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INTEGRATION PROCESSES AND MARGINAL VERTICAL β -CONVERGENCE IN THE EUROPEAN UNION MEMBER STATES

Abstract

The aim of the paper is to examine the connection between the intensity of integration processes and the real convergence process in the group of 28 member states of the European Union, with special regard to individual countries' impact on it. A study of β -convergence process in „new” UE member states' pre-accession period (1993-2004) and the period after enlargement of the EU (2004-2014) was conducted. To investigate the individual contribution of the related countries to the „catching-up” process in the EU, the concept of marginal vertical β -convergence was used.

In the light of the conducted empirical studies, there is a positive connection between the level of member states' engagement in the economic and institutional integration and convergence rate in the European Union. The stronger interconnections between member states are, the higher speed of the β -convergence process is. The respective member states' impact on β -convergence process is diversified. The degree of that diversity is decreasing while institutional and economic links between „old” and „new” member states of the EU are deepening.

JEL Classification Code: **F15, F43, C51.**

Keywords: marginal vertical convergence, integration, catching-up process, the European Union.

Introduction

The phenomenon of real convergence, which is the process of gradually reducing the development gap between countries, measured by GDP per capita, has long been the subject of theoretical and empirical discussion. It is empirically proved that it is impossible at the global level (Baumol, 1986; Dowrick, Nguyen,

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1989; de Long, 1988). It is more likely to occur in the group of countries whose economies operate in a similar manner, i.e. have a similar level of economic and technological development, complementarity of economic structures, close geographic locations and institutional connections, ensuring the convergence of income to a common steady state. Thus, the so-called conditional convergence (or club convergence) exists in more homogenous groups of countries, for example in integration groups like the European Union. Furthermore, one can assume that gradual integration processes may accelerate catching-up process between member states (Bukowski, 2011).

The results of theoretical and empirical studies on the positive impact of integration processes on economic growth (and convergence) are ambiguous. According to R. Solow's neoclassical model, open economies should converge as long as the savings ratios are similar and technology is exogenous. Since fixed capital is subject to diminishing marginal returns, each economy will converge on a unique, long-run stable growth path (determined by the growth of the labour and technology). Poorer countries having capital (labour) ratios below their long-run optimum level are characterized by a higher rate of return on fixed investment than richer countries (Solow, 1956). Therefore, poorer countries should grow faster than rich ones and catch up with them. Following this line of reasoning Matrin et.al (2001) claim that opening up the country in a way that it happens in the framework of an integration process, should trigger a convergence process, as capital should flow to capital scarce countries to take advantage of higher returns. The above statements are also in accordance with J. Viner's (1950) trade and integration theory confirming that economic integration (static effects- trade creation and division) leads to the real convergence process between countries. Later theories of economic integration considering dynamic effects of integration process like economies of scale (Corden, 1972), technological change (Balassa, 1965), investment creation and diversion (Dunning, Robson, 1988), development of the private sector (Lawrence 1996), foreign direct investment (Inotai 1991; Ethier 1998) confirm their positive impact on market structure, competition and productivity growth of integrated countries.

However, the existence of the convergence process between integrating countries in the new growth theory models is not confirmed. After considering the assumption that the returns to capital do not have to be diminishing and that technology is endogenous and a subject to decision-making processes at individual firms, the impact of economic integration on convergence is not as clear as in the neo-classical models (Romer, 1990). Increasing returns on human capital (Lucas, 1988) and individual R&D efforts as the main engine of economic growth deny the phenomenon of member states' following the same long-term growth path and reducing income disparities in integration groups. Furthermore, the new trade theory pioneered by Krugman (1991) and developed by Ottaviano

and Puga (1998), delivers several reasons why economic integration may lead to increasing income inequality, rather than convergence.

Economic convergence has been one of the main goals of European integration process, repeated in all the EU treaties. Article 174 of the Treaty of Lisbon states that „The Community shall aim at reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions...” (EU Treaty of Lisbon, 2007). In early nineties of the 20th century a vast group of less developed Central and Eastern Europe countries started their integration process with relatively richer Western Europe countries. In recent decades, after signing their association agreements with the European Community, these „poorer” candidates and then- the full EU members- were taking gradual steps toward the liberalization of trade, capital and labour markets, harmonization of economic policy and the foundation of the European Economic and Monetary Union. There are good reasons to expect increased per capita real income convergence (β - convergence), especially in the period after joining the EU in 2004 (Estonia, Czech Republic, Hungary, Latvia, Lithuania, Malta, Cyprus, Poland, Slovakia, Slovenia), in 2007 (Bulgaria, Romania) and in 2013 (Croatia), when their degree of engagement in economic and institutional integration was much higher than in the pre-accession period.

