Original Paper

Measuring the economic convergence by the OLS method. The European case

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ABSTRACT

Rural regions within the European Union, in despite of the urbanization process and long term urban migration patterns, represent a significant part of the territory and portion of labor stock. Regional policy has been in place since 1957 (Treaty of Rome) however, it has not been enough effective in order to mitigating the regional inequalities across its member states, despite significant investment spent on employment and growth. Regional inequalities evenly widened due to the entrance of new states of Central and Eastern Europe in 2004 and 2007. Paper is focused on measuring the process of economic convergence, exclusive among the predominantly rural regions within the member states of EU in time period 2003-2013. For the purpose of measuring the convergence process, we opted for a beta-convergence approach via using of cross-sectional linear regression analysis. The next focus is given on the examining of the sigma-convergence, which is tested by the standard deviation of real GDP per capita. Results have shown up statistically significant economic convergence between the rural regions in selected time period. Furthermore, lower standard deviation in regional inequalities between the rural regions in selected time period also has been recorded. Thus, continuing economic convergence process among the member states of EU we cannot rule out.

KEYWORDS: economic convergence, rural regions, income inequality, beta-convergence, sigma-convergence

JEL CLASSIFICATION: D20, D40, M10

INTRODUCTION

Predominantly rural regions in the EU represent 52 % of the territory and 23 % of the population. In 2010 they generated 16 % of GVA and 21 % of the employment in total. However, in some aspects, there are significant differences between the EU-15 an EU-12 state, or so called "old member" and "new member" states. For instance, the share of predominantly rural regions in the territory is quite similar (50 % counts for EU-15 and 57 % counts for EU-12, respectively). However the share of predominantly rural regions in terms of

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population, GVA and employment is significantly higher in the EU-12 the in the EU-15: in the EU-12; 40 % of the population live in predominantly rural regions (18 % in the EU-15), they produce 29 % of the total GVA (14 %, in the EU-15) and account for 36 % of total employment (17 % in the EU-15) [4].

Within the European Union, predominantly rural regions often belong to social-economically disadvantaged. This phenomena had evenly its historical roots in the past, in the era of feudalism which had been dominating in most of the European countries.

In an overwhelmingly rural society, in which the productivity of agriculture was comparatively low, the vast majority of people were peasants and farmers. Often the farmers paid one-half or more of their output as rent for protection [10]. Thus, the countryside has been always tightly connected with the agriculture, extracting the ores and lumber, breeding and grazing the livestock.

The transition during the late 18th and early 19th centuries from Merchant capitalism to industrial capitalism as the dominant mode of production is conventionally ascribed to the Industrial Revolution. Prior to 1800, living standards in the world economy were roughly constant over the very long run: per capita wage income, output and consumption did not grow. Modern industrial economies, on the other hand, enjoy unprecedented and seemingly endless growth in living standards [6].

Industrialization process was the main driver of the urbanization which had been carrying the seeds of the economic inequality and income gap, between the urban and rural areas which is steadily rising.

In terms of economic conditions, one of the strongest findings is that current inequality is highly dependent on previous inequality [8]. If we measure the GDP as an annual flow of incomes (wages, rents, interests, dividends and profits) to the holders of production factors, we can equalize the income per head as a GDP per head.

In general, income inequality may arise due to a) changes affecting the labor supply (immigration, part-time labor, institutional changes related to minimal wage, unionism, etc. ; b) changes affecting the labor demand such a capital market liberalization, outsourcing, technological change, etc. [1].

Until the crisis in 2008, disparities between regional economies in the EU were shrinking. For instance, in 2000 average GDP per head in the most developed 20 % of the regions was about 3.5 times higher than that in the least developed 20 %. By 2008, the difference had narrowed to 2.8 times. However, the crisis seems to have brought this tendency to an end and between 2008 and 2011, regional disparities widened. In some regions, GDP per head in real terms (i.e. at constant prices) declined considerably, as, for instance, in Közep-Dunántúl (Hungary) or in Estonia, where it fell by 15 % between 2008–2009. Between 2008–2009, real GDP per head also fell in more developed countries such as Finland, Sweden and Italy. Regional disparities also widened significantly, between 2000–2011, in Bulgaria and Romania, Greece and in some regions of United Kingdom [5].

EU eastward enlargement brings about the obligation for EU policy to deal with a considerably increased range of income disparities within the EU. Considering the community´s objective to enhance economic and social cohesion (Arcticle 2 of the Treaty on

European Union), this represents a challenging task. Cohesion policy, the second[1] largest item in the EU budget, has to be adjusted to this change in the scale of disparities. With respect to EU policy, which aims at regional equity, absolute convergence is the appropriate concept to be used. However, considering the variety of regions in Europe, including large structural differences, conditional convergence might be more realistic [9].

