Regional Income Disparities and Convergence: Does Spatial Dependence Matter?

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Abstract

The paper deals with exploring regional economic growth, income disparities and convergence in the countries of the European Union. Overall, 861 regions – mainly at the regional level NUTS-3 – of the EU enlarged in May 2004 are analyzed for the period 1995 - 2003. Spatial econometric methods are applied in order to identify existing spatial interaction and to control effects of spatial autocorrelation. The estimators confirmed that that there is spatial dependence between observations. The results of the analysis show that poorer regions mainly situated in the European periphery have tended to grow faster than the relatively rich European core regions. However, this catching-up process has been painfully slow and it has been driven mainly by national factors. Particularly, national growth rates in the new member states (NMS) have been dominated by very dynamic metropolitan areas. The forces that drive regional convergence seem to have not yet prevailed in NMS. If it can be expected that the dynamics of growth centers in the NMS spillover to rural, more remotely situated and poor regions it might be inefficient to support only those regions with low income levels.

Keywords: regional disparities, convergence, spatial econometrics, regional policy

1. Introduction

There has been a growing interest in exploring regional economic growth, income disparities and convergence between the countries and regions of the EU particularly in the framework of enlargement processes. Several theoretical and empirical approaches have been proposed in order to explore regional disparities, its dynamics regional income convergence. Majority of previous studies have neglected spatial interactions of regional units and indicators that characterize economic development ([1]; [2]; [3]; [4]). Taking into account that regional data cannot be regarded as independently generated because of the presence of similarities among neighbouring regions, the standard estimation procedures can lead to serious bias and inefficiency in the estimates of the convergence rate (see also [5]; [6]).

We want to test the hypothesis whether spatial dependence does matter for regional growth performance and income convergence during the period which is characterised by serious political and economic changes supporting European Union enlargement processes. The analysis of regional income disparities and convergence within the EU countries is conducted using [22] income data of the EU-25 countries and their NUTS-3[1] level regions during the period 1995-2003. The GDP per capita in purchasing power standards (PPS) of the NUTS-3 regions are used as the proxies of regional income in order to analyze income disparities and convergence. The years under observation characterize a preparative period of the fifth enlargement (the so-called east—enlargement) of the EU that took place in May 2004. During this period, which in the current paper is defined as the EU pre-enlargement period, the political decisions about the candidate and the acceding countries were made. The decisions about the candidate countries were made in 1997 (the Luxembourg group: the Czech Republic, Cyprus, Hungary, Estonia and Slovenia) and 1999 (the Helsinki group: Bulgaria, Romania, Latvia, Lithuania, Malta and Slovakia) and about the acceding countries in 2002 (the Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland Slovakia and Slovenia). Two new countries Bulgaria and Romania joined EU in 2007. In order to test the role of spatial dependence in regional income convergence we use both non-spatial and spatial estimation techniques.

The paper is organized as follows: Section 2 introduces theoretical framework and section 3 for exploring regional income convergence. Section 3 gives a short overview of data used for empirical analysis. Section 4 describes regional income disparities during the period under investigation. Sections 5 and 6 present main empirical results regional income convergence analysis. Section 7 concludes considering some proposals for policy implications.

2 . Theoretical Framework

The concept of convergence has been a central issue around which the recent decades' growth literature has evolved (see also [7]. The question is whether the income levels of poorer countries are converging to those of richer countries or not. Economic theory does not give a unique answer to what is the direction of the income convergence processes. Both convergence and divergence (the so-called negative convergence) may occur. Based on several theories, the optimistic (mainly neoclassical growth theory) and pessimistic (mainly endogenous growth theory) approach of explaining convergence processes can be distinguished. The former predicts decrease of disparities of income levels because of decreasing returns of capital and the latter continually significant and even increasing inequality because of positive returns to scale. The endogenous growth theory considers government policy to be absolutely necessary for reducing inequality, while the neoclassical growth theory does not. The integration theory, the classical trade theory and the New Economic Geography (NEG) do not support clearly nor the convergence optimism neither the

[1] NUTS - Nomenclature of Statistical Territorial Units of EUROSTAT.

pessimism. NEG ([8]) claims that location is playing an important role in economic activity of a region. The economic situation of a region depends also on several other factor, for example on interrelations to its' neighbours. Poor regions have ordinarily better chances for development when they are surrounded by rich neighbours.