Generally, the majority of empirical studies of convergence process in the European Union (regardless of the method employed) confirms its existence (e.g. Growiec (2005); Schadler, Mody, Abiad, Leigh (2006); Michałek, Siwiński, Socha (2007); Soszyńska (2008); Liberda (2009); Rapacki (2009); Siwiński (2009); Wolszczak-Derlacz (2009); Batóg (2010); Halmai i Vásáry (2010); Adamczyk i Łojewska (2011); Tatomir i Alexe (2011); Stañisić (2012); Stawicka (2012); Walczak (2012); Grzelak i Kujaczyńska (2013); Rapacki, Próchniak (2014)). The results of new empirical studies suggest, however, that negative demographic trends in the European Union may lead to inversion of the current convergence tendencies and may cause divergence process between „new” and „old” EU countries (Matkowski, Próchniak, Rapacki, 2013, 2014). Thus, the discussion on the connection between integration and convergence has not been finished yet.

However, the most significant disadvantage of the mentioned surveys (confirming convergence in the EU or not) is that they are focused only on investigating the existence and rate of general convergence process in the analysed group of countries. They do not identify the individual impact of the particular countries on catching-up process in the European Union. The solution of that problem may be a specific approach consisting in testing the vertical marginal β -convergence.

The aim of the paper is, first of all, to examine the existence and rate of the real β - convergence process in the group of 28 member states of the European Union in the period from 1993 to 2014. The analysis is conducted also in two sub-periods. The first one is the pre-accession period for „new” UE member

states (1993-2004) and the second (2004-2014) is the period after enlargement of the EU, when almost all of the analysed countries were full members of the EU or at the final stage of joining it (Romania, Bulgaria and Croatia). The second goal of the paper is to exhibit the individual contribution of the related countries to the β -convergence process in the UE. The new concept of the marginal vertical β -convergence is used for that purpose. The differentiation of the countries in terms of their impact on catching-up process in the EU is investigated in the pre- and after- accession period.

1. General and marginal vertical β – convergence concept

The easiest way to verify the hypothesis of β convergence is estimating the structural parameters of the following equation 1.

$$\frac{1}{T} \ln \frac{Y_{Ti}}{Y_{0i}} = \alpha_0 + \alpha_1 \ln Y_{0i} + \varepsilon_{ii} \quad (1)$$

where:

$\frac{1}{T} \ln \frac{Y_{Ti}}{Y_{0i}}$ – the average growth rate of GDP per capita of country i between the period T and the base period 0

$\ln Y_{0i}$ – the logarithm of the initial level of per capita income of country i

The left side of the equation represents the average growth rate of GDP per capita of country i between the period T and the base period 0. The explanatory variable is the logarithm of the initial level of per capita income of country i . The negative value of the parameter α_1 means the occurrence of convergence.

The rate of convergence is reflected by β coefficient defined by the following formula 2.

$$\beta = -\frac{1}{T} \ln(1 + \alpha_1 T) \quad (2)$$

where: T – the number of years.

The higher the coefficient β value (between 0 and 1), the higher the convergence rate.

The additional coefficient used very often in convergence analysis is the half-life of convergence coefficient, defined by the following formula 3.

$$T_{1/2} = \frac{\ln 2}{\beta} \quad (3)$$

It indicates the amount of time it will take to cover half the distance separating the current starting point of the countries from their long-term equilibrium point. In other words, it indicates the amount of time it will take to reduce income disparities between the analysed countries by 50%.

The idea of the marginal, vertical convergence is to estimate the individual contribution of a country to general convergence process in the analysed group of countries. The method comes from microeconomic methods of investment risk calculations. Risk can be calculated as the difference between the level of risk calculated for the full portfolio and for the portfolio with $N-1$ elements (Hozer, 2004).

Following this line of reasoning, to calculate the value of marginal, vertical convergence for country i the following equation (4) can be used.

$$\beta_i = \beta - \beta_i^{N-1} \quad (4)$$

where:

β_i – vertical marginal convergence β for country i

β – β coefficient (convergence rate) for the group of N countries

β_i^{N-1} – β coefficient (convergence rate) for the group of $N-1$ countries (without country i).

