



**Stefan Carnicky**  
PhD (Economics), Professor,  
University of Economics in Bratislava  
13, Tajovskeho Str., Kosice, 04130, Slovak Republic  
[stefan.carnicky@euke.sk](mailto:stefan.carnicky@euke.sk)  
ORCID ID: <http://orcid.org/0000-0003-4797-442X>



**Silvia Megyesiova**  
PhD (Economics), Associate professor,  
University of Economics in Bratislava  
13, Tajovskeho Str., Kosice, 04130, Slovak Republic  
[silvia.megyesiova@euke.sk](mailto:silvia.megyesiova@euke.sk)  
ORCID ID: <http://orcid.org/0000-0002-6815-5629>



**Monika Conkova**  
PhD (Economics), Assistant professor,  
University of Economics in Bratislava  
13, Tajovskeho Str., Kosice, 04130, Slovak Republic  
[monika.conkova@euke.sk](mailto:monika.conkova@euke.sk)  
ORCID ID: <http://orcid.org/0000-0002-8041-6588>



**Cyril Zavadsky**  
PhD (Economics), Assistant professor,  
University of Economics in Bratislava  
13, Tajovskeho Str., Kosice, 04130, Slovak Republic  
[cyril.zavadsky@euke.sk](mailto:cyril.zavadsky@euke.sk)  
ORCID ID: <http://orcid.org/0000-0002-8053-6483>

## Productivity development and convergence across the EU Member States

**Abstract.** The EU Member States have different levels of development. The state of development can be rated in various ways, using some economic or human development indicators. Enhancement of economic well-being of the EU countries belongs to the main goals of the 28 EU Member States. The improvement of well-being expects the convergence of socio-economic indicators. Labour productivity (LP) belongs to indicators of economic competitiveness reflecting the standard of living. Almost in all of the initial EU countries LP is higher than LP in the «new» EU members. In 2000 LP in purchasing power standard (PPS) was as low as 9,314 in Romania, but due to a strong increase by 256% LP reached PPS 33,188 in 2015. The lowest increase in LP in the same time span was achieved in Italy, where LP increased by only 19.4% from PPS 51,287 to PPS 61,244. Between the Visegrad Four countries Slovakia's LP grew by a highest rate of 107.8% and so the proportion of LP in Slovakia compared to EU-28 average (EU-28=100) increased from 53.7% in 2000 to 83.6% in 2015. Not only in Slovakia, but a strong jump of LP in PPS was achieved also in Poland (by 95.3%), in Hungary (by 72.5%), and in Czech Republic (by 67.6%). The convergence process of LP was typical for the period till the beginning of the economic crisis. From 2000 until 2008 the convergence of LP between the EU members was achieved in Beta- and Sigma-convergence. The coefficient of variation of LP decreased from 36.4% in 2000 to 27.4% in 2008. The economic crisis activated the divergence of LP. In 2015 the coefficient of variation increased to 31.7%. We expect that the convergence process of LP will successfully continue in periods of recovery and expansion of the EU economies.

**Keywords:** Productivity; Labour Productivity; Production; GDP; Gross Value Added; Variability; Employment; Slovakia; Visegrad Four