Empirical literature investigating convergence, economic growth and inequality issues emphasises the question summarized by the Shakespearian-like dilemma "*is income inequality harmful for economic growth*?" The relationship between economic development and income inequality is still not clear. In 1955 Simon Kuznets introduced the hypothesis of an inverted-U relationship between the economic development and inequality which has been called the Kuznets Curve ever since. According to this hypothesis income inequality ordinarily rises in the early stages of economic development and declines in the latter. Later empirical studies offer different results. In the 1990-s some consensus was in concluding that inequality is harmful for economic growth (e.g. [9]). These studies were mainly carried out at country level and the conclusions were that the economies with a higher level of initial inequality are likely to experience lower growth rates in the long run. Using more sophisticated research methodologies and different datasets some authors got also results which predicted a positive relationship between inequality and growth (e.g. [10]). [11] found a positive relationship between inequality and growth concluding that the results of the growth-inequality relationship studies remarkably depend on the datasets and estimation techniques. Differences between results of the studies that are based on the panel data and those that are based on cross-section data could be explained as follows 1) panel techniques look at changes within countries over time, while cross-section studies look at differences between counties with the possibility that the within-country and cross-country relationship might work through different channels; 2) panel studies look at the issue from a short-/medium-run viewpoint, while cross-section studies may investigate the relationship in the long-run period (see also [5]).

Thus, as we noticed from the revising of the previous studies, the empirical results of exploring income convergence, growth and inequality vary considerably depending on the chosen methods of an analysis and on the sample of the countries and periods. Neither economic theory nor previous empirical studies can give clear outlooks of regional income convergence processes in EU countries and their regions; further empirical analysis is necessary for elaborating regional policy instruments.

2. Methodological Framework

2.1. Absolute and conditional beta convergence

If poorer economies grow faster than richer ones, there should also be a negative correlation between the initial income level and the subsequent growth rate. This situation is defined as beta (β)-convergence: β-convergence is a negative relation between the initial income level and the growth rate of income. It should be noticed that β-convergence is a necessary but not a sufficient condition for σ–convergence to occur. A negative β from a growth-initial level regression does not necessarily imply a reduction in variation of regional income or growth rates over time (see [12]).

When discussing convergence processes the distinction between absolute and conditional convergence is usually made. The absolute convergence hypothesis is based on the assumption that economies – countries or regions - converge towards the same steady state equilibrium. With similar saving rates, poorer countries or regions experience faster economic growth than richer ones. This follows from the assumption of diminishing returns which implies a higher marginal productivity of capital in a capital-poor country. The absolute convergence hypothesis argues that per capita incomes in different economies equalise in the long run and that expresses the so-called convergence optimism. In contrast, the concept of conditional convergence emphasises possible spatial heterogeneity in parameters that affect growth and lead to differences in the steady state. This requires that appropriate variables are included in the right side of the growth-initial level regression in order to control for these differences. The conditional convergence hypothesis assumes that convergence will occur, if some structural characteristics - like the demographic situation, government policy, human capital endowment and employment rate, etc - have an impact on income growth. Hence, conditional convergence may occur even if the absolute convergence hypothesis is not valid. So conditional convergence processes may take place even, if poor countries do not tend to grow faster than rich countries.

In order to test for regional convergence, we use the common cross-sectional OLS approach with the growth rate of per capita income as dependent variable and the initial income level as an explanatory variable (both in natural logarithms). Since national characteristics were found to play an important role in growth and convergence processes, we apply dummy variables for countries to control for country-specific effects (e.g. [13]; [14]). This allows steady-states to differ between countries. Hence, the model with the inclusion of country dummies tests for conditional convergence, while the model without country dummies tests the hypothesis of absolute convergence. In the conditional convergence model, however, it is still assumed that regions within the same country approach the identical steady-state.[2]

$$\ln\left(\frac{y_{iT}}{y_{i0}}\right) = \alpha_0 + \alpha_1 \ln(y_{i0}) + \sum_{j=1}^{N} \alpha_{2j} c_{ji} + \varepsilon_i \qquad (1)$$

where

y_{i1995} – GDP *per capita* (PPS) in region *i* in 1995 (initial year),

y_{i2003} – GDP *per capita* (PPS) in region *i* in 2003 (final year),

c_{ij} = 1 if region *i* belongs to country *j*, otherwise d_{ij} = 0,

α_0, α_1 and α_{2j} - parameters to be estimated,

ε_i – error term.