To obtain the value of vertical marginal β -convergence for country i it is essential to estimate the structural parameters of equation (1) for the entire group of countries and its modification with corrected data. The mentioned modification consists in eliminating from the full dataset observations for investigated country i (Batóg, 2010). Individual β_i coefficient is the difference between β and β_i^{N-1} (calculated with the use of estimated structural parameters of model (1) and its modification and formula 2). The positive value of β_i coefficient indicates a positive impact of country i on general convergence process.

In a similar way it is possible to calculate individual country's contribution to half-life of convergence (see formula 5).

$$T_{1/2i,i} = T_{1/2} - T_{1/2,i}^{N-1} \quad (5)$$

where:

$T_{1/2i,i}$ – half- life of convergence for country i

$T_{1/2}$ – half- life of convergence for the group of N countries

$T_{1/2,i}^{N-1}$ – half-life of convergence for the group of $N-1$ countries (without country i)

The negative sign of half-life of convergence coefficient for country i means that the investigated country has a positive impact on half-life of convergence and shortens the time needed to reduce income disparities in examined group of countries. The obtained indicator $T_{1/2i,i}$ is measured in number of years.

2. Results

The above mentioned formulas were used to conduct a study of β -convergence in a group of 28 European Union Member States. Data on GDP per capita based on purchasing-power-parity (PPP) in current international dollars (Geary-

Khamis dollar) in the period of 1993 - 2014 was obtained from the International Monetary Fund World Economic Outlook Database.

As the aim of the research was to exhibit the positive connection between the degree of countries' involvement in economic (and institutional) integration and β - convergence process, in addition, the analysis was divided into two (mentioned above) sub-periods: 1993-2004 and 2004-2014. For the majority of „new” EU countries the first sub-period was initiated by signing association agreements and completed by full membership in the EU structures or- as in the case of Bulgaria and Romania - finishing the negotiation process. The exception was Croatia that started its accession process later, at the beginning of 2000. However, including Croatia in the survey is justified because its degree of involvement in the integration processes in the UE in the period 1993-2004 was, just as the rest of examined „new” countries, lower than in the next period 2004-2014. In table 1 the estimation of structural parameters of equation (1) using the data for the period from 1993 to 2014 are included.

Table 1. Equation 1: Classical least squares method estimation, used observations 1-28
Dependent variable (Y): $PPPI_n Y_{t0} T19932014$

variable	coefficient	stand. error	student's t	p value	significance
const	0.210653	0.0288268	7.3075	<0.00001	***
1_PPPY1993	-0.0181416	0.00304576	-5.9564	<0.00001	***

Source: own calculations using GRET.L.

The results indicate the presence of β convergence in the EU-28. The negative value of the structural parameter α_1 of the equation 1 indicates a negative correlation between the initial level of income per capita in 1993 and economic growth rate in the period of 1993-2014. The value of the coefficient β calculated according to formula (2) amounted to 2.3%. This means that in the analysed period, the countries with lower GDP per capita „approached” the level of prosperity of the former EU-15 at a rate of approximately 2.3% per year. The value of half-life of convergence coefficient calculated according to formula (3) amounted to approximately 30 years.

The results of estimation of structural parameters of equation (1) using the data for the period from 1993 to 2004 indicates the presence of β convergence in the EU-28 (table 2).

The negative value of the structural parameter α_1 of the equation was obtained. The value of the coefficient β amounted to 1.7% and it was lower than its value for the entire period 1993-2014. This means that in the analysed period, the countries with lower GDP per capita „approached” the level of prosperity of richer

countries at a rate of 1.7% per year. According to the obtained results, it will take about 40 years to reduce income disparities in the EU by 50% (the value of half-life of convergence coefficient- 40.641).

Table 2. Equation 1: Classical least squares method estimation, used observations 1-28
Dependent variable (Y): PPPlnYtyoT19932003

variable	coefficient	stand. error	student's t	p value	significance
const	0.192246	0.0454165	4.2329	0.00025	***
l_PPPY1993	-0.0155511	0.00479857	-3.2408	0.00326	***

Source: own calculations using GRETL.

In table 3 the estimation of structural parameters of equation (1) using the data for „after- accession” period (2004-2014) are included.