**JEL Classification:** E23; E24; J21

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**Чарніцкі Ш.**

кандидат економічних наук, професор, Університет економіки у Братиславі

**Мегесьова С.**

кандидат економічних наук, доцент, Університет економіки у Братиславі

**Чонкова М.**

кандидат економічних наук, асистент, Університет економіки у Братиславі

**Завадські Ц.**

кандидат економічних наук, асистент, Університет економіки у Братиславі

**Розвиток продуктивності та конвергенція в країнах-членах ЄС**

**Анотація.** Члени Європейського Союзу мають різний рівень розвитку. Сам рівень розвитку може бути визначено у різний спосіб, використовуючи індикатори економічного чи суспільного розвитку. Підвищення економічного добробуту є одним із ключових завдань 28 країн-членів Європейського Союзу. Для виконання цього завдання країни ЄС забезпечують конвергенцію соціально-економічних індикаторів. Продуктивність праці (ПП) є індикатором економічної конкурентоспроможності, що відображає один із аспектів добробуту суспільства. Майже всі старі країни-члени ЄС демонструють більш високий рівень ПП порівняно з новими членами Євросоюзу. Проте нові країни-члени демонстрували непогані темпи конвергенції продуктивності праці. Хоча економічна криза 2008 року уповільнила зближення показників ПП у старих та нових членів ЄС, цей процес знову демонструє позитивну динаміку на тлі відновлення європейської економіки.

**Ключові слова:** продуктивність праці; виробництво; ВВП; варіабельність; конвергенція; працевлаштування; Європейський Союз; Словаччина; Вишеградська четвірка.

**Чарницки Ш.**

кандидат экономических наук, профессор, Университет экономики в Братиславе

**Мегесева С.**

кандидат экономических наук, доцент, Университет экономики в Братиславе

**Чонкова М.**

кандидат экономических наук, ассистент, Университет экономики в Братиславе

**Завадски Ц.**

кандидат экономических наук, ассистент, Университет экономики в Братиславе

**Развитие производительности труда и конвергенция в странах-членах Европейского Союза**

**Аннотация.** Члены Европейского Союза находятся на разном уровне развития. Сам уровень развития может быть определен разными способами, опираясь на использование показателей экономического и общественного развития. Повышение экономического благосостояния является одной из ключевых задач 28 членов Европейского Союза. Для достижения этой цели страны ЕС обеспечивают конвергенцию социально-экономических показателей. Производительность труда (ПТ) выступает показателем экономической конкурентоспособности, который отображает один из аспектов благосостояния общества. Почти все изначальные члены ЕС демонстрируют более высокий уровень ПТ, чем новые члены Евросоюза, присоединившиеся к нему в 21 веке. Однако новые члены ЕС демонстрировали неплохие темпы конвергенции производительности труда. Хотя экономический кризис 2008 года замедлил темпы сближения показателей производительности труда у старых и новых членов ЕС, этот процесс снова стал демонстрировать положительную динамику на фоне восстановления европейской экономики.

**Ключевые слова:** производительность труда; ВВП; вариабельность; конвергенция; трудоустройство; Европейский Союз; Словакия; Вышеградская четверка.

**1. Introduction**

International comparison of the economic status and development is usually done by comparison of the levels and real changes of the gross domestic product (GDP). However, deeper analysis of the productivity is needed to discover the competitiveness, standard of living within a country or its regions. Measures of productivity are important indicators for statistical analysis of economic growth of a country. Productivity is a ratio of a volume measure output to a measure of input use [13]. It explains the principal of economic development and growth, it reduces the income gaps between the countries (Herman, 2016) [9]. Economic growth is positively affected by exports and inward foreign direct investment (Stoevsky, 2014) [16].

**2. Brief Literature Review**

Indicator of labour productivity (LP) can be calculated as a ratio between GDP, or gross value added, and the total number of hours worked, or total employment (Freeman, 2008) [7]. Productivity growth is positively associated with growth of living standards and positive change in real labour compensation (Baldwin et al., 2014) [1]. Not only the productivity of a national economy is used for analytical purposes, but also the productivity of smaller regional units (Martino, 2015) [11], or productivity of economic branches helps to understand the status and changes of the whole economy [10; 12]. Convergence is one of the main goals of countries that are members of intergovernmental unions like the EU or OECD, but it is also the goal of policy makers in any country in the world (Pashkevych & Papizh, 2014) [14]. Convergence is the phenomena of the member states of union because countries usually have a different level of socio-economic development (Grzebyk & Stec, 2014) [8].

**3. Purpose**

The main goal of the article is to analyse the economic indicators, and especially productivity in all 28 EU Member States with the emphasis on convergence process of the labour productivity from 2000 till 2015.

