Examining Agriculture from a Regional Perspective: Implications for the Common Agricultural Policy[*]

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Abstract. Regional convergence is one of the major goals of the European Union. In this paper, the intention is to augment the existing literature on regional convergence across the NUTS-2 regions of EU-27 in terms of agricultural labour productivity during the period 1995-2004. A low annual rate of absolute convergence is estimated for the NUTS-2 regions over the period 1995-2004. The rate of regional convergence exhibits a considerable variation across different territorial divisions of the European Union. The implications of these results are discussed in the context of the Common Agricultural Policy and respective recommendations are issued.

Keywords: Agriculture, European Union, CAP

1. Introduction

Recent years have witnessed a growing number of attempts to assess regional convergence using extensive datasets, such as the regions of the European Union (EU). This focus of interest is not entirely unexpected given the concern about regional convergence or what the European Commission calls 'regional cohesion'. As Button and Pentecost (1999) point out '[…] if the growth rates of regions deviate significantly this, it is feared, can generate instabilities. Those in the poorer regions feel resentment at the prosperity of others' (p. 2). In this literature industrial sites are mainly considered from a planning or environmental point of view, thereby largely neglecting the economic perspective Nevertheless, in the so far literature regional convergence is mainly considered from a aggregate point of view, i.e. for the economy a whole[1], neglecting the agricultural sector[2], especially at the regional level.

[*] The findings, interpretations and conclusions are entirely those 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.

[1] It is not difficult to document studies on regional convergence across Europe (e.g. Button and Pentecost, 1995; Neven and Gouyette, 1995; Álvarez-Garcia *et al*., 2004; Ezcurra *et al*., 2005). Fewer studies refer specific sectors, explicitly, usually manufacturing (Pascual and Westermann, 2002; Gugler and Pfaffermayr, 2004) or services (e.g. Button and Pentecost, 1993).

[2] Some notable exemptions are the studies by Soares and Ronco (2000), Bivand and Branstad (2003, 2005).

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Regional convergence in terms of the agricultural sector is a key issue, especially in connection with the Common Agricultural Policy (CAP). The second pillar of the CAP ('rural development') and the agricultural and rural sections of the Structural Fund Programs of the European Regional Policy attempt to promote a 'regionalisation' of agricultural policies. As regions in the EU take more political and administrative responsibilities, the 'regionalisation' of CAP incurs opportunities and challenges for regions. However, Trouvé and Berriet-Solliec (2010) point out the risk that this regionalisation might increase inequalities across regions. Therefore, a clear and precise knowledge of the existing convergence pattern across the European regions is essential for an effective reform of the CAP. This paper attempts to shed some further light on that issue. We should emphasise at the outset that the approach used in this paper is mainly quantitative. However, it is hoped that this paper will be able to isolate some interesting views on the issue of convergence in RALP across Europe. The rest of this paper is structured in the following manner. Section 2 is devoted to an overview of agriculture in Europe. Two of the most commonly used measures of regional convergence are discussed in Section 3. Section 4 presents the econometric results. In the concluding section we offer a possible explanation for the results we obtain and suggest that might afford an interesting policy conclusion.

2. Agriculture in the European Union

Europe faces probably the worst recession since World War II. The current economic crisis has wiped out years of economic and social progress and exposed structural weaknesses in Europe's economy. More than 80 million people are at risk of poverty; 19 million of them are children while 8% of labour force does not earn enough to make it above the poverty threshold[3]. Unemployment, budget deficits[4] and divergent growth patterns result to accumulation of government debts and put uncertainty and unpredictability for the single currency (euro). The GDP in the EU-27 has fall by 4% in 2009, industrial production has dropped back to the levels of the 1990s and 23 million people (10% of active population) are unemployed[5]. According to EUROSTAT (2010), employment rate rose from an average of 65.4% in 2007 to only 65.9% in 2008. The Lisbon employment target (70%) is set to be achieved in 2010[6]. However, in 2008, only 94 NUTS-2 regions, out of 271 regions, had already achieved this target for 2010, while 50 regions were still 10 percentage points below the overall employment target. Relatively low employment rates were

[3] Poverty threshold is defined as 60% of the average income in each Member State of the EU.

[4] Budget deficits were 7% of the GDP, on average (the target of 3% of GDP is set to be achieved by 2013) and debt levels at over of 80% of the GDP.

[5] Only two-thirds of labour force in the EU is currently employed, compared to over 70% in the US and Japan.

[6] It is questionable, however, if, under the present circumstances, the target of the employment 75% of the population aged 20-64 set by Europe 2020 would be achieved.

recorded in the south of Spain, the south of Italy, Greece, Poland, Slovakia, Hungary, Bulgaria and Romania, whereas a relatively high employment rate characterises the regions of Netherlands, United Kingdom, Denmark, Sweden and Finland.

Europe faces a moment of transformation and three factors can be taken into consideration: globalisation, energy consumption and climate change. Globalisation creates more opportunities for producers and entrepreneurs, who are in a position of enjoying larger markets and higher competitions. Consumers will benefit from higher living standards through lower prices and a wider choice of goods. A general increase in economic activity and trade will enhance labour demanded and real wages for skilled labour create employment and increase economic growth. Globalisation is driving scientific and technological progress, making the European dimension ever more important in boosting knowledge, mobility, competitiveness and innovation. The opening up of huge new markets creates vast opportunities for Europeans, but it will at the same time test Europe's capacity to further adjust to structural change and manage the social consequences of that change. The dissemination of innovation and know-how will also increase productivity. However, globalisation might also bring structural adjustment. Increasing competition can put additional pressure on local firms and, indirectly, on wages, especially for low-skilled labour. Regions are enlarging their area of influence, sometimes globally. Several regions in the EU should restructure their economic base and promote continuous innovation (in products, management and processes), as well as human and social capital – to face the challenge of globalisation. Nonetheless, the benefits of globalisation remain concentrated in a limited number of regions with advanced urban centres. Globalisation is likely to increase regional imbalances within Europe. Most regions located in the Southern and Eastern parts of the EU, stretching from Latvia, Eastern Slovakia, Hungary, Bulgaria and Romania to Greece, Italy, Spain and Portugal, appear to be much more exposed to the challenges of globalisation. This vulnerability is predominantly due to the relatively large share of low value added activities in these regions and weaknesses in workforce qualifications, which may lead to difficulties in attracting investment and creating or maintaining jobs.