Table 3. Equation 1: Classical least squares method estimation, used observations 1-28
Dependent variable (Y): PPPlnYtyoT20042014

variable	coefficient	stand. error	student's t	p value	significance
const	0.247328	0.0455154	5.4339	0.00001	***
l_PPPY2004	-0.0220473	0.00455114	-4.8444	0.00005	***

Source: own calculations using GRETL.

The results indicate the presence of β convergence in the EU-28 (the negative value of the structural parameter α_1). The value of the coefficient β amounted to 2.5%. This means that in the analysed period the rate of β -convergence (catching-up) process was higher than in the „pre-accession” period by 0.8 percentage point. The time needed to reduce GDP per capita disparities between EU members was shorter and amounted to approximately 27 years (the value of half-life of convergence coefficient – 27.4505).

In table 4 the results of marginal vertical β -convergence of EU countries for the period 1993-2004 are presented. They were obtained through the estimation of 28 econometric models (modified equation 1, with corrected data). In the second and fourth column the speed of β -convergence process and half-life of convergence indicator for the group of 27 countries -after elimination of the examined country i – are included. The values of countries' β_i and half-life of convergence coefficients (calculated in accordance with equation 4 and 5) are contained respectively in the third and last column.

Table 4. Results of the marginal vertical convergence of the European Union member states in the period 1993-2004

Country	β_i^{N-1}	β_i	$T_{1/2,i}^{N-1}$	$T_{1/2,i}$
Austria	1.69	0.01	40.95	-0.31
Belgium	1.68	0.03	41.30	-0.66
Bulgaria	2.09	-0.39	33.11	7.53
Croatia	1.76	-0.05	39.43	1.21
Cyprus	1.70	0.00	40.70	-0.06
Czech Republic	1.70	0.00	40.70	-0.06
Denmark	1.68	0.02	41.18	-0.54
Estonia	1.48	0.22	46.72	-6.07
Finland	1.73	-0.02	40.08	0.56
France	1.66	0.05	41.82	-1.18
Germany	1.63	0.07	42.41	-1.77
Greece	1.70	0.00	40.66	-0.02
Hungary	1.73	-0.03	40.05	0.59
Ireland	1.79	-0.08	38.78	1.87
Italy	1.66	0.05	41.88	-1.24
Latvia	1.47	0.24	47.17	-6.53
Lithuania	1.55	0.15	44.64	-4.00
Luxembourg	2.04	-0.33	34.05	6.59
Malta	1.53	0.18	45.37	-4.73
Netherlands	1.70	0.01	40.77	-0.13
Poland	1.69	0.01	40.99	-0.34
Portugal	1.70	0.00	40.71	-0.07
Romania	2.02	-0.31	34.33	6.31
Slovak Republic	1.70	0.01	40.77	-0.12
Slovenia	1.70	0.01	40.86	-0.22
Spain	1.71	0.00	40.62	0.02
Sweden	1.72	-0.02	40.20	0.44
United Kingdom	1.73	-0.03	39.96	0.68

Source: own calculations using GRETL.

In the light of the obtained results, the contribution of respective countries to general convergence process in the EU diverged significantly in the period 1993-2004. In the group of 28 member states one can identify the group accelerating relevantly convergence in the EU, the group with a slight positive or negative impact and the group of countries slowing down that process. In the first mentioned group were „candidates” for UE membership- Estonia, Latvia, Lithuania and Malta with β_i coefficient ranging from 0.1 to 0.25 percentage point. In the group of coun-

tries with low positive, low negative or even neutral influence on catching-up process were „old” UE members like Austria, Belgium, Denmark, France, Germany, Italy and also „candidates” of that time- Slovakia, Slovenia and Poland.

Among countries definitely slowing down the catching-up process in the EU were Bulgaria and Romania- countries with the lowest level of GDP per capita in 1993 and insufficiently high rate of economic growth in the period 1993-2004. At the same time, these countries were characterised by relatively low degree of economic interconnections with other EU countries and its candidates. Moreover, Luxembourg- the richest EU country, growing at high rate of 4% in the analysed period- was another country with negative influence on general convergence process in the EU. Luxembourg, Bulgaria and Romania also contributed to extending the time needed to reduce income disparities in the EU. Including them into analysis resulted in extending the half-life of convergence by 4-6 years. In turn, including Estonia, Lithuania, Latvia and Malta made it 4-6 years shorter.