**4. Results**

Gross value added (GVA) composes about 90% of the GDP in EU Member States. Real change of the GVA copies the real changes of GDP. In 2009, when the decline of the economic output of the EU Member States was due to the economic crisis mostly effected, the real GVA compressed altogether in 27 EU states. The highest decline was achieved in the Baltic countries; in Estonia by 15.3%, in Lithuania by 14.8% and in Latvia by 12.0%. Poland was the only country with a real increase of the GVA by 3.1% in 2009. Poland belongs together with Slovakia, Czech Republic and Hungary to the Visegrad Four (V4) countries. The real change of the GVA in V4 members is presented in figure 1. The annual real increase of GVA before 2008 was higher in V4 countries than the average annual change of 28 EU countries. The real decline in 2009 was almost identical for three of V4 countries (except Poland, where a positive real development was achieved) to the average change for the EU Member States.

Due to recovery of the EU economies in 2010 the real GVA declined only in 4 countries (Greece, Croatia, Latvia, Romania). In 2011 the situation did not change a lot, and same four EU Member States demonstrated GVA declined, with a highest drop in Greece (-9.0%). A wave of negative development

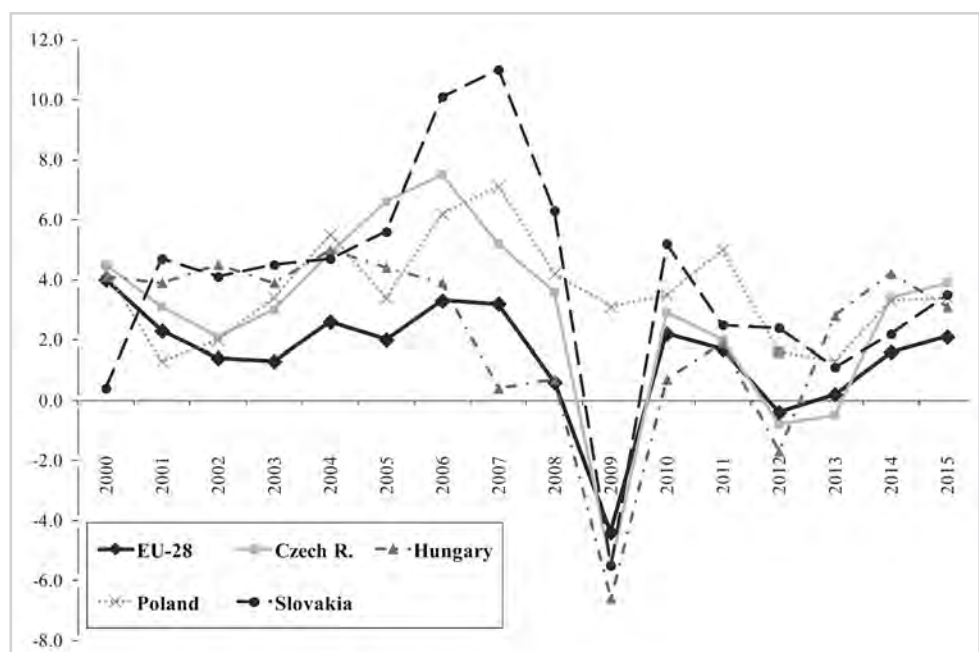


Fig. 1: Real change of gross value added, y-y, %  
Source: Eurostat, further elaborated by the authors

returned in 2012, when 16 EU countries altogether were hit by a negative real GVA growth, including two of V4 Members (Czech Republic and Hungary). A very moderate increase of the real GVA in EU-28 by only 0.2% in 2013 was a result of a negative change of GVA in 9 EU countries, including Czech Republic. In 2014 only in 3 countries real GVA changed negatively, while in 2015 all EU Members achieved increase of the real GVA.