The EU is characterised by a growing external energy dependency, especially in the fossil energy sources (oil, gas, coal) and in nuclear energy sources (uranium)[7]. Agriculture and industry, especially Small-Medium Enterprises (SMEs), have been hit hard by the economic crisis and all sectors adjusting their production processes and products to a low-carbon economy. Energy prices appear to have become ever more volatile with extreme price peaks. Peripheral regions located in Eastern and southern Member States appear to be more vulnerable. Energy consumed directed by agriculture is related to the use of machinery, such as tractors, and the heating of livestock stables and greenhouses. There is also the indirect energy use for the production of agrochemicals, farm machinery and buildings while considerable

[7] In 2005, 53% of energy consumption in the EU was covered by imports.

amounts of natural gas are used for the production of inorganic nitrogen fertilisers. Although the use of machinery and mineral fertilisers results to increases in agricultural productivity and food supply, nevertheless it contributes to the depletion of non-renewable energy sources and to global warming (CO_2 emissions from fossil fuel consumption). The total consumption of energy by agriculture in the EU-27 has decreased by 7% since 2005; from 29,939 kilo tonnes of oil equivalent to 27,826 in 2007 (EUROSTAT, 2010a). The share of agriculture in final energy consumption by all sectors, in the EU-27 on average has been steadily declining, from 2.7% in 2000 to 2.4% in 2007. Nevertheless, this share exhibits considerable variations across the EU-27 countries (8.1% in the Netherlands and 0.6% in the United Kingdom). This index, however, does not reveal anything about the intensity of energy use by agriculture and depends on the size of agricultural sector, the energy use and size of the remaining sectors. Therefore, a more appropriate indicator would be the final energy consumption of all energy products by agriculture in kilograms of oil equivalent per hectare of utilised agricultural area. According to EUROSTAT (2010), the average energy consumption in the EU-27 is 161 kilograms of oil equivalent per hectare. The highest energy consumption per hectare is recorded for the Netherlands (2,166 kilograms of oil equivalent) due to the high intensity of production in heated greenhouses, the most energy consuming type of crop production.

Climate change will, in the long-run, lead to an increase in average annual temperatures, alter rainfall quantities and patterns, and raise the sea level and the risk of coastal erosion. In Southern regions, climate change is projected to worsen existing conditions through declining precipitation and drought. More than 170 million people (about one third of the EU population) live in regions most affected by climate change. Regions subject to the highest pressure are generally located in the South and East of Europe, Spain, Italy, and several southern parts of France Greece, Bulgaria, Malta, Hungary and Romania. Although agriculture is of particular importance for the low-income Southern regions, nevertheless these are characterised by a low capacity for adoption to climate change. The Alpine areas with reliable snowfall will decrease and the industry will have to shift its focus to summer holidays, whereas Mediterranean regions might suffer from temperatures above the heat comfort zone and loss of biodiversity. In the energy sector, climate change will lead to changing patterns of energy demand and to greater fluctuations in energy production and demand, particularly in regions with a high share of renewable energy[8] and varying availability of water for cooling of large-scale heating power plants. These effects will impact on regional growth potential in affected regions and create disparities with those regions that are less affected by climate change. Changing weather conditions will have a negative impact on

[8] The share of renewable energy resources in consumer's energy consumption exhibits considerable variation across the EU countries. The highest percentage is recorded for Sweden (about 40% in 2005), due to geothermal and hydro energy production, while the lowest are found in the UK, Luxembourg and Malta. Increasing tendencies are evident in Latvia, Lithuania, Romania and Estonia.

human health and well-being in several areas[9]. In this respect, the Mediterranean regions will suffer the most from worsening conditions, while Northern, Western and Eastern European regions will see a less serious deterioration or even a temporary improvement in conditions. Changes in temperature and precipitation will also lead to changing agricultural yields and production methods with distinct patterns throughout Europe. In fisheries, climate change will place an even greater strain on marine ecosystems subject to over fishing. This is likely to intensify the existing social and environmental disparities between the EU regions, especially in terms of regional agricultural labour productivity (RALP).

The Treaty of Rome expresses a commitment to "ensure a fair standard of living for the agricultural community, particularly by increasing the individual earnings of persons engaged in agriculture" while increased productivity in agriculture is one of the main goals of the Common Agricultural Policy (CAP); a policy which still dominates the EU budget[10].

Even a swift glance at the various publications of EUROSTAT (1999, 2007) reveals that this activity follows a declining tendency. For instance, total employment in agriculture has fallen from 16.3 million in 1970 to 7.9 million in 1994. In 2005 the share of agriculture, hunting, forestry and fisheries in Europe's (EU-25) total employment was just 4.9% while in this share EU-15 was 3.7%. An employment share more than 10% is recorded for five countries (Greece, Latvia, Lithuania, Austria and Poland). In EU-15, throughout a period of ten years (1995-2005), the labour input[11] in agriculture has declined by an average rate of 2% annually while for the EU-25 countries, this share was about 2.5% (Table 1). This decline in agriculture is accompanied with an increase of labour employed in sectors related to services. To be more specific, in 2005 the share of economic activities in total employment of EU-25 was 67.6% in services, 27.5% in industry and 4.9% in agriculture.

A similar tendency is observed for the share of agriculture in Gross Value Added (GVA) (Table 2). In 2005, about 2% of the EU-25 GVA is produced by sectors related to agriculture. The share of these sectors in the New Member States (NMS) is relatively higher compared to that of the EU-12 and EU-15. Nevertheless, there examples of EU-15 countries in which the share of agriculture is higher than NMS (Greece and Poland with shares 5.2% and 4.8%, respectively). In 2005 the share of agriculture in the total GVA of EU-26 was less than 1.8%. Nevertheless, agriculture does not seem to be evenly distributed across the EU countries. For

[9] The increasing number of heat-related deaths, the limited availability and quality of drinking water, constitute examples of such negative impacts.

[10] For a more detailed of the CAP see Fennell (1979, 1997), Grant (1997), Scott (1995), among others.

[11] Labour input is measured in terms of Annual Works Units (AWUs), defined as full-time equivalent employment (total hours worked) divided by the average annual number of hours worked in full-time jobs within an economic territory. It covers all persons providing salaried and non-salaried labour input to the agricultural industry.

example, France, the largest agricultural producer in the EU-12, contributes 19.1% in total agricultural output, followed by Italy (14.7%) and Spain (12.2%)[12].

