

Income Gap between the New and Old EU Member States and Its Determinants in the Period 1996–2017

Introduction

In the early nineties of the 20th century, 11 post-socialist countries of Central and Eastern Europe (CEE)¹ as well as Cyprus and Malta started their integration process with relatively richer European Union member states. In the next years, after signing their association agreements with the European Community, these poorer candidates and then EU members have taken gradual steps toward the liberalization of trade, capital and labour markets, harmonisation of economic policy and the foundation of the Economic and Monetary Union. The expected effect of EU membership should be an increasing level of GDP per capita.

Indeed, in the pre- and post-accession period, the per capita income gap between new entrants (EU-13) and the “former fifteen” (EU-15) was significantly reduced due to a catching-up process. A higher GDP per capita growth rate of the new EU countries compared to the old member states (having a significantly higher initial income levels) indicated the existence of real income convergence in the European Union. It has been confirmed by the results of many empirical studies (e.g. Batóg 2010, Halmai and Vásáry 2010, Adamczyk and Łojewska 2011, Tatomir and Alexe 2011, Stańsić 2012, Stawicka 2012, Walczak 2012, Grzelak and Kujaczyńska 2013, Rapacki and Próchniak 2014, Młynarzewska-Borowiec 2018). There are also studies confirming convergence of GDP per capita among the new EU member states (mainly CEE countries). The convergence rate within this group is generally higher than that for the entire European Union (see e.g. Mat-

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¹ Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia

kowski and Próchniak 2004, Vojinovic and Oblotnik 2008, Vojinovic, Oblotnik and Próchniak 2010).²

Of course, the progress of individual countries in shortening their GDP per capita distance to richer EU economies was diversified. It was probably connected both with their initial economic and technological potential and their abilities to take advantage of the positive integration effects, which in turn shaped the factors influencing their GDP per capita levels. Among GDP per capita determinants it is worth considering accumulation of labour force and accumulation of capital and technology, derived directly from Solow's (1956) model, as well as accumulation of human capital, mainly related to the level of education (Mankiw et al. 1992). According to Rodrick (2002), accumulation of the above-mentioned "traditional" factors is strongly shaped by the quality of institutions in the country (efficiency of their functioning, law enforcement) and it depends on the openness of economy (trade intensity, mobility of labour and capital).³

Assessing the possibilities of the individual new member states in closing their income gap to the richest EU countries, it is worth to point out that in the future these opportunities may decrease or even disappear due to the emergence of the so-called middle income trap. It may happen that after experiencing fast GDP per capita growth and reaching a middle-income status, the new EU economies will follow a lower growth trajectory. According to the literature, the mentioned slowdown of the convergence process is often associated with the over-reliance on traditional growth determinants (labour force and capital accumulation) at the early stage of the catching-up period (Eichengreen et al. 2011, 2013). Further development requires a shift from labour-intensive production towards more innovative and technologically advanced production (Agénor et al. 2012). It was proved that slowdowns in GDP per capita growth are less likely in middle-income economies where human capital resources are larger and high-technology products account for a relatively large share of exports (Eichengreen et al. 2011, 2013; Felipe et al. 2012). Countries with a high quality of their legal systems and institutions are also regarded as less exposed to this trap (Ayar et al. 2013).

The impact of the above determinants on GDP per capita growth in EU countries is the subject of many empirical studies. So far, most of them have been conducted for various groups consisting of both old and new EU member

² It is worth mentioning that there are also some studies where no visible acceleration of the convergence process after their EU-accession was proved (e.g. Cavenaile and Dubois 2011). Furthermore, most of the authors of the recent papers claim that the convergence process in the EU has slowed down and some divergence tendencies have appeared as the result of the world economic crisis and debt crisis in the euro area (Staňišić 2012, Kaitila 2013, Dauerstädt 2014, Simionescu 2014). Some other studies question the overall convergence tendency within the EU and suggest the occurrence of some "convergence clubs" (Borsi and Metiu 2013, Gligorić 2014)

³ Rodrick's concept of deep determinants also pointed to the importance of geography (geographic location, natural resources, climate, etc.), but in this research, concerning the countries from the same region, this factor seems to be irrelevant.