Strong real increases of the GVA before the beginning of the economic crisis were typical not only for the V4 countries, but also for other «new» EU Member States. The changes of the GVA influenced also the changes in productivity. The labor productivity can be calculated as the fraction of GVA to the total employment. And so the productivity depends not only on the level of GVA, but also on the level of employment. The labour productivity (LP) is a driver of economic growth. For international comparison of LP the productivity in purchasing power standards (PPS) was used.

In 2000 LP ranged from PPS 9,314 (Romania) to PPS 71,826 (Luxembourg). The lowest level of LP was shown by Romania constantly from 2000 till 2004. From 2005 till 2015 the worst position of LP per person employed was held by Bulgaria. On the other hand, the highest levels of LP from 2000 till 2014 were typical for Luxembourg. In 2015 Ireland's productivity jumped to a historically highest level at PPS 108,554 (Figure 2).

The convergence process of LP showed positive signals till the beginning of the economic crisis. The Sigma convergence can be measured using the coefficient of variation (CV). The CV of LP decreased from 36.4% in 2000 to 27.4% in 2008. In 2009-2011 the variability of LP measured by CV was higher than 28%. In 2012 and 2013 the CV again declined to 27.2% and 27.4% respectively. A positive sign of a recovery of the EU economies was again associated with an increase of the CV in LP. Also, due to an extremely high level of LP in Ireland, the CV increased to 31.7% in 2015. Eurostat estimate the real growth of Ireland's GDP by 26.3% plausible, but Eurostat will examine the methodology used in the calculation of the GDP figure in more detail by the end of the year 2016. According to Eurostat, significant increase of the GDP was due to the relocation of a limited number of big economic operators to Ireland (European Commission, 2016) [5], but huge increase of the GDP in Ireland should not fundamentally increase the level of the total GDP, GVA data for the EU-28, due to a very small share of the Irish economy in the total EU output (only around 2%).

The productivity shifts in the V4 countries can be positively rated mainly in Slovakia, Czech Republic and Poland. Slovakia's labour productivity reached PPS 23,044 in 2000, eighth position in the EU (see Table 1). The positive development of LP in Slovakia was associated not only with an increase of LP to PPS 40,542 in 2008, but also with a rise to eleventh position. At the end of time period analysed Slovakia's LP reached PPS 47,879 (rank 12). Between

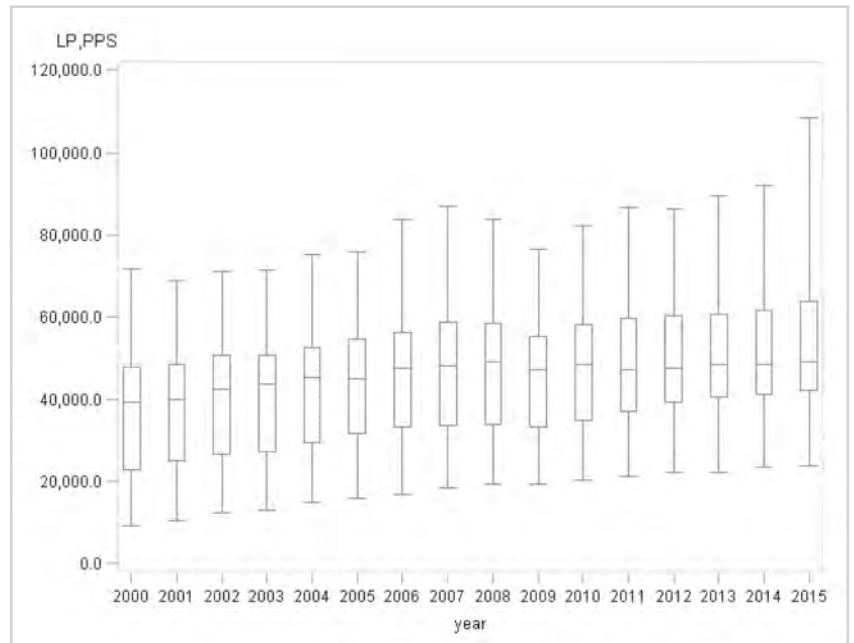


Fig. 2: Box plots of LP per person employed in PPS (EU-28)  
Source: Eurostat, further elaborated by the authors