Table 1. Labour Input in Agriculture

	1995	2000	2005	1995-2000	2000-2005
	AWU (1,000 persons)			Annual Change (in %)	
EU-25	**:**	**10,540**	**9,310**	**:**	**-2.5**
EU15	**7,209**	**6,529**	**5,797**	**-2**	**-2.3**
Belgium	84	75	71	-2.3	-1.2
Czech Republic	:	166	157	:	-1.1
Denmark	90	76	65	-3.3	-2.9
Germany	792	685	583	-2.9	-3.2
Estonia	70	65	38	-1.7	-10.2
Greece	645	586	610	-1.9	0.8
Spain	1,102	1,101	989	-0.02	-2.1
France	1,137	1,028	943	-2	-1.7
Ireland	232	172	167	-5.8	-0.5
Italy	1,463	1,383	1,159	-1.1	-3.5
Cyprus	:	24	22	:	-1.7
Latvia	:	149	136	:	-1.7
Lithuania	:	187	151	:	-4.1
Luxembourg	5	4	4	-2.6	-1.4
Hungary	780	676	521	-2.8	-5.1
Malta	5	4	4	-0.4	-0.8
Netherlands	221	220	197	-0.1	-2.2
Austria	198	175	169	-2.4	-0.7
Poland	:	2,495	2,292	:	-1.7
Portugal	619	503	370	-4.1	-5.9
Slovenia	111	104	91	-1.3	-2.6
Slovak Republic	203	143	101	-6.8	-6.6
Finland	141	111	96	-4.6	-2.8
Sweden	90	77	76	-3.3	-0.2
United Kingdom	391	334	299	-3.1	-2.2
Bulgaria	:	771	626	:	-4.1
Romania	:	3,645	2,515	:	-7.2

: Not Available. Source: EUROSTAT (2007)

[12] Depending on the specific year, Germany after unification is classified as the second power in agriculture in the EU-12.

Table 2. Gross Value Added in Agriculture (% of the total economy)

	1995	2000	2002	2003	2004	2005
EU-25	**2.8**	**2.3**	**2.2**	**2.1**	**2.1**	**1.9**
EU-15	**2.7**	**2.2**	**2.1**	**2**	**2**	**1.8**
Belgium	1.5	1.5	1.4	1.1	1.1	1.1
Czech Republic	5	3.9	3.3	3.1	3.3	2.9
Denmark	3.5	2.6	2.2	2	1.9	1.5
Germany	1.3	1.3	1.1	1.1	1.2	1
Estonia	8	4.9	4.2	3.7	3.8	3.7
Greece	9.9	7.3	7	6.7	5.7	5.2
Spain	4.5	4.4	4	4	3.8	3.3
France	:	2.8	2.7	2.5	2.5	2.2
Ireland	7	3.4	2.6	2.5	2.5	:
Italy	3.3	2.8	2.6	2.5	2.5	2.3
Cyprus	5.1	3.6	3.7	3.4	3	2.9
Latvia	9.1	4.6	4.6	4.1	4.4	4.1
Lithuania	11.4	7.9	7	6.4	5.8	5.7
Luxembourg	1	0.7	0.6	0.6	0.5	0.4
Hungary	6.7	5.4	4.7	4.3	4.8	4.3
Malta	:	2.3	2.5	2.5	2.5	2.5
Netherlands	3.5	2.6	2.3	2.3	2.2	2.2
Austria	2.7	2.1	2	1.9	1.9	1.6
Poland	8	5	4.5	4.4	5.1	4.8
Portugal	5.7	3.8	3.3	3.4	3.3	2.8
Slovenia	4.2	3.2	3.2	2.6	2.7	2.5
Slovak Republic	5.9	4.5	5.1	4.5	4.5	4.3
Finland	4.3	3.5	3.3	3.2	3.1	2.9
Sweden	2.7	1.9	1.8	1.8	1.8	1.2
United Kingdom	1.8	1	0.9	1	0.9	0.9
Bulgaria	:	13.9	12.1	11.6	10.9	9.3
Romania	:	12.4	12.6	13.0	14.3	10.1

: Not Available. Source: EUROSTAT (2007)

Agriculture accounts for about 20%, on average, of the working population in Greece and only 2% in Belgium and the UK. In 1988 as an illustration, the percentage employed in agriculture ranged from 45.9% in the region of Central Greece down to 0.2% in the Brussels-Gewest region and 0.3% in Bremen. In terms of RALP, about 46% of the EU-27 regions are below the European average with the majority of them located in Southern Mediterranean and Eastern Europe. Northern regions, especially in the UK and Netherlands, characterised by a cost effective agricultural sector, display a level of labour productivity two times higher than regions located in Southern and Eastern countries, which are generally characterised by relatively high shares of labour force employed in agriculture. A

rather stable distribution of crop-specialist, livestock-specialist and mixed farming holdings is detected between 2003 and 2007. About 40% of agricultural holdings in the EU-27 are specialized[13] in cropping (filed crops, horticulture and permanent crops), 22% in livestock (grazing livestock, granivores, i.e. animals mainly feeding on cereals, such as pigs and poultry) and 38% on mixed farming holdings. Regions in the Mediterranean (especially in Greece, Italy, Portugal and Spain) and in Scandinavian countries are highly specialized in crops while livestock farming is the dominant activity in the agricultural sector of several regions in Ireland, the UK, Germany and the Benelux countries. On the other hand, mixed farming is found in most regions of the New Member States (NMS). Considerable variations are also detected in the regional distribution of input expenditure. On average, input expenditure is rather low in the regions of Portugal (less than 190 euros per hectare) while the average input expenditure in the western coastal regions is in the range between 630 and 1,040 euros per hectare.

From what has been said in this section, it is obvious that there are considerable differences in agriculture across the EU-27. Clearly, this implies that rate of convergence might differ across the European regions. It becomes of crucial importance, therefore, to determine an appropriate framework for examining the trends in regional convergence. The following section presents a contextual review of two of the most commonly used measures of regional convergence.

3. The Empirical Framework

In the context of *regional convergence*, the term 'region' refers either to areas determined according to similarities in geographical characteristics or areas corresponding to administrative divisions, which may be arbitrary. The relevant literature makes extensive use of two alternative notions; σ-convergence and absolute β-convergence.

Conceptually, σ-convergence is based upon the cross-sectional dispersion in per-capita GDP and is defined as a decreasing tendency in the dispersion of per-capita GDP. Typically, σ-convergence is measured by standard deviation ($\sigma_{i,t}$) (Dalgaard and Vastrup, 2001):

$$\sigma_{i,t} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left[\log\left(\frac{y_i}{y^*}\right)\right]^2} \quad . \qquad (1)$$

where $\log y^* \equiv \frac{1}{n}\sum_{i=1}^{n}\log y_i$.