The annual rate of convergence β can be obtained using the equation

$$\beta = -\ln(1-\alpha_1)/T \qquad (2)$$

where T denotes the number of years between the initial and the final year of observation. Another common indicator to characterise the speed of convergence is the so-called half-life τ, which can be obtained from the expression:

$$\tau = \ln(2)/\beta \qquad (3).$$

The half-life shows the time that is necessary for half of the initial income inequalities to vanish. We estimate both, absolute and conditional convergence across regions in the EU. Since convergence patterns are supposed to differ between the EU-15 and the NMS, we estimate separate models for both country-groups as well.

[2] All estimations are carried out using SpaceStat 1.91.

2.2. Spatial dependence and weight matrix

The OLS estimations of the equation (1) assume that all observations in the sample are independent from one another. Especially when a cross-section of regions rather than countries is analysed, the consideration of spatial interaction is important. Ignored spatial dependence can lead to serious consequences in the estimation results in form of the omitted variables bias.

We should take into consideration that also NEG models emphasise the importance of relative location to regional development and there is empirical evidence that regions in a relatively dynamic and prosperous neighbourhood have a better chance to grow than those surrounded by poor and less dynamic regions (see [15]; [16]; [17]). If it happens, however, that growth processes across regions are interrelated and not covered by explanatory variables, the convergence relationship may be misspecified in equation (1).

Spatial interactions among regions can be modelled by means of the spatial weight matrix *W* which is supposed to resemble spatial structure and intensity of spatial effects. There are various possibilities to design a spatial weight matrix. Though it may affect the estimation results, the choice for the design of the spatial weight is somewhat arbitrary because the exact nature of spatial effects is usually not known a priori. However, the possible consequences have to be kept in mind (see [18]).

A common approach is to use the concept of binary contiguity: the elements of the matrix w_{ij}=1 if region *i* and region *j* share a common border or are within a certain distance to each other and w_{ij}=0 otherwise (e.g. [15]). The weight matrix we use, however, will take into account the distance by a decreasing weight the farther the distance between regions *i* and *j* is. The squared inverse of the great circle distance between the geographic centres of the regions is used here as spatial weight. Furthermore, we implement a critical distance cut-off, above which spatial interaction is assumed to be zero. The functional form of the squared inverse of distances can be interpreted as reflecting a gravity function (compare [16]). The distance matrix is row-standardized so that it is relative and not absolute distance that matters.

$$W = \begin{cases} w_{ij} = 0 \quad if \ i = j \\ w_{ij} = 1/d_{ij}^2 \quad if \ d_{ij} \le D \\ w_{ij} = 0 \quad if \ d_{ij} > D \end{cases} \qquad (4),$$

where

$w_{i,j}$ - spatial weight for interaction between regions *i* and *j*;
d – distance between centroids of regions *i* and *j*;
D – critical distance cut-off.

According to Anselin [19], spatial autocorrelation can be defined as a spatial clustering of similar parameter values. If there are more similar values - high or low ones - clustered in one area than there could be by chance, there will be a positive spatial autocorrelation in parameter values. In the opposite case of spatial proximity of dissimilar values, there is negative spatial autocorrelation.

2.3. Spatial models for exploring regional income convergence

Spatial autocorrelation can appear in two different forms: the substantive form and the nuisance form of spatial dependence (see [20]). The former results from direct regional interactions in the observed activity. Ignoring this form of spatial autocorrelation as in equation (1) may lead to biased estimates. The latter form of spatial dependence is restricted to the error term. It stems from measurement errors such as a wrongly specified regional system that does not reflect the spatial structure of economic activities. Ignoring this form may lead to inefficient estimates.

In order to deal with these forms of spatially dependent observations, the spatial error model (SEM) and the spatial lag model (SLM) are estimated as suggested by Anselin [20]. Both models are estimated by maximum likelihood (ML). In these models, spatial dependence is taken into account by the incorporation of the spatial weight matrix *W*.

We estimate the following spatial error model (SEM) including country dummies:

$$\ln(\frac{y_{iT}}{y_{i0}}) = \alpha_0 + \alpha_1 \ln(y_{i0}) + \sum_{j=1}^{N} \alpha_{2j} c_{ji} + \varepsilon_i \text{, with } \varepsilon_i = \lambda[W \cdot \varepsilon]_i + u_i \quad (5),$$

where

λ - spatial autocorrelation coefficient,

$[W \cdot \varepsilon]_i$ - the *i*-th element from the vector of the weighted errors of other regions,

c_{ij} = 1 if region *i* belongs to country *j*, otherwise d_{ij} = 0,

α_0, α_1 and α_{2j} - parameters to be estimated,

ε_i and u_i - normally independently distributed error terms.