Tab. 1: Labour productivity in PPS and rank of the LP

Year 2000			Year 2008			Year 2015		
Rank	EU-28	40 242,2	Rank	EU-28	50 710,9	Rank	EU-28	57 293,5
1	RO	9 314,0	1	BG	19 289,8	1	BG	23 752,3
2	BG	12 202,0	2	RO	24 398,2	2	RO	33 187,6
3	LV	16 266,3	3	LV	28 899,9	3	LV	36 457,9
4	LT	16 793,4	4	PL	30 057,4	4	HR	36 909,1
5	EE	17 983,6	5	EE	32 628,1	5	HU	37 281,3
6	PL	21 553,6	6	LT	32 703,3	6	EE	38 563,5
7	HU	21 610,8	7	HU	33 982,0	7	LT	41 343,5
8	SK	23 043,7	8	HR	34 001,8	8	PL	42 090,4
9	HR	25 288,0	9	PT	36 952,6	9	PT	43 961,3
10	CZ	27 279,5	10	CZ	38 385,0	10	SI	44 865,1
11	PT	27 730,3	11	SK	40 541,6	11	CZ	45 724,6
12	SI	29 514,7	12	SI	40 886,4	12	SK	47 879,0
13	CY	36 383,3	13	MT	46 647,8	13	EL	48 044,7
14	EL	37 504,1	14	CY	47 051,6	14	CY	48 548,9
15	MT	39 340,8	15	EL	49 062,0	15	MT	49 144,2
16	ES	41 584,9	16	DK	51 646,2	16	UK	58 582,8
17	DE	42 986,8	17	ES	52 174,9	17	FI	59 114,9
18	DK	43 272,5	18	DE	54 289,5	18	ES	59 613,8
19	FI	45 303,2	19	FI	56 598,1	19	IT	61 243,8
20	SE	46 536,5	20	UK	57 285,1	20	DE	61 445,8
21	NL	47 671,8	21	IT	57 541,6	21	DK	62 412,1
22	FR	48 055,3	22	SE	58 354,3	22	NL	63 726,8
23	UK	48 144,1	23	AT	58 364,6	23	SE	64 200,8
24	AT	48 871,0	24	FR	58 541,5	24	FR	65 540,0
25	IT	51 287,6	25	NL	59 392,3	25	AT	65 634,1
26	IE	51 342,2	26	BE	63 664,5	26	BE	73 741,8
27	BE	54 713,5	27	IE	64 473,4	27	LU	98 750,0
28	LU	71 826,4	28	LU	83 614,9	28	IE	108 554,1

Country codes: BE - Belgium, BG - Bulgaria, CZ - Czech Republic, DK - Denmark, DE - Germany, EE - Estonia, IE - Ireland, EL - Greece, ES - Spain, FR - France, HR - Croatia, IT - Italy, CY - Cyprus, LV - Latvia, LT - Lithuania, LU - Luxembourg, HU - Hungary, MT - Malta, NL - the Netherlands, AT - Austria, PL - Poland, PT - Portugal, RO - Romania, SI - Slovenia, SK - Slovakia, FI - Finland, SE - Sweden, UK - the United Kingdom