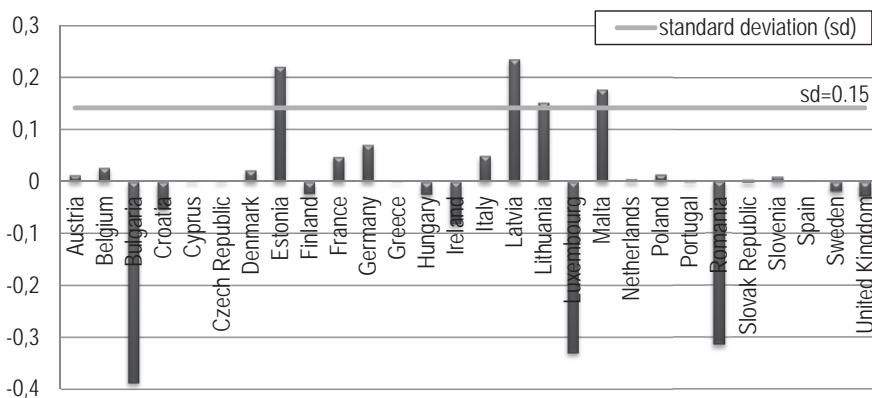


Figure 1. Individual β_i coefficients of European Union member states and standard deviation in the period 1993-2004

Source: own calculations.

Furthermore, the average value of individual β_i coefficients in the period 1993-2004 for the group examined countries amounted to -0.0071 p.p. It means, that, on average, EU countries had a very small but negative influence on the catching-up process. In order to investigate the degree of countries' differentiation in terms of their impact on general convergence rate, the value of standard deviation was also calculated. It amounted to 0.15 percentage point.

In the period 2004-2014 (when β -convergence rate in the EU was higher than in „pre- accession” period and amounted to 2.5 %) individual β_i coefficients of respective member states were, however, lower than in the period 1993-2004.

Table 5. Results of the marginal vertical convergence of the European Union member states in the period 2004-2014

Country	β_i^{N-1}	β_i	$T_{1/2,i}^{N-1}$	$T_{1/2,i}$
Austria	2.61	-0.08	26.57	0.88
Belgium	2.54	-0.01	27.34	0.12
Bulgaria	2.47	0.06	28.06	-0.61
Croatia	2.54	-0.01	27.32	0.13
Cyprus	2.49	0.04	27.85	-0.40
Czech Republic	2.52	0.01	27.55	-0.10
Denmark	2.52	0.00	27.48	-0.03
Estonia	2.48	0.04	27.94	-0.49
Finland	2.52	0.01	27.54	-0.09
France	2.52	0.00	27.49	-0.04
Germany	2.60	-0.07	26.66	0.79
Greece	2.47	0.05	28.03	-0.58
Hungary	2.59	-0.07	26.73	0.72
Ireland	2.45	0.07	28.28	-0.83
Italy	2.46	0.06	28.16	-0.71
Latvia	2.39	0.14	29.01	-1.56
Lithuania	2.28	0.25	30.41	-2.96
Luxembourg	3.03	-0.50	22.88	4.57
Malta	2.52	0.01	27.52	-0.07
Netherlands	2.58	-0.05	26.92	0.53
Poland	2.37	0.15	29.23	-1.78
Portugal	2.55	-0.03	27.16	0.29
Romania	2.65	-0.13	26.15	1.30
Slovak Republic	2.39	0.14	29.04	-1.58
Slovenia	2.52	0.00	27.45	0.00
Spain	2.49	0.03	27.81	-0.36
Sweden	2.60	-0.08	26.65	0.80
United Kingdom	2.53	-0.01	27.36	0.09

Source: own calculations using GRETL.

It means that the impact of particular countries on general β -convergence process became more unified, as they went forward to closer institutional and economic connections as full members of the EU.

In the light of the results obtained for the period 2004-2014, in the group of countries exerting the most positive impact on β -convergence rate in the EU were Lithuania, Latvia, Poland and Slovakia with β_i coefficients amounting to

about 0.15 percentage point. The group of EU member states with a slight positive influence on catching-up process extended in „after-accession” period. In this group there were mainly „new” EU countries (not mentioned above) apart from Romania and Hungary.