In the spatial error model, spatial dependence is restricted to the error term, hence on average per capita income growth is explained adequately by the convergence hypothesis. The SEM, therefore, is an appropriate model specification for the so-called nuisance form of spatial dependence.

The spatial lag model (SLM) is suitable when the ignored spatial effects are of the substantive form, where regional growth is directly affected by the growth rates of the surrounding regions. Growth effects from neighbouring regions are incorporated through the inclusion of a spatial lag of the dependent variable on the right-hand side of the equation:

$$\ln(\frac{y_{iT}}{y_0}) = \alpha_0 + \rho\left[W \cdot \ln(\frac{y_T}{y_0})\right]_i + \alpha_1 \ln(y_{i0}) + \sum_{j=1}^{N} \alpha_{2j} c_{ji} + \varepsilon_i \quad (6)$$

where

ρ - the spatial autocorrelation coefficient,

W - the weight matrix and $\left[W \cdot \ln(\frac{y_T}{y_0})\right]_i$ is the *i*-th element of the vector of weighted growth rates of other regions; other denotations see by the equation (5).

3. Dataset and Regional System

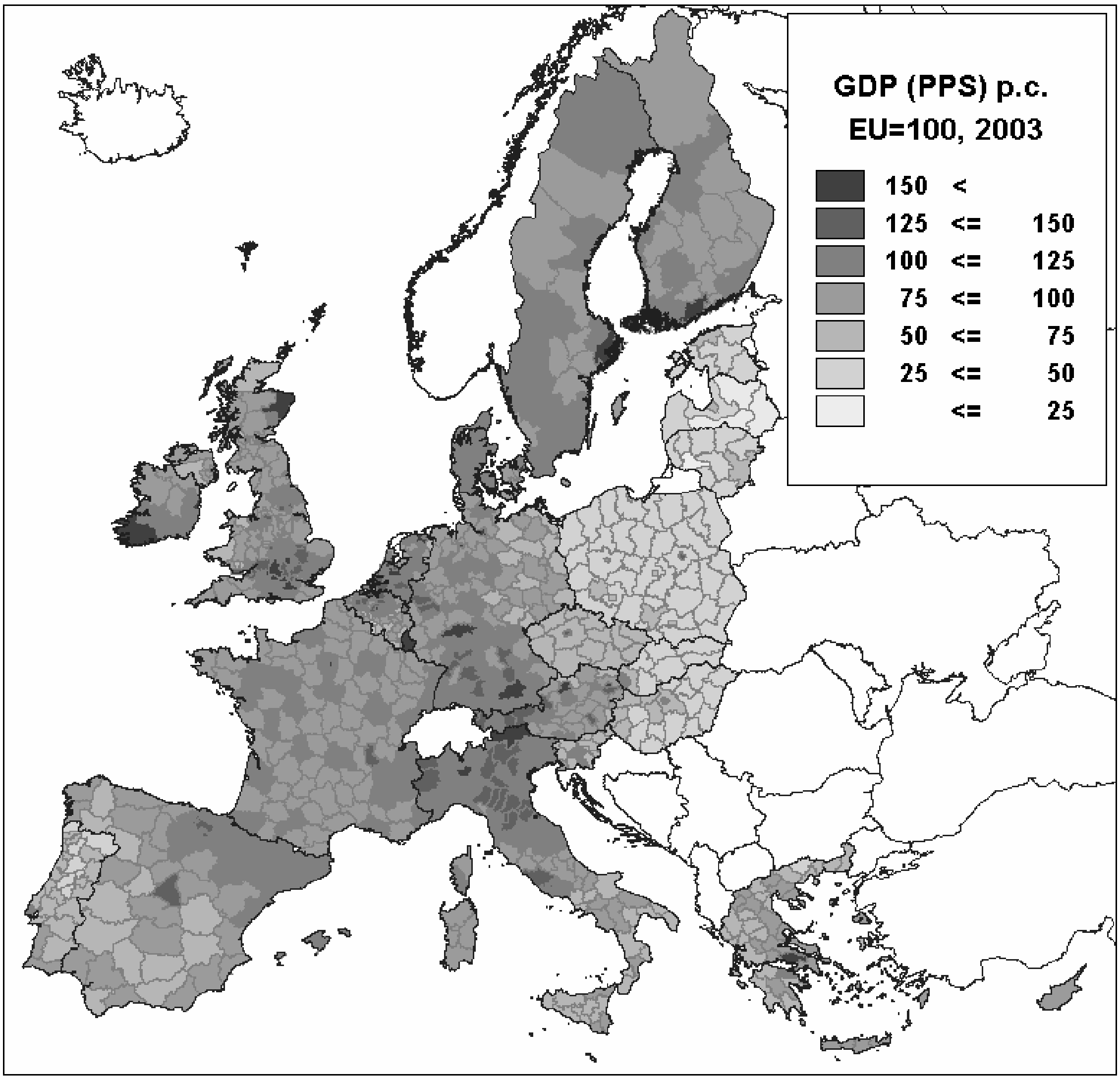
In order to analyse regional income disparities and convergence in EU we use GDP per capita data measured in purchasing powers standards (PPS) taken from the Eurostat database. Data in PPS are adjusted for differences in national price levels, but not for differing price levels within countries. Although there are considerable regional within-country differences in price levels, these data are used because we think that they still provide a better approximation for regional wealth than data in Euro. Furthermore, GDP in PPS is used to recognise eligibility of regions to be supported by EU structural funds in the range of Objective 1. It should be noted that Eurostat warns against using PPS adjusted GDP values to calculate growth rates over years. However, we do not analyze the dynamics of single countries or regions, but the relative development of income levels between countries and regions which should ease the problem.