Source: Eurostat, further elaborated by the authors



the V4 countries Slovakia in 2015 had the highest level of LP in PPS, the highest position between the EU Member States. The rank of the Czech republic's LP did not change a lot, from tenth position in 2000 to 11<sup>th</sup> in 2015. But LP change was significant - from PPS 27,280 in 2000 to PPS 45,725 in 2015. Poland and Hungary had more turbulent development of the rank position of their LP. While Poland started with sixth position in 2000, the situation changed in negative way in 2008, when Poland's LP plunged to fourth position. Due to positive dynamics of Polish economy, which was not affected by negative change of GVA in span of crises, the position of LP increased to 8<sup>th</sup> in 2015. The worst position between the V4 countries in 2015 was occupied by Hungary, which with a LP of PPS 37,281 reached only the fifth position between the 28 EU countries. Comparing LP in V4 countries with the average level of the EU, we witness positive signs. In 2000 LP in Poland reached only 53.6% of the average level of EU-28, followed by Hungary (53.7%), Slovakia (57.3%) and Czech Republic (67.8%). In 2015 LP in V4 countries compared to the average level of the EU was 83.6% in Slovakia, while in Czech Republic - 79.8%, in Poland - 73.5%, and in Hungary - 65.1%. It means that the increase of LP in V4 countries was stronger than the overall increase of LP in 28 EU Members.

A strong positive development of LP was typical not only to the V4 countries, but also to other «new» Member States. According to these findings, we may speak about Beta convergence process of LP in the EU. To verify the hypothesis about Beta convergence process of LP two periods of time were chosen. The first period was related to convergence till the beginning of the economic and financial crisis, and the second period revealed convergence from 2009 till 2015. In our work the convergence process of LP was investigated, while in most scientific reports convergence of GDP per capita [3, 4], income per capita (Peiro-Palomino, 2016) [15], or fiscal aggregates were rated (Censolo & Colombo, 2016) [2].

In figure 3 we see strong convergence process of LP in PPS of the EU countries for the period from 2000 until 2008. The Pearson's correlation coefficient  $r_{xy}$  between LP in 2000

and the average annual real change of LP was negative, very close to -1, and statistically significant with a very low probability value  $p$  ( $r_{xy} = -0.816, p < 0.0001$ ). The countries in figure 3 are divided into 4 quadrants according to the average values of LP and annualised growth rates of LP for all 28 Member States. In the left upper quadrant almost all «new» Member countries are located. The countries in this quadrant had a low LP in 2000, but the low level of the productivity was associated with a strong real growth of LP. For example, Romania had LP in 2000 at PPS 9,314, but the annualized rate of growth between 2000 and 2008 was extremely high and reached 8.4%. Strong annual average real growth rate higher than 3% during the same time span was achieved in following EU countries: Lithuania (7.1%), Latvia (5.5%), Slovakia (4.9%), Estonia (4.7%), Bulgaria (4.0%), Hungary (3.7%), Czech Republic (3.5%), Slovenia (3.1%), and Poland (3.1%). In the left lower quadrant only two countries are positioned: Portugal and Cyprus. Both countries had a lower LP than the average EU-28 level, and the growth rate was also a bit lower than the average EU growth rate of 1.1%. Almost all of the former EU-15 are positioned in the right lower quadrant of the figure 3. For these countries high level of LP associated with a very low real LP growth is typical. In case of Italy even a real annualized decline was achieved between 2000 and 2008. The strong annualised real growth rate of LP of the former post socialist countries, where LP in 2000 was very low, creates a good assumption for the convergence process of LP between the EU countries, and the same assumption was confirmed by a declining coefficient of variation.

The economic crisis negatively influenced the overall convergence process of LP. Figure 4 presents the association between LP in PPS and the annualised real change of LP for the period from 2009 till 2015. The correlation coefficient was negative but not statistically significant ( $r_{xy} = -0.287, p = 0.131$ ). Unexpectedly high annualized growth of LP was achieved in Ireland (5.5%), it was mainly due to high increase of the Ireland's GVA in 2015 by 23.2%. Still in the left upper quadrant from the average EU-28 levels are the «new» Member States.