[13] The terms 'specialisation' is used to describe the trend towards a single dominant activity in farm income. An agricultural holding is characterised by EUROSTAT as specialised if a particular activity provides a Standard Cross Margin (SGM), i.e. the difference between gross production and costs, at least two-thirds of the total SGM of the holding.

σ-convergence is signified when $\sigma_{i,T} < \sigma_{i,0}$ or more generally, when $\sigma_{i,t} \to 0$, as $t \to T$, where T is a terminal time.

Absolute β-convergence requires that regions with relatively low initial labour productivity grow faster that those with relatively high labour productivity. Consider a distribution of regional labour productivity, i.e. $\mathbf{Y_{i,0}} = [Y_{\min,0}, \cdots, Y_{\max,0}]$ and the associated rates of growth, i.e. $\mathbf{g_{i,T}} = [g_{\min,T}, \cdots, g_{\max,T}]$. Absolute convergence occurs when $g_{i,T} \to g_{\min,T}$ as $Y_{i,0} \to Y_{\max,0}$, as shown in Figure 1:

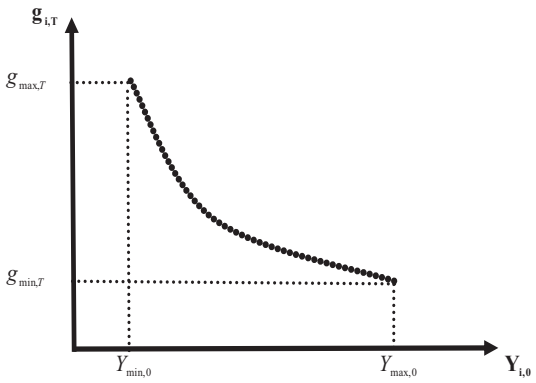

Fig. 1. Catch-up between 'Poor' and 'Rich' Regions

Assume that regional growth ($g_{i,T}$) over a given time period ($T = 0, \ldots, t$) is a function of the initial level of labour productivity ($Y_{i,0}$). This assumption can be expressed as follows (Goddard and Wilson, 2001):

$$g_{i,T} = f(Y_{i,0}). \quad (2)$$

Assume further that labour productivity ($Y_{i,T}$) grows as follows,

$$Y_{i,T} = e^{g_{i,T}} Y_{i,0}. \quad (3)$$

Taking logarithms and solving equation (2) for $g_{i,T}$ yields:

$$g_{i,T} = y_{i,t} - y_{i,0}. \quad (4)$$

Hence, the test for regional convergence is formulated in terms of the following dynamic regression equation:

$$g_{i,T} = a + b y_{i,0}. \quad (5)$$

In equation (5), the parameter b, the 'convergence coefficient', reflects the partial correlation between the growth rate and the initial level of labour productivity ($f'_{g_{i,T} y_{i,0}}$). Absolute convergence requires that $b \in [-1 \;\; 0]$ while $b \in [0 \;\; 1]$ indicates that $g_{i,T} \to g_{\max,T}$ as $y_{i,0} \to y_{\max,0}$. In the latter case high-productivity regions grow faster than low-productivity regions increasing the existing gap between them. If $b = 0$ implies that $g_{i,T} = a$, i.e. regions grow at a

given rate which can be considered as an indication of an autonomous growth rate that maintains productivity differences across regions. There is, of course, the case when $b = -1$, which Romer (1996) describes as 'perfect convergence'. Similarly, the condition $b = 1$ can be conceived as 'perfect divergence'.

In this context, it is possible (and necessary given the concerns of this paper) to construct a precise measure of the *speed* at which regions converge. Following Barro and Sala-i-Martin (1995) the convergence coefficient can be expressed as follows:

$$b = -(1 - e^{-\beta T}). \tag{6}$$

Equation (6) can be written as follows:

$$e^{\beta T}(b+1) = 1 \Rightarrow e^{\beta T} = \frac{1}{(b+1)}. \tag{7}$$

Solving equation (7) for β it is possible to obtain an expression for the speed at which regions approach the steady-state value of labour productivity. Thus, the average rate of convergence over a time period is given by the following ratio:

$$\beta = -\frac{\ln(b+1)}{T}. \tag{8}$$

Given that $b \in [-1 \quad 0]$ signifies convergence, then $\beta \in [0 \quad 1]$. A value of $\beta = 0$ indicates absence of absolute convergence while $\beta = 1$ indicates a rate leading to perfect convergence. It follows, therefore, that a higher β corresponds to more rapid convergence. Estimating equation (4) using various data sets, Sala-i-Martin (1996a) estimates a 'surprisingly' similar rate of convergence across both regional and national economies, and forms the 'mnemonic rule' that 'economies converge at a speed of about two percent per year.' (p. 1326).

Barro and Sala-i-Martin (1995) argue that even if absolute β-convergence holds, the dispersion of per-capita income does not necessarily tend to decline over time and β-convergence can occur simultaneously with absence of σ-convergence. In this respect σ-convergence is a stricter criterion than β-convergence. Friedman (1992) argues that β-convergence is a weak criterion due to the fact that is a regression to the mean. Carree and Klomp (1997) offer a solution to this problem using the following ratio:

$$S_{i,T} = \sqrt{N}\,\frac{\hat{\sigma}_{i,1}^2 / \hat{\sigma}_{i,T}^{\ 2} - 1}{2\sqrt{1-(1-\hat{\beta}_i)^2}}. \tag{9}$$

where N is the number of observations.

The hypothesis of convergence is accepted if $S_{i,T} \neq 0$.

Having outlined the main features of the regional convergence model, this paper will proceed to evaluate the pattern of regional convergence across the NUTS-2 regions of the EU-27.

3. Convergence in RALP across the EU-27 regions

Agricultural productivity can be approximated in various ways. In this paper we exploit data on GVA per worker since this measure is a major component of differences in the economic performance of regions and a direct outcome of the various factors that determine regional 'competitiveness' (Martin, 2001). The regional groupings used in this paper are those delineated by EUROSTAT and refer to 310 NUTS-2 regions[14]. The EU uses NUTS-2 regions as 'targets' for convergence and defined as the 'geographical level at which the persistence or disappearance of unacceptable inequalities should be measured' (Boldrin and Canova, 2001, p. 212). Despite considerable objections for the use of NUTS-2 regions as the appropriate level at which convergence should be measured, the NUTS-2 regions are sufficient small to capture sub-national variations (Fischer and Stirböck, 2006).