The results of an analysis also depend on the selection of regions included in the sample and the chosen level of regional aggregation. In principle, the choice for the level of aggregation is somewhat arbitrary. On the one hand, spatial heterogeneity and spatial interaction may be covered when the units of observation are relatively large regions. On the other hand, using a very low level of regional aggregation increases the danger of slicing functional regions into halves. In the latter case, spatial interaction between regions, which in fact belong to one functional unit, may be observed wrongly (see also [18]). Most of the so far existing studies on convergence across European regions used NUTS-2 level data or higher levels of regional aggregation (e.g. [12]; [16]; [21] or [13]). Also eligibility for Objective 1 is assessed at the NUTS-2 level. However, since the spatial dimension of regional spillovers is not so clear and might be very small in some cases, it is of interest to investigate such processes across a sample of rather small regions. We agree with viewpoint of Bräuninger and Niebuhr [14], that there might be spillovers which have effects only over such short distances that they cannot be observed in a sample of NUTS-2 regions. We, therefore, analyse regional disparities and convergence processes at a rather low level of aggregation across 861 regions in the EU-25. The sample comprises 97 so-called planning regions ("*Raumordnungsregionen-ROR"*) in Germany. German planning regions are functional regions that comprise several NUTS-3 regions. All other regions in the sample are NUTS-3 regions. Furthermore, we conduct separate analyses for the 739 regions in the EU-15 and the 122 regions in the NMS since we assume that there are structural differences in the regional convergence processes across these groups of countries.

4. Regional Income Disparities in EU

The spatial distribution of regional income levels in the EU-25 shows a centre-periphery-structure (Figure 1). Most of the relatively rich regions were situated along the so-called "blue banana", which ranges from the southern part of England to Northern Italy. In the EU-15, regions with income levels below 75% of the EU-25 average can be found mainly in the southern periphery. There was a considerable income gap between the EU-15 and the NMS. In 1995, a bit more than two thirds of all regions in the NMS experienced income levels below 50% of the EU-25 average. Only the five capital regions Prague (126%), Bratislava (95%), Ljubljana (94%), Budapest (89%) and Warsaw (89%) as well as Cyprus (82%) had income levels above 75%. In 2003, the majority of capital regions of the NMS have reached clearly above average income levels: Warsaw (139%), Prague (138%), Budapest (122%), Bratislava (116%) and Ljubljana (109%) ([22]).