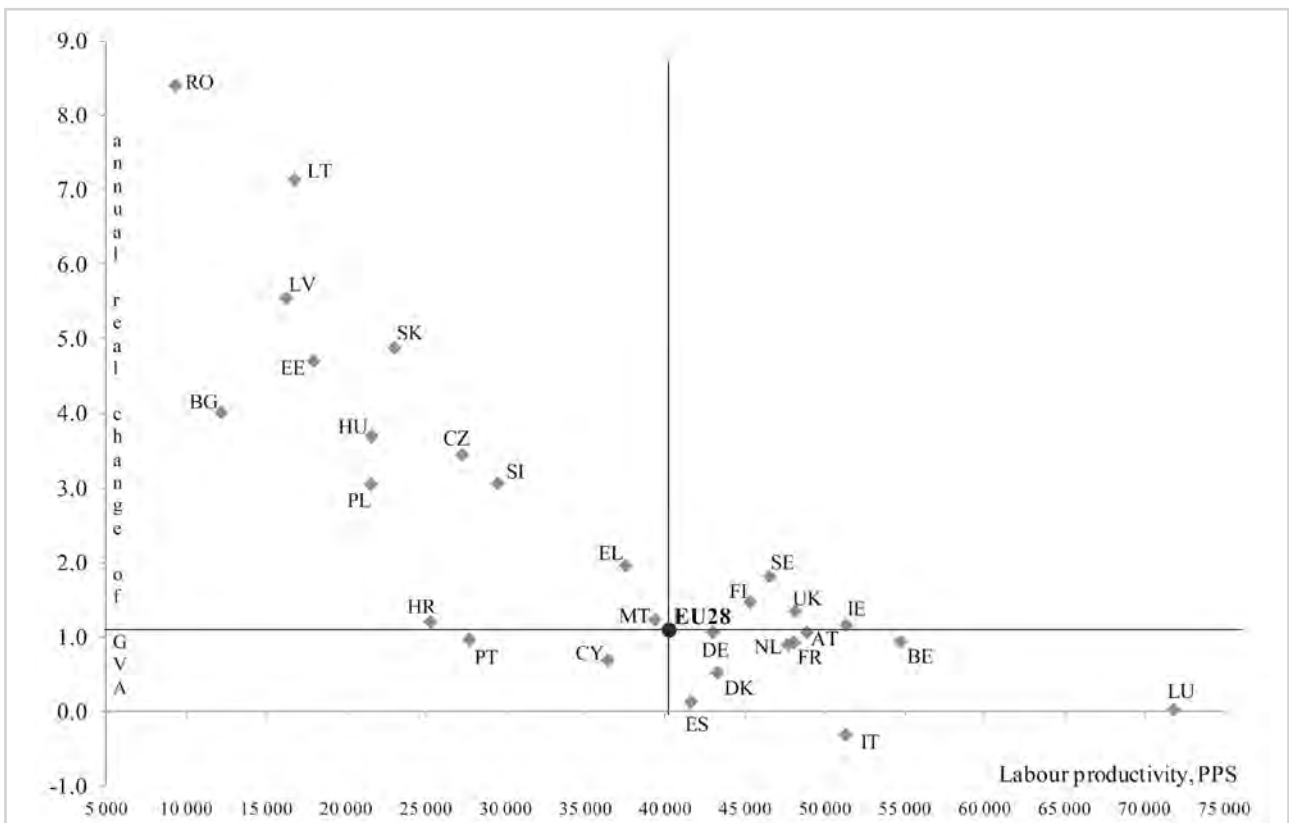


Fig. 3: Association of LP (in 2000) and annualised real change of GVA, 2000-2008  
Source: Eurostat, further elaborated by the authors