The time period extends from 1995 to 2004; a time period that might be considered as somehow short. However, Durlauf and Quah (1999) point out that convergence-regressions, such as equation (4), are valid for shorter time periods as well, since they are based on an approximation around the 'steady-state' and supposed to capture the dynamics toward the 'steady-state'.

The values of standard deviation for the initial and the terminal years of the analysis (0.9 and 0.88, respectively) seem to confirm the hypothesis of σ-convergence across the NUTS-2 regions of the EU-27. Additional support is provided by the $S_{i,T}$ ratio, which is estimated to be positive (0.27).

Figure 2 summarises the potential for absolute convergence between 1995 and 2004. Essentially, this figure is a scatterplot which shows the average annual growth rate against the initial level of labour productivity.

[14] A list of the NUTS-2 regions used in this paper is provided in Appendix. Due to data limitations, previous studies on regional convergence across the EU-27 regions used to treat countries, such as Denmark, Lithuania and Slovenia as NUTS-2 regions. In this paper, the empirical analysis is enhanced using data for the NUTS-2 regions of the aforementioned countries.

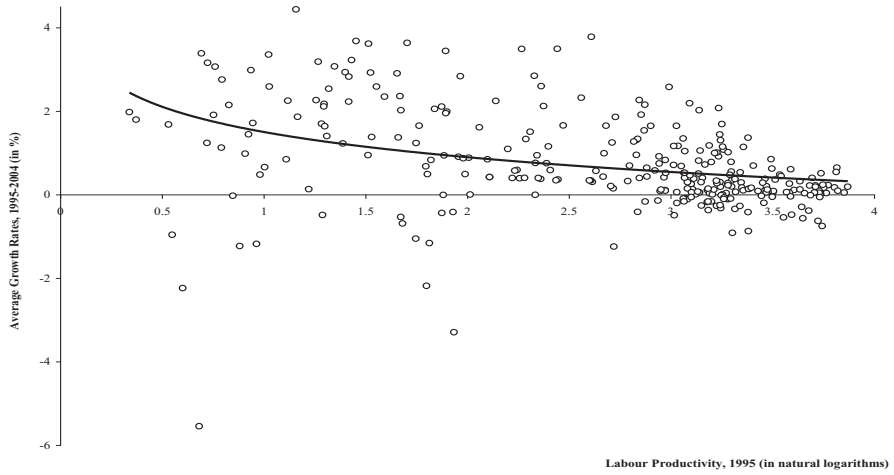

Fig. 2. Absolute β-convergence in RALP, EU-27 regions, 1995-2004

Casual inspection of the data in Figure 2 provides some indication of an inverse relationship between the average annual growth rate and initial level of RALP. Nevertheless, this property does not appear to be uniform across all the NUTS-2 regions of the EU-27. As Figure 2 makes visible, this property seems to be constrained in a certain group of regions with a relatively high initial level of RALP. Several regions, on the other hand, appear to diverge, in the sense that relatively low initial levels of labour productivity are associated with relatively low rates of growth and vice versa.

The presence of absolute convergence (or divergence), however, cannot be confirmed by visual inspection alone. A formal test for absolute convergence can be expressed in terms of the following regression equation:

$$g_{i,T} = a + b_1 y_{i,t_0} + \varepsilon_i . \qquad (\mathbf{10})$$

where ε_i is the random error-term, $t_0 = 1995$ and $T = 10$.

Equation (8) is estimated using Ordinary Least Squares (hereafter OLS), for the NUTS-2 regions of EU-27 while separate regressions are carried out for the regional divisions of EU-12, EU-15 and the NMS[15]. The results are set out in Table 3 and show that the convergence coefficient (b_1) to be negative and statistically significant at the 95% level in the case of the NUTS-2 regions of the EU-27. Table 3 also shows the average rate of convergence, implied by equation (8).

[15] These are Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovak Republic, Romania and Bulgaria.

Table 3: Regional Convergence in Agriculture

	EU-27	EU-15	EU-12	NMS
Depended Variable: $g_{i,T}$ OLS				
a	0.2678	0.4689	0.6313	0.1037
b_1	-0.0437	-0.1084	-0.1601	0.0665
Implied β (in %)	**0.4471**	**1.1473**	**1.7451**	**-0.6441**

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

The presence of absolute convergence in the form of a negative relationship between the rate of growth and initial level of labour productivity is suggested by this evidence, and the NUTS-2 regions of the EU-27 have, on average, shown a tendency to converge over the period 1995-2004, albeit at a relatively slow rate of 0.45% per annum. Given this slow rate of convergence, it would take a very long time for *all* the EU-27 regions to reach a common level of labour productivity, as predicted by the absolute convergence model.

Analysis for the NUTS-2 regions of the EU-12 and EU-15 shows that the regions of EU-12 exhibit a relatively high average rate of convergence compare to that estimated for the regions of the EU-15 (1.75% and 1.14%, respectively). On the other hand, the property of absolute convergence does not appear to characterise the regions of the new and ascending countries. As the results imply, these regions actually diverge at a rate almost equal to 0.6% per annum. There is a positive relationship between the rate of growth and initial level of labour productivity, suggesting that in these countries initially high-productivity regions grow at expanse of initially low-productivity regions.

Estimating equation (10) separately for each EU-27 country[16], yields the results in Table 4[17]. It is clear that the property of regional convergence is restricted mainly in the EU-15 with the Netherlands to exhibit the highest rate (8.2% per annum). The results also indicate that only 4 NMS (Czech Republic, Hungary, Slovenia and Romania) are able to converge.

[16] Luxembourg, Cyprus and Malta are considered as single NUTS-2 regions and had to be excluded.

[17] For brevity, only the coefficients and the rates of convergence are shown.