The majority of EU „former 15” e.g. Luxembourg, Germany, Sweden, Netherlands, Austria, Portugal, Spain and United Kingdom was in the „slowing down” group. After including Luxembourg into the survey, half-life of convergence coefficient increased by 4.5 years; in the case of including other countries mentioned above – by one year. Their negative impact on the catching-up process in the EU results from the fact that, for example, Luxembourg with the initial GDP per head at the level of twice higher than EU average, was characterised by relatively high GDP per capita growth (2% per year) in the period 2004-2014. Spain, by contrast, with the initial income level of three times lower than in Luxembourg, achieved the annual growth rate of 1.5%.

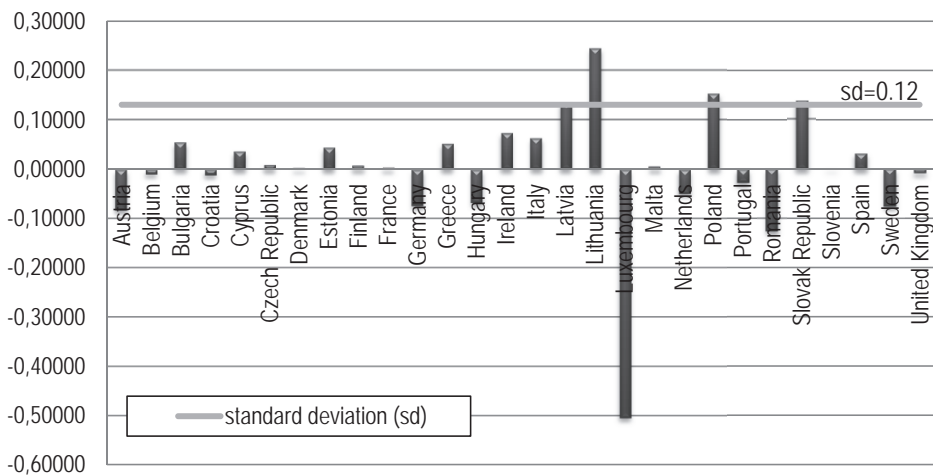


Figure 2. Individual β_i coefficients of European Union member states and standard deviation in the period 2004-2014

Source: own calculations.

The average value of individual β_i coefficients in the group of 28 EU countries in the period 2004-2014 amounted to 0.00075. It means, on average, EU member states had a very small but positive influence on the catching-up process. Standard deviation, reflecting the degree of countries' diversity in terms of their impact on general convergence rate, was lower than in the period 1993-2004 and amounted to 1.2. It confirms that the individual contribution of countries to the catching-up process in the EU was more unified than in the „pre-accession” period.

Conclusions

The presented analysis of convergence conducted for the European Union in two sub-periods 1993-20014 and 2004- 2014 furnishes evidence that the „catching-up” process in that regional group exists and –what is essential from the point of view of paper’s aim - its rate is higher in the second, „after-accession” period. Thus, one can draw the conclusion that there is a positive connection between the member states’ level of engagement in economical and institutional integration and the convergence rate in the European Union. The closely interconnected the countries are, the higher speed of β -convergence process is. In the period 2004-2014, when the majority of examined countries was official members of the EU and when their economical and institutional links were much stronger (compared with the period 1993-2003), the convergence rate in the EU was higher and amounted to 2.5%, even though, almost all of the European countries experienced GDP per capita slowdown as the result of financial and economic crisis after 2007. Nevertheless, the problem of the impact of economic crisis on β -convergence process in the UE seems to be a very interesting issue, worth to deepen in subsequent studies.

Although β - convergence process in the European Union exists, the respective member states’ contribution to it is diversified. In both analysed sub-periods one can easily distinguish the group of countries accelerating β -convergence process and slowing it down. In the group mentioned first „new” EU members play a more and more important role, especially Lithuania, Latvia, Poland and Slovakia. However, according to the obtained results of the vertical marginal β -convergence examination, the degree of that diversity is decreasing while institutional and economic links between „old” and ”new” European Union member states are deepening. Their impact on „catching-up” process is much more positive and unified.

One can assume that not only in the EU but also in other regional groups in Asia, North and South America or in Africa, gradual integration processes, consisting in implementation of the same necessary system changes „forced” by the membership and intensification of economic interconnections, may be reflected in more unified member states’ impact on β -convergence process. The above mentioned hypothesis should be verified in the future with the use of the method based on average data, implemented in that paper or with the use of panel data. Methods based on panel data are regarded as more solid due to taking into account a large number of observations and various methods of estimation, so one should consider employing it to study the convergence process in the European Union too.

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