Figure 1: Regional income levels relative to the EU-25 average, 2003

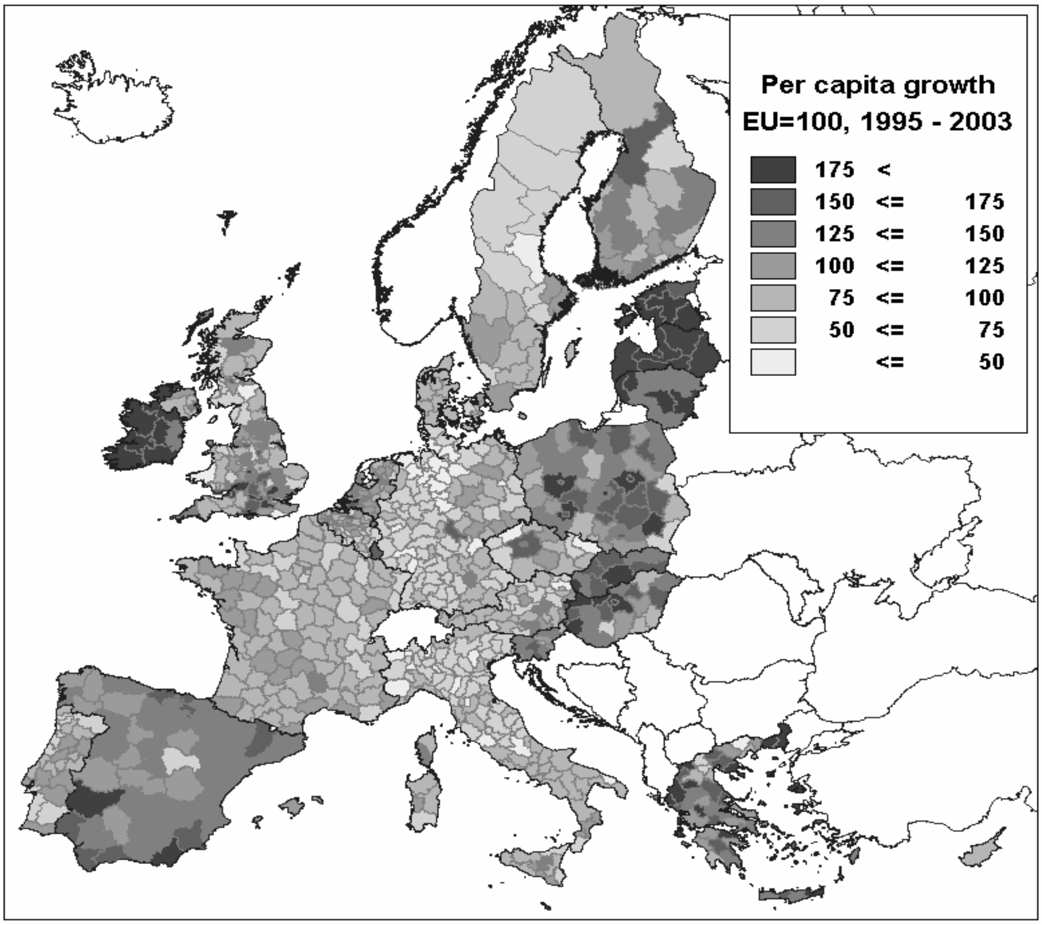


Source: Eurostat 2006; own calculations.

Overall, the clustering of relatively rich regions in the centre of the EU-25 has weakened between 1995 and 2003 (see Figure 1). In the NMS, especially agglomerations and some regions, which are close to a border of a EU-15 country, have approached the EU-25 average income level until 2003. The capitals Warsaw (139%), Prague (138%), Budapest (122%), Bratislava (116%) and Ljubljana (109%) have reached even clearly above average income levels in 2003.

The spatial pattern of per capita growth between 1995 and 2003 shows that regions in the periphery tended to grow faster (see Figure 2). Most regions in Spain, Greece, Ireland, Finland and in the NMS experienced growth rates above the EU-25 average growth rate. Within the range of the "blue banana" relatively few regions, mainly in the area of London and in the Netherlands, reached above average per capita growth. This may indicate that a general catching-up process of the poorer periphery in the EU-25 as well as a catching-up process of the NMS towards the income level in the EU-15 had taken place.

Figure 2: Regional per capita growth relative to the EU-25 average, 1995 - 2003



Source: Eurostat 2006; own calculations.

However, there is a noticeable difference between the growth processes in the EU-15 and the NMS. While in the former group of countries the growth leading regions were mostly not amongst the richer regions in 1995, quite the opposite is the case in the latter. In each respective country of the NMS, in particular, the relatively rich agglomerations – mainly the capital regions – and their hinterland were among the most dynamic regions. As a consequence regional disparities within the NMS might be increasing, while regional income levels within the EU-15 might converge.

5. Spatial dependence

As a measure of spatial dependence of income levels and growth in the EU, we use Moran's *I*- statistic. When Moran's *I* is positive and significant, there is a tendency towards a clustering of similar parameter values in the sample.

$$I_t = \frac{N \sum_{i=1}^{N} \sum_{j=1}^{N} x_{i,t} x_{j,t} w_{i,j}}{N_b \sum_{i=1}^{N} x_{i,t}^2} \quad (7),$$

where

$x_{i,t}$ - variable in question in region *i* and in year *t* (in deviations from the mean);

N - number of regions;

N_b - sum of all weights (since we use row-standardized weights N_b is equal to *N).*

Table 2 shows the Moran coefficient *I* using the weight matrix as specified above.