Table 4. Regional Convergence in Agriculture: Country Analysis

	b_1	Implied β (in %)
Belgium	-0.1906	2.1149
Denmark	-0.0821	0.8563
Germany	-0.2614	3.0304
Ireland	-0.3763	4.7207
Greece	-0.0231	0.2337
Spain	-0.2643	3.0695
France	0.0370	-0.3629
Italy	-0.3559	4.3995
Netherlands	-0.5580	8.1634
Portugal	0.1263	-1.1891
United Kingdom	-0.3656	4.5509
Austria	-0.0427	0.4359
Sweden	0.0014	-0.0136
Finland	-0.3840	4.8450
Bulgaria	0.4640	-3.8119
Czech Republic	-0.3659	4.5552
Estonia	0.0742	-0.7155
Latvia	0.0874	-0.8375
Lithuania	0.0180	-0.1787
Hungary	-0.2063	2.3100
Poland	0.0857	-0.8224
Slovenia	-0.0403	0.4109
Slovakia	0.0893	-0.8556
Romania	-0.1154	1.2261

The results in Table 4 illustrate several points. The existence of different rates of convergence in different levels of territorial disaggregation is, perhaps, not unexpected. The EU cannot be characterised as a static entity and its spatial composition has changed considerably since its early days. The EU is, as Button and Pentecost (1999) aptly call, 'a fluctuating geographical area' (p. 45). Successive enlargements of the EU have brought into the union regions with low levels of labour productivity in agriculture, a fact which has obviously brought additional difficulties in the process of regional convergence in EU. With a larger number of regions the patterns of convergence can, of course, become more complex with some groups of regions converging while others diverge and where outlying or peripheral regions can distort the overall pattern.

This dissimilarity in the rates of convergence implies considerable 'within' countries variations in growth rates. Almost all countries exhibited standard

deviations in growth rates lower than the international standard deviations, as shown in Table 5. In contrast, there is a greater variability of internal regional growth rates for most of the NMS. This provides some support to the argument that inter-regional disparities tend to increase during the initial stages of development[18].

Table 5. Growth Differentials in RALP

	Standard Deviation	Minimum	Maximum	Range
EU-27	1.1600	-5.5438	4.4418	9.9856
EU-12	0.8767	-3.2910	3.7840	7.0750
EU-15	0.8827	-3.2910	3.7840	7.0750
NMS	1.4947	-5.5438	4.4418	9.9856
Belgium	0.3166	-0.4763	0.5586	1.0349
Denmark	0.4876	-0.9124	1.1736	2.0860
Germany	0.4686	-5.5438	1.6563	7.2001
Ireland	0.0804	-0.1032	0.4247	0.5278
Greece	0.1877	0.2776	0.9490	0.6714
Spain	0.9298	-0.2660	2.8402	3.1062
France	0.0976	-0.1588	0.2802	0.4390
Italy	1.0460	-0.0549	3.4988	3.5536
Netherlands	0.4223	-0.6232	0.9216	1.5447
Portugal	2.4485	-3.2910	3.4944	6.7854
United Kingdom	0.8991	-0.5414	3.7840	4.3254
Austria	1.2673	-0.6871	3.6386	4.3257
Sweden	0.3912	-0.1615	1.1474	1.3089
Finland	0.8193	-0.8705	1.3497	2.2202
Bulgaria	0.5822	0.9866	2.5918	1.6052
Czech Republic	0.9766	-0.2465	2.2682	2.5147
Estonia	0.8103	1.3843	3.6861	2.3018
Latvia	0.9433	-0.4826	3.3903	3.8729
Lithuania	1.1302	-0.4826	3.1648	3.6474
Hungary	0.4209	0.4952	1.9558	1.4606
Poland	1.6595	-2.2358	3.3587	5.5945
Slovenia	0.7852	1.6173	4.4418	2.8245
Slovakia	0.2527	0.3445	0.9958	0.6513
Romania	0.9620	0.3445	2.9877	2.6432

The empirical results, reported in this section might be considered, to a certain extent, as descriptive. In particular, there is a critical question that an answer should be provided. What do these empirical results imply about the effectiveness of the

[18] This idea is put forward by Williamson (1965).

CAP in regional agricultural convergence? It seems that this policy had little effect in promoting regional convergence in agriculture. CAP can be seen as a mechanism able to rectify regional imbalances, although historically has been managed by national and European authorities. Overall, CAP policies seem to have little success in promoting regional convergence or the effects of these policies are slow in restoring regional imbalances. This can be attributed, possibly, to two factors. A first factor is related to the absence of an explicit regional perspective in designing and implementing CAP. Future agricultural policies should aim towards countries with 'slow-converging' regions, i.e. regions in which intervention is more urgent compare to regions belonging to others groups. A second factor refers to 'inferior' responses of regions in low-paths. Indeed, several such regions, especially in the Mediterranean area, had limited experience in incorporating CAP initiatives in their production structures. It might be argued that CAP benefits were rather an 'additional' income to the produces in these regions, rather than as an opportunity for improvement.

4. Concluding Remarks

In the case of the EU, and although an increasing number of empirical studies have paid attention to issues of economic convergence, the empirical assessment of agricultural productivity convergence has not so far received the due attention. In this paper some new empirical work has been set in the context of an expanding empirical literature that has concerned itself with question of regional convergence. To be more precise, the hypothesis of convergence in terms of agricultural labour productivity is tested empirically using data for the NUTS-2 regions of the European Union over the period 1995-2004. Taken as a whole, we think that these results are important for the ongoing European policy debate about regional convergence.

What is clarified by the econometric results is that the European regions exhibit a slow tendency of convergence in terms of agricultural labour productivity. Convergence appears to be considerably faster within the EU-12 and EU-15 regions. In terms of implications for public policy, especially regional policy, this paper raises a number of pertinent issues. Firstly, regional assistance should, to a substantial extent, be diverted towards those regions that exhibit a relatively low rate of convergence. Secondly, the greater part of effort and assistance should be directed to improve the underlying structural conditions of slow-converging regions and thereby generate an economic environment that more closely resembles the combination of characteristics found in the fast-converging regions, such as product-mix, adoption of new techniques and innovations in agriculture and so forth.

While the empirical results are serious in the own right, they must be placed in perspective. There is a little pretence that the forgoing analysis provides an exhaustive account of all the factors that affect the process of regional convergence in terms of agriculture productivity. For example, additional complications arise from the multidimensional nature of the institutional and political structure of the CAP; a policy with spatial implications. Nevertheless, the CAP has been designed

and managed at the national level. The variations in the rates of convergence in terms of regional convergence in agricultural productivity reported in this paper suggest that an explicit regional dimension should be taken in the next CAP reform, anticipated in 2013. The challenge for policy makers and practitioners at different administrative levels is to appreciate the heterogeneous territorial context in Europe and get inspiration for including an explicit spatial dimension in further policy development. Examination of the interaction between the political and spatial dimensions of CAP to individual regions remains an important area for future research.