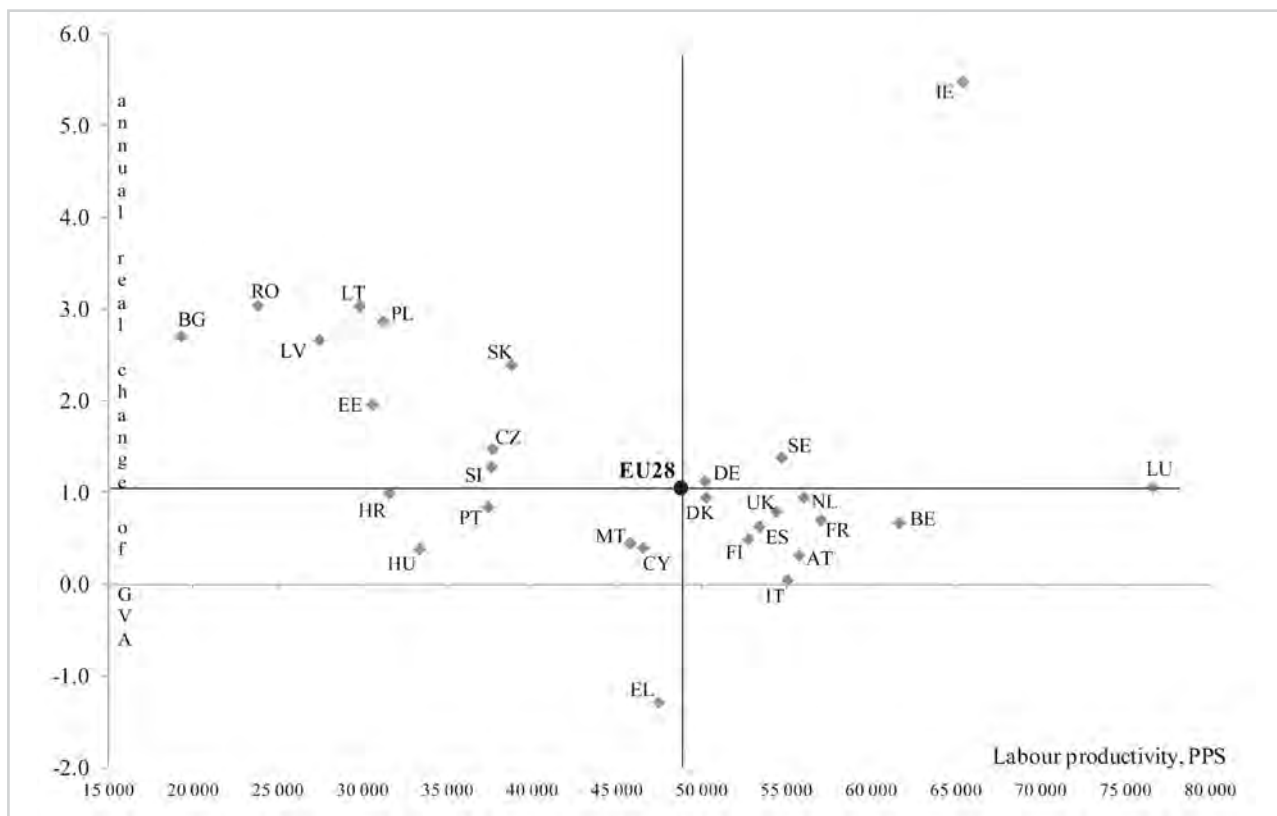


Fig. 4: Association of LP (in 2009) and annualised real change of GVA, 2009-2015  
Source: Eurostat, further elaborated by the authors

However, unlike previous time lapse, in the left lower quadrant 6 countries are located. For countries in this quadrant we see lower LP than the average level of the EU-28, and the low LP here is associated with a lower annualized growth rate.

From the V4 countries, Hungary is positioned in the left lower quadrant with a very moderate real annualized LP growth rate of only 0.4%.

### 5. Conclusion

The economies of V4 countries and other «new» EU Member States have undergone significant changes. Increase of their LP before the crisis was very strong. The lower levels of

LP in combination with a significant annual growth of LP from 2000 till 2008 created good principals for Beta and also Sigma-convergence process of LP. Unfortunately, the convergence of LP was halted by the recession of the EU countries. Slovakia, Czech Republic and Poland improved their position between the EU-28 countries in respect to their levels of LP. The best improvement was shown by Slovakia, up from position 8 in 2000 to 11 in 2015. On the other hand, among V4 countries only Hungary downgraded from 7<sup>th</sup> position to 5<sup>th</sup>. Recovery of the EU economies will be associated not only with an LP growth, but also with LP convergence.

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