Table 1: Moran's *I*-test for spatial autocorrelation (randomization assumption)

Critical distance cut-off (km)	Moran coefficient I (Standardized z-value)		
	$\ln\left(\frac{y_{i2003}}{y_{i1995}}\right)$	$\ln(y_{i1995})$	$\ln(y_{i2003})$
100	0.54** (21.27)	0.75** (29.77)	0.67** (26.71)
200	0.51** (29.35)	0.74** (42.43)	0.66** (37.49)
300	0.48** (31.63)	0.72** (47.34)	0.63** (41.77)
400	0.45** (32.44)	0.70** (49.72)	0.61** (43.82)
500	0.44** (32.77)	0.68** (50.80)	0.60** (44.80)
600	0.42** (32.67)	0.65** (50.74)	0.58** (44.78)
700	0.41** (32.60)	0.63** (50.55)	0.56** (44.65)
800	0.40** (32.37)	0.62** (50.12)	0.55** (44.33)
900	0.39** (32.09)	0.60** (49.64)	0.53** (43.94)
1000	0.38** (31.82)	0.59** (49.13)	0.52** (43.54)
2000	0.34** (30.27)	0.52** (46.38)	0.47** (41.33)

**significant at the 0.01 level.

Different critical distance cut-offs were applied in order to check for the sensitivity to changes in the spatial weight. Growth rates and income levels in both years are clearly more spatially clustered than they could have been by pure random. In all cases Moran's *I* is highly significant. Hence, there is strong evidence for spatial dependence among the regions in the EU. The coefficient *I* is highest with the lowest distance cut-off of a hundred kilometers and is decreasing with increasing distance cut-offs. However, the significance is lower with short distance cut-offs and highest with a cut-off at 500 km. With larger distance cut-offs both, the coefficient *I* and its significance, are decreasing. This indicates that the intensity of spatial dependence declines with larger distances between the respective regions. Regional interactions over a distance of more than 500 km seem to be less important. Therefore, we use 500 km as a critical distance cut-off.

6. Regional Income Convergence in EU

The estimation results of absolute and conditional (with country dummies) convergence equations are presented in table 1 containing estimation results of both non –spatial (OLS estimations, see equation 1) and spatial (SLM and SEM, respectively equations (5) and (6)) models.

According to the non-spatial estimations we can say, that, there was a significant process of absolute convergence across EU regions. In the EU-25 regional income levels converged at an average pace of 2% p.a. At this speed, it takes 35 years for half of the disparities to vanish. While the convergence speed in the group of the EU-15 countries was only slightly lower - at a rate of 1.8% p.a., regional incomes in the NMS converged at a rate of 1.4% - only significant at the 5%-level. This implies half-lives of 38 years in the EU-15 and 50 years in the NMS.

The speed of convergence is considerably slower when country effects are taken into account. In the conditional models, there is no significant convergence found in the EU-25, the convergence rate β in the EU-15 halves to 0.9% p.a. – which implies a half-life of 81 years - and in the NMS it changes even signs. In the NMS, regional per capita incomes actually diverged at a rate of 1.5% p.a. when country dummies were employed.

Table 1. Regression analysis

Country dummies	**EU-25**	**EU-15**	**NMS**	**EU-25**	**EU-15**	**NMS**
	NO			**YES**		
OLS model						
Convergence speed	2.0**	1.8**	1.4**	0.3	0.9**	-1.5**
Half-life	35	38	50	240	81	-
AIC	-1371.4	-1230.1	-151.1	-1721.3	-1483.3	-190.2
SER - Spatial Error Model						
Convergence speed	0.6**	0.7**	-0.2	0.2	0.7**	-1.0*
Half-life	116	105	-	283	99	-
AIC	-1636.1	-1467.4	-185.5	-1764.8	-1568.7	-199.0
SLM - Spatial Lag Model						
Convergence speed	0.6**	0.7**	0.3	0.2	0.6**	-1.4**
Half-life	110	103	253	344	113	-
AIC	-1640.1	-1473.2	-174.9	-1755.0	-1558.2	-197.8

** significance level 0.01; * significance level 0.05.

The model-fits of the conditional convergence estimations are much better than those in absolute convergence models. According to the adjusted R^2 initial income levels explain 20% of the differences in regional growth rates in the EU-25, only 9% in the EU-15 and 6% in the NMS, while 48%, 37% and 37% are explained in the conditional models for the EU-25, the EU-15 and the NMS respectively.