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APPENDIX: The NUTS-2 Regions of EU-27

Country	Number of Regions	Region
Belgium	1	*be10* Région de Bruxelles
	2	*be21* Prov. Antwerpen
	3	*be22* Prov. Limburg (B)
	4	*be23* Prov. Oost-Vlaanderen
	5	*be24* Prov. Vlaams Brabant
	6	*be25* Prov. West-Vlaanderen
	7	*be31* Prov. Brabant Wallon
	8	*be32* Prov. Hainaut
	9	*be33* Prov. Liège
	10	*be34* Prov. Luxembourg (B)
	11	*be35* Prov. Namur
Denmark	1	*dk001* København og Frederiksberg Kommuner
	2	*dk002* Københavns amt
	3	*dk003* Frederiksborg amt
	4	*dk004* Roskilde amt
	5	*dk005* Vestsjællands amt
	6	*dk006* Storstrøms amt
	7	*dk007* Bornholms amt
	8	*dk008* Fyns amt
	9	*dk009* Sønderjyllands amt
	10	*dk00a* Ribe amt
	11	*dk00b* Vejle amt
	12	*dk00c* Ringkøbing amt
	13	*dk00d* Århus amt
	14	*dk00e* Viborg amt
	15	*dk00f* Nordjyllands amt
Germany	1	*de11* Stuttgart
	2	*de12* Karlsruhe
	3	*de13* Freiburg
	4	*de14* Tübingen
	5	*de21* Oberbayern
	6	*de22* Niederbayern
	7	*de23* Oberpfalz
	8	*de24* Oberfranken
	9	*de25* Mittelfranken
	10	*de26* Unterfranken
	11	*de27* Schwaben
	12	*de30* Berlin
	13	*de41* Brandenburg - Nordost
	14	*de42* Brandenburg - Südwest
	15	*de50* Bremen
	16	*de60* Hamburg
	17	*de71* Darmstadt
	18	*de72* Gießen
	19	*de73* Kassel
	20	*de80* Mecklenburg-Vorpommern
	21	*de91* Braunschweig
	22	*de92* Hannover
	23	*de93* Lüneburg
	24	*de94* Weser-Ems
	25	*dea1* Düsseldorf
	26	*dea2* Köln
	27	*dea3* Münster
	28	*dea4* Detmold
	29	*dea5* Arnsberg
	30	*deb1* Koblenz
	31	*deb2* Trier
	32	*deb3* Rheinhessen-Pfalz
	33	*dec0* Saarland
	34	*ded1* Chemnitz
	35	*ded2* Dresden
	36	*ded3* Leipzig
	37	*dee1* Dessau
	38	*dee2* Halle
	39	*dee3* Magdeburg
	40	*def0* Schleswig-Holstein
	41	*deg0* Thüringen
Greece	1	*gr11* Anatoliki Makedonia, Thraki
	2	*gr12* Kentriki Makedonia
	3	*gr13* Dytiki Makedonia
	4	*gr14* Thessalia
	5	*gr21* Ipeiros
	6	*gr22* Ionia Nisia
	7	*gr23* Dytiki Ellada
	8	*gr24* Sterea Ellada
	9	*gr25* Peloponnisos
	10	*gr30* Attiki
	11	*gr41* Voreio Aigaio
	12	*gr42* Notio Aigaio
	13	*gr43* Kriti
Spain	1	*es11* Galicia
	2	*es12* Principado de Asturias
	3	*es13* Cantabria
	4	*es21* Pais Vasco
	5	*es22* Comunidad Foral de Navarra
	6	*es23* La Rioja
	7	*es24* Aragón
	8	*es30* Comunidad de Madrid
	9	*es41* Castilla y León
	10	*es42* Castilla-la Mancha
	11	*es43* Extremadura
	12	*es51* Cataluña
	13	*es52* Comunidad Valenciana
	14	*es61* Andalucia
	15	*es62* Región de Murcia
	16	*es63* Ciudad Autònoma de Ceuta (ES)
	17	*es64* Ciudad Autònoma de Melilla (ES)
	18	*es70* Canarias (ES)
France	1	*fr10* Ile de France
	2	*fr21* Champagne-Ardenne
	3	*fr22* Picardie
	4	*fr23* Haute-Normandie
	5	*fr24* Centre
	6	*fr25* Basse-Normandie
	7	*fr26* Bourgogne
	8	*fr30* Nord - Pas-de-Calais
	9	*fr41* Lorraine
	10	*fr42* Alsace
	11	*fr43* Franche-Comté
	12	*fr51* Pays de la Loire
	13	*fr52* Bretagne
	14	*fr53* Poitou-Charentes
	15	*fr61* Aquitaine
	16	*fr62* Midi-Pyrénées
	17	*fr63* Limousin
	18	*fr71* Rhône-Alpes
	19	*fr72* Auvergne
	20	*fr81* Languedoc-Roussillon
	21	*fr82* Provence-Alpes-Côte d'Azur
	22	*fr83* Corse
	23	*fr91* Guadeloupe (FR)
	24	*fr92* Martinique (FR)
	25	*fr93* Guyane (FR)
	26	*fr94* Reunion (FR)
Italy	1	*itc1* Piemonte
	2	*itc2* Valle d'Aosta/Vallée d'Aoste
	3	*itc3* Liguria
	4	*itc4* Lombardia
	5	*itd1* Provincia Autonoma Bolzano-Bozen
	6	*itd2* Provincia Autonoma Trento
	7	*itd3* Veneto
	8	*itd4* Friuli-Venezia Giulia
	9	*itd5* Emilia-Romagna
	10	*ite1* Toscana
	11	*ite2* Umbria
	12	*ite3* Marche
	13	*ite4* Lazio
	14	*itf1* Abruzzo
	15	*itf2* Molise
	16	*itf3* Campania
	17	*itf4* Puglia
	18	*itf5* Basilicata
	19	*itf6* Calabria
	20	*itg1* Sicilia
	21	*itg2* Sardegna
Netherlands	1	*nl11* Groningen
	2	*nl12* Friesland
	3	*nl13* Drenthe
	4	*nl21* Overijsel
	5	*nl22* Gelderland
	6	*nl23* Flevoland
	7	*nl31* Utrecht
	8	*nl32* Noord-Holland
	9	*nl33* Zuid-Holland
	10	*nl34* Zeeland
	11	*nl41* Noord-Brabant
	12	*nl42* Limburg (NL)