MATERIAL AND METHODS

Convergence between economies, which can be countries or regions, is defined as the tendency for the levels of per capita income, or levels of per product (productivity), to equalize over time which will happen only if a catching-up process takes place. One theory, which tries to explain above mentioned topic is „neo-classical theory" of convergence, which argues that due to diminishing returns to reproducible capital, poor countries or regions with low capital/labor ratios have a higher marginal productivity of capital, and therefore, will grow faster than richer ones, give the same level of saving investment. In this context, the tendency for disparities do decline over time is explained by the fact that factor costs are lower and profit opportunities are higher in poor regions compared to richer regions. Therefore, low income regions will tend to grow faster and will catch-up the leading ones. In the long run, income differences and growth rates will be equalized across regions [2].

The beginnings of studying convergence can be seen as studying absolute convergence, which can be defined as a process in which economies with lower capital per worker grow faster than economies with higher capital per worker. In contrast, if we measure convergence among more homogenous samples with the same institutional parameters we speak of conditional convergence. Absolute or conditional convergence can be verified by β-convergence and σ-convergence.

Methodology to study β-convergence comes from original Baumol study of real convergence between economies [3]. For the purpose of the paper the Baumol equation, we modify as follows:

$$\frac{1}{T} log\left(\frac{y_{i,T}}{y_{i,0}}\right) = \alpha + \beta log\left(y_{i,0}\right) + \varepsilon_i \tag{1}$$

where T is the end of the time period, y_t is GDP per capita at the end of time period (2013), t_0 is the initial time period, y_{t_0} is GDP per head at the beginning of time period (2003), α is level constant, β is slope parameter and ε is statistical error.

The concept of σ-convergence also comes from neoclassical growth theory. The σ-convergence is defined as lowering of variance of real GDP per capita logarithm among economies in time. Sigma convergence is then described as catching up effect. If the variance or real GDP per capita logarithm is denoted as σ_t^2 in group of countries in time t then σ-convergence among t and $t+1$ means:

$$\sigma_t^2 > \sigma_{t+1}^2 \tag{2}$$

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[1] Note: Cohesion policy in current programming period 2014–2020 became the first largest policy of the EU

The sample data include GDP per capita in current prices, calculated in euro for all predominantly rural regions within the countries of EU for two time periods 2003 and 2013, respectively.

Practical side of the model we evaluate via using the coefficient of determination, R^2, based on residual analysis [7]:

$$R^2 = 1 - \frac{\sum_{i=1}^{n} e_i^2}{\sum_{n=1}^{n} (y_i - \bar{y})^2} \tag{3}$$

where e_i^2 means the residual sums of squares, as a difference between observed and estimated values.

The statistical significance of the model we submit to test of the associated hypothesis, whereby as a ground we use table data of Fisher distribution with k and $(n - k - 1)$ degrees of freedom. If, the computed value is greater than the critical value of Fisher distribution (based on chosen significance level α), we fail to reject the alternative hypothesis.

$$F = \frac{\frac{R^2}{k}}{\frac{1 - R^2}{n - k - 1}} \tag{4}$$

Finally, we apply Durbin-Watson test in order to rule out possible autocorrelation between the random errors

$$d = \frac{\sum_{t=2}^{n} (e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2} \tag{5}$$

If

$$d_L < d < 4 - d_U \tag{6}$$

where d_L means lower bound interval and d_U means upper bound interval. We accept zero hypothesis, there is an absence of the autocorrelation.

RESULTS AND DISCUSSION

Primary we would like to summarize basic descriptive statistics about the sample in order to examine its position and the variability. Furthermore, we can observe deviations in selected parameters between the selected time periods 2003 – 2013, respectively.

From the Tab. 1, we can see minor changes in examining parameters between observed time periods. Based on parameters (mean, median, stdandard deviation, kurtosis, skewness) we can conclude that the situation had been evolving a slightly better.

Cross-sectional regression is not drawn by an effort to find model which could predict future development of the convergence process. The goal is to find out whether among EU economies is the convergence process present or there are more divergence tendencies.

Mathematically, the estimate of a regression model of cross-section data for the rural regions of EU countries can be written as follows:

$$\frac{1}{T} log\left(\frac{GDP_{i,T}}{GDP_{i,0}}\right) = \alpha + \beta log(GDP_{i,0}) + \varepsilon_i \qquad (7)$$

Tab.1 Summary of the descriptive statistics between the time periods 2003-2013

Mean	14321	Mean	18427
Standard Error	2095	Standard Error	2305
Median	13413	Median	14114
Standard Deviation	10265	Standard Deviation	11292
Sample Variance	105360324	Sample Variance	127513202
Kurtosis	-1.3721	Kurtosis	-1.34397
Skewness	0.2907	Skewness	0.3948
Range	30282	Range	34189
Minimum	1819	Minimum	3957
Maximum	32101	Maximum	38146
Sum	343699	Sum	442251
Count	24	Count	24

From the Tab. 2, we can observe that estimated β-coefficient has a negative slope, thus we can see moderately positive convergence among rural regions of EU countries. We can conclude, that among the observing EU countries in chosen time frame, a positive convergence process we cannot rule out. According to the theory initially poorer regions have tended to grow faster that countries initially richer and converge to the common state.

