxfordshire	0.0019662		0.0190825	**	0.0210645	**
ukj2 Surrey, East and West Sussex	-0.0252528		0.0077732	**	0.0108393	**
ukj3 Hampshire and Isle of Wight	-0.0091957	**	0.0068755		0.0026791	

ukj4 Kent	-0.0122541		0.0062504	**	0.0003087	
ukk1 Gloucestershire, Wiltshire and North Somerset	0.0008817		0.0147264	**	0.0112932	
ukk2 Dorset and Somerset	0.0410556		0.0161021	**	0.0003807	
ukk3 Cornwall and Isles of Scilly	0.0644619		0.0006444		-0.0106421	
ukk4 Devon	0.0303667		-0.0072258	**	-0.0009158	**
ukl1 West Wales and The Valleys	0.0132954	**	-0.0068377		0.0003595	**
ukl2 East Wales	-0.0026647		0.0009703	**	0.0081844	
ukm1 North Eastern Scotland	-0.0165903	**	-0.0128904	**	0.013115	
ukm2 Eastern Scotland	-0.0262768		-0.011855		0.0041162	**
ukm3 South Western Scotland	0.0136084	**	0.0162417		0.0028419	**
ukm4 Highlands and Islands	0.000598	**	0.0049764	**	-0.0065786	
ukn0 Northern Ireland	-0.0161734	**	0.0063124		0.0032519	

Notes: ** indicates significance at 95% level. The specific choice of the polynomial order is then made using the Akaike and the Schwartz-Bayesian information criteria.

NOTES

[1] For Ricardo the process of growth leads to convergence, while Marx and Malthus argue that growth exaggerates an already established unevenness leading to divergence. A more detailed discussion can be found in BOYER (1997).

[2] Although originally developed for national economies, ALEXIADIS and TOMKINS (2004) demonstrated that it is equally suited to regional economies.

[3] As this study has a large number of observational units (viz. 267 regions) and the ADF is geared towards testing convergence between *pairs* of regions it produces a rather complicated and possibly misleading picture.

[4] Table A1 in the Appendix lists the regions used in this study.

[5] See for example NEVEN and GOUYETTE (1995), OXLEY and GREASLEY (1995), etc. On the other hand, OÖSTERHAVEN and BROERSMA (2007) offer a particular interesting approach in detecting clusters based on a sectoral decomposition of labour productivity. This analysis, however, is restricted in the context of the regions of a single country (Denmark).

[6] See Table A1 in the Appendix.

[7] Neighbouring is operationalised here as sharing a common border. This relation however is not reciprocal; e.g. the central French region Île de France (fr10), shares a common border with by five regions, viz. Champagne-Ardenne (fr21), Picardie (fr22), Haute-Normandie (fr23), Centre (fr24) and Bourgogne (fr26). The region Centre (fr24) shares common borders only with Haute-Normandie (fr23) and Bourgogne (fr26). It should thus be made explicit that although there are 72 neighbouring leading regions, only 64 of them have a reciprocal neighbouring relation.

[8] For a review of these models see MARTIN (1999), MARTIN and SUNLEY (1998), among others.

[9] This is also the case when comparisons are made with the respective EU27 averages.