Country	Number of Regions	Region
Portugal	1	*pt11* Norte
	2	*pt15* Algarve
	3	*pt16* Centro (PT)
	4	*pt17* Lisboa
	5	*pt18* Alentejo
	6	*pt20* Região Autónoma dos Açores (PT)
	7	*pt30* Região Autónoma da Madeira (PT)
United Kingdom	1	*uke1* Tees Valley and Durham
	2	*uke2* Northumberland, Tyne and Wear
	3	*uke31* Cumbria
	4	*uke32* Cheshire
	5	*uke33* Greater Manchester
	6	*uke34* Lancashire
	7	*uke35* Merseyside
	8	*uke1* East Ridding and North Lincolnshire
	9	*uke2* North Yorkshire
	10	*uke3* South Yorkshire
	11	*uke4* West Yorkshire
	12	*ukf1* Derbyshire and Nottinghamshire
	13	*ukf2* Leicestershire, Rutland and Northants
	14	*ukf3* Lincolnshire
	15	*ukg1* Herefordshire, Worcestershire and Warks
	16	*ukg2* Shropshire and Staffordshire
	17	*ukg3* West Midlands
	18	*ukh1* East Anglia
	19	*ukh2* Bedfordshire, Hertfordshire
	20	*ukh3* Essex
	21	*uki1* Inner London
	22	*uki2* Outer London
	23	*ukj1* Berkshire, Bucks and Oxfordshire
	24	*ukj2* Surrey, East and West Sussex
	25	*ukj3* Hampshire and Isle of Wight
	26	*ukj4* Kent
	27	*ukk1* Gloucestershire, Wiltshire and North Somerset
	28	*ukk2* Dorset and Somerset
	29	*ukk3* Cornwall and Isles of Scilly
	30	*ukk4* Devon
	31	*ukl1* West Wales and The Valleys
	32	*ukl2* East Wales
	33	*ukm1* North Eastern Scotland
	34	*ukm2* Eastern Scotland
	35	*ukm3* South Western Scotland
	36	*ukm4* Highlands and Islands
	37	*ukn0* Northern Ireland
Finland	1	*fi13* Itä-Suomi
	2	*fi18* Etelä-Suomi
	3	*fi19* Länsi-Suomi
	4	*fi1a* Pohjois-Suomi
	5	*fi20* Åland
Sweden	1	*se01* Stockholm
	2	*se02* Östra Mellansverige
	3	*se04* Sydsverige
	4	*se06* Norra Mellansverige
	5	*se07* Mellersta Norrland
	6	*se08* Övre Norrland
	7	*se09* Småland med öarna
	8	*se0a* Västsverige
Austria	1	*at11* Burgenland
	2	*at12* Niederösterreich
	3	*at13* Wien
	4	*at21* Kärnten
	5	*at22* Steiermark
	6	*at31* Oberösterreich
	7	*at32* Salzburg
	8	*at33* Tirol
	9	*at34* Vorarlberg
Bulgaria	1	*bg31* Severozapaden
	2	*bg32* Severen tsentralen
	3	*bg33* Severoiztochen
	4	*bg34* Yugozapaden
	5	*bg41* Yugozapaden
	6	*bg42* Yuzhen tsentralen
Czech	1	*cz01* Praha
	2	*cz02* Strední Cechy
	3	*cz03* Jihozápad
	4	*cz04* Severozápad
	5	*cz05* Severovýchod
	6	*cz06* Jihovýchod
	7	*cz07* Strední Morava
	8	*cz08* Moravskoslezsko
Cyprus	1	*cy00* Cyprus
Hungary	1	*hu10* Közép-Magyarország
	2	*hu21* Közép-Dunántúl
	3	*hu22* Nyugat-Dunántúl
	4	*hu23* Dél-Dunántúl
	5	*hu31* Észak-Magyarország
	6	*hu32* Észak-Alföld
	7	*hu33* Dél-Alföld
Malta	1	*mt00* Malta
Poland	1	*pl11* Lódzkie
	2	*pl12* Mazowieckie
	3	*pl21* Malopolskie
	4	*pl22* Slaskie
	5	*pl31* Lubelskie
	6	*pl32* Podkarpackie
	7	*pl33* Swietokrzyskie
	8	*pl34* Podlaskie
	9	*pl41* Wielkopolskie
	10	*pl42* Zachodniopomorskie
	11	*pl43* Lubuskie
	12	*pl51* Dolnoslaskie
	13	*pl52* Opolskie
	14	*pl61* Kujawsko-Pomorskie
	15	*pl62* Warminsko-Mazurskie
	16	*pl63* Pomorskie
Slovakia	1	*sk01* Bratislavský kraj
	2	*sk02* Západné Slovensko
	3	*sk03* Stredné Slovensko
	4	*sk04* Východné Slovensko
Estonia	1	*ee001* Põhja-Eesti
	2	*ee004* Lääne-Eesti
	3	*ee006* Kesk-Eesti
	4	*ee007* Kirde-Eesti
	5	*ee008* Lõuna-Eesti
Latvia	1	*lv003* Kurzeme
	2	*lv005* Latgale
	3	*lv006* Riga
	4	*lv007* Pieriga
	5	*lv008* Vidzeme
	6	*lv009* Zemgale
Lithuania	1	*lt001* Alytaus (Apskritis)
	2	*lt002* Kauno (Apskritis)
	3	*lt003* Klaipedos (Apskritis)
	4	*lt004* Marijampoles (Apskritis)
	5	*lt005* Panevezio (Apskritis)
	6	*lt006* Siauliu (Apskritis)
	7	*lt007* Taurages (Apskritis)
	8	*lt008* Telsiu (Apskritis)
	9	*lt009* Utenos (Apskritis)
	10	*lt00a* Vilniaus (Apskritis)
Slovenia	1	*si001* Pomurska
	2	*si002* Podravska
	3	*si003* Koroska
	4	*si004* Savinjska
	5	*si005* Zasavska
	6	*si006* Spodnjeposavska
	7	*si009* Gorenjska
	8	*si00a* Notranjsko-kraska
	9	*si00b* Goriska
	10	*si00c* Obalno-kraska
	11	*si00d* Jugovzhodna Slovenija
	12	*si00e* Osrednjeslovenska
Romania	1	*ro11* Nord-Vest
	2	*ro12* Centru
	3	*ro21* Nord-Est
	4	*ro22* Sud-Est
	5	*ro31* Sud - Muntenia
	6	*ro32* Bucuresti – Ilfov
	7	*ro41* Sud-Vest Oltenia
	8	*ro42* Vest
Ireland	1	*ie01* Border, Midlands and Western
	2	*ie02* Southern and Eastern
Luxemburg	1	*lu00* Luxembourg (Grand-Duché)