Tab. 2 Summary of β-convergence model

α	$\bar{\beta}$	R^2	F	d
3.057	-0.2927	0.758	34.61	1.652

Additionally, coefficient of determination R^2 gain 0.758, which can be assessed as sufficient. The total quality of the model is significant, for F = 34.61 we found table value 5.72 (α = 0.05), so $F > F_{(2, 22)}$. Durbin-Watson statistics gain $1.224 < 1.652 < 4 - 1.553$, for $k = 2$ and $n = 25;\ \alpha = 0.05$, thus possible autocorrelation we can rule out.

Finally, we take σ-convergence test where we computed $\sigma_{2003} = 0.94$ and $\sigma_{2013} = 0.68$, respectively. Since $\sigma_{2003} > \sigma_{2013}$, became to lowering of the variance of the real GDP capita logarithm among rural regions in time.
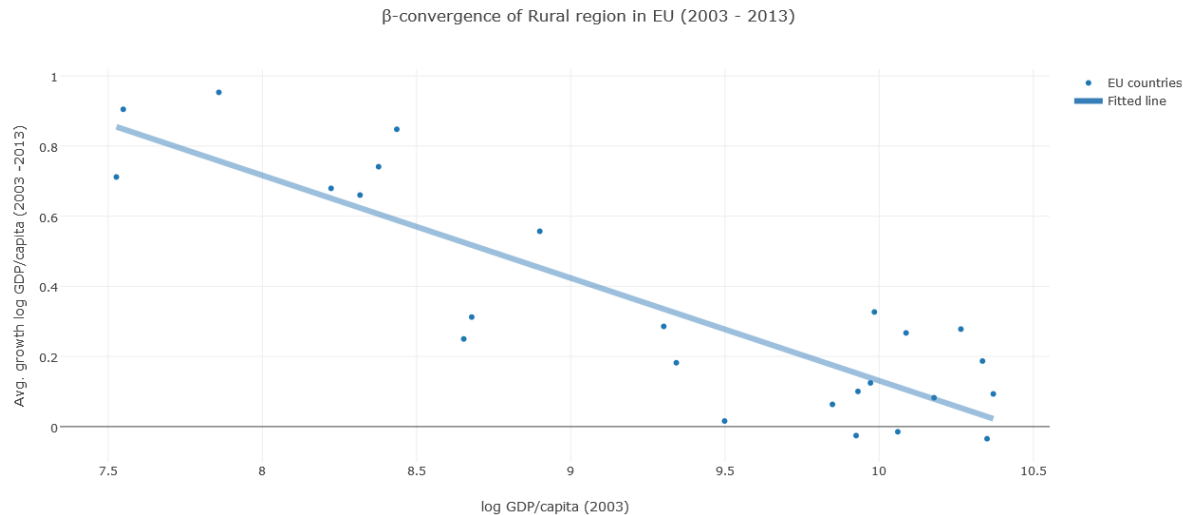

Fig. 1 β-convergence in rural regions of EU countries 2003–2013
Source: Author

CONCLUSIONS

The aim of the paper was to evaluate the dynamics of evolution of regional disparities among the rural regions between the so called "old" and "new" member states of the EU in terms of economic convergence. For this purpose, the concept of beta – and sigma-convergence were adopted. In the reference period 2003 – 2013 beta-convergence between the rural regions of EU countries can be confirmed. Furthermore, also sigma-convergence has been recorded.

It means that initially poorer rural regions, mainly from new member states of EU showed a higher average rate of economic growth that initially richer states. The total variance in income per capita in explored time period also decreased, thus the variance in incomes also converges to common state.

Generally, rural regions in EU countries belong to most undeveloped. The main obstacles to development are relatively sparsely populated territory, low market volume, lack of investments, inferior infrastructure and other factors. Endogenous resources of the territory play the crucial role in bringing the region on the development path. Heavily subsidized agriculture in the frame of CAP of EU, might be one of the factor of common convergence of rural regions to common state.

The future policy implications might be based on stimulating the endogenous potential of the countryside, which is traditional view. Investments in education, preserving natural potential

and renewing the cultural heritage of countryside in the long run might be the path for economic growth and employment creation of rural citizens.

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