The results of the SLM and the SEM show both significant spatial autocorrelation. The coefficients of the spatially lagged dependent variable (ρ) and of the lagged error (λ) are all statistically highly significant indicating that regions are affected in their development by neighbouring regions. The estimations in both the SEM and the SLM without control for country specific effects yield considerably lower convergence rates than the OLS estimations.[3] In both spatial specifications, the estimated rate of convergence is 0.6% in the EU-25 and 0.7% in the EU-15. These rates imply half-lives of more than a hundred years.

In both models, there was no significant convergence in the NMS. Lower convergence rates in the spatial models show that the OLS estimates are biased, which points to the substantive form of spatial autocorrelation. According to the Akaike Information Criterion (AIC), the model-fits of the spatial estimations are remarkably better compared to the absolute convergence OLS estimations.[4]

When country dummies are included into the spatial models, the estimations yield somewhat similar results to those of the conditional OLS estimations. Thus, there was a very slow process of conditional convergence taking place in the EU-15, while income levels within the countries of the NMS diverged.[5] Also the model-fits do not vary remarkably. This indicates that the OLS estimates of the conditional model are not seriously biased and spatial effects are sufficiently captured by the use of country dummies. Hence, national macroeconomic factors seem to be more influential on regional growth than the presence of spatial effects. Similar results were found by Bräuninger and Niebuhr [14] or Geppert et al [23].[6] Overall, convergence processes in the EU25 seem to be predominantly a national phenomenon.

7. Conclusion

The results of the EU-25 regional income analyses during the EU pre-enlargement period (1995–2003) show significant regional disparities in both the old and new member states (the candidate countries during the pre-enlargement period). The differences between the highest and lowest income levels of NUTS-3 regions in the EU-25 in 2003 were more than 30-fold. There exists a core-periphery structure with relatively high income levels in the centre of the EU and relatively low income levels in peripheral regions. Furthermore, regional incomes in the NMS were particularly low. In 2003 income levels in 60% of all NUTS-3 regions in the NMS were below the half of the EU-25 average income level. Only few regions (7%) in the NMS experienced income levels above 75% of the EU-25 average.

Not only the differences were large, also the speed of regional income convergence was slow as shown by *beta*-convergence analysis. The latter also found an important influence of country-specific factors to regional income levels' convergence process. Taking national effects into account reveals that the general catching-up process was driven mainly by country-specific effects. This is particularly the case in the NMS. When regions are allowed to converge towards country-specific steady state levels of per capita income, the convergence rate across regions in the NMS becomes negative. Hence, in the course of a general catching-up of the NMS regional within-country disparities have increased. This can be explained by the high dynamics in the regions which happened to be already relatively rich at the outset in 1995. Predominantly, the richest and most dynamic regions in the NMS were the capital

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[3] It has to be noticed that the direct comparison of the β-coefficients of the spatial models and the OLS-model is not quite correct because the estimated speed of convergence in the former comprises also indirect and induced effects (compare [17]).
[4] The R^2 in ML-estimations is only a pseudo-measure and therefore not suitable for comparison to OLS. Therefore the AIC is used (see [20]).
[5] Though only significant at the 5%-level in the SEM.
[6] The spatial Breusch-Pagan test detects heteroscedastic error terms in estimations for the EU-25 and the EU-15, which requires some caution with interpreting the results.

regions and their hinterland as well as some other metropolitan areas. Consequently, many remote and rural regions have lagged behind the relatively rich and dynamic growth leaders.

Overall, the estimations of the spatial econometric models show that spatial dependence across regions does matter. However, since spatial autocorrelation seems to be sufficiently captured by country dummies, the results demonstrate that national macroeconomic factors seem to be more important for regional growth than spatial interaction. Simultaneous processes of a general catching-up of the NMS towards the EU15 on the one hand and increasing regional disparities within the NMS on the other hand hint at the existence of a trade-off between high growth rates on the national level and regional within-country convergence in the NMS. This possible relationship between national growth and regional within-country inequality should be considered by EU cohesion policy pursuing the community objectives. The forces that drive regional convergence seem to have not yet prevailed in NMS. However, if it can be expected that, sooner or later, the dynamics of the relatively rich metropolitan areas in the NMS spill over to rural, more remotely situated regions, all regions in the respective countries might benefit in the future. Therefore, it might be inefficient to support only those regions with low income levels as it is currently done by the EU. In order to pursue the community objectives, EU structural policy has to find the right balance between preventing deterioration in some regions and promoting regional dynamics and growth poles

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