states⁴. However, the literature also includes some research covering only the new EU members, where the impact of the afore-mentioned traditional or deep determinants is verified. However, Cyprus and Malta are usually excluded from the analysis. For example, Grela et al. (2017) showed that in the period 1997–2014 accumulation of capital (investment rate) still had a significant impact on GDP per capita of the CEE countries. The accumulation of capital was strongly supported by the influx of foreign direct investment. Simionescu (2018), using Bayesian bridge regressions, also confirmed a significant impact of FDI inflows on GDP per capita in the CEE countries. The results of the research by Próchniak (2011) carried out for ten CEE countries in the period 1993–2009 suggested that the most important determinants of GDP per capita in these countries were investment rate (including FDI) and human capital (measured by the education level of the labour force). In turn, Spruk (2011) in his research on the conditional convergence in seven CEE countries suggested that one additional year of total schooling boosts the rate of real GDP per capita growth by 0.03 percentage points on average, holding all other factors constant. Also Khalilov and Yi (2018), using four different methods of econometric modelling, found evidence of the significant importance of human capital resources (tertiary enrolment rate) in shaping GDP per capita of seven CEE countries in the period 1999–2014. They also proved a positive impact of the openness of economy (intensity of trade) and R&D expenditure on GDP per capita level of these countries. A positive relationship between R&D expenditure and GDP per capita was also confirmed by Pop Silaghi et al. (2014) in a study covering ten CEE countries in the period 1998–2008. But, on the other hand, Kacprzyk and Doryń (2017) found no evidence of relationship between R&D expenditure and GDP per capita of the new EU member states in the period 1993–2011. The evidence of a significant impact of the institutional factor on the GDP per capita of the CEE countries can also be found in the literature. For example, in his empirical research (based on the Spearman correlation coefficients), covering 9 new EU members and Moldova in 2016–2017, Terzic (2017) claimed that developing an environment for quality institutions and business sophistication is a crucial determinant of their GDP per capita levels.

The purpose of this paper is to examine how the individual new EU member states reduced their GDP per capita distance to the “old fifteen” (EU-15) in the period 1996–2017 (i.e. to check whether the real income convergence in the EU occurred) and what are their chances to close the income gap in the nearest future. Due to the diversity of the EU-13 group, the study also attempts to capture some differences in the factors that determine their GDP per capita. The paper verifies a hypothesis that the individual new EU members were strongly differentiated in terms of the factors shaping their per capita income, which consequently influenced their successes in reducing the distance to the richest EU countries.

⁴ See Barro 1996, Hall and Jones 1999, Acemoglu et al. 2005, Rodrick 2002, Valeriani and Peluso 2011, Docquier 2014, Grossman and Helpman 1990, 1991, Barro and Sala-i-Martin 1997, Ben-David and Loewy 1998, Fetahi-Vehapia et al. 2015, Pilinkiene 2016, Wielki et al. 2018.

The study attempts to cover both pre- and post-accession period of 11 CEE countries that entered the EU along with Cyprus and Malta (EU-13). Taking into account the aim of the study, including the last two economies in the research seems to be justified. However, these two non-post-socialist countries were significantly different from the rest in terms of their GDP per capita level, especially at the initial stage of integration, so it is important not only to assess their results in closing the income gap to the EU-15, but also to identify the factors that determined their per capita income levels compared to the other EU-13 countries. Due to the scarcity of statistical data for the period 1990–1995, the time range of this study had to be shortened and ultimately it covers the period from 1996 to 2017. The study uses econometric methods, especially cross-sectional and panel growth regression models.

Apart from this Introduction and Conclusions, the paper includes four analytical parts. Section 1 shows the disparities in GDP per capita levels between the new and old EU member states in the period 1996–2017. Section 2 contains the analysis of the real income convergence process within the EU-28 and EU-13 groups. Section 3 presents some forecasts of further income convergence between the new and old EU member countries. Section 4 gives an econometric analysis of GDP per capita determinants in the new EU member states, which shape their dynamics and catching-up prospects. Conclusions summarize the findings.

1. GDP per capita disparities between the new and old EU member states

In the period 1996–2017, 13 EU candidates and then new EU members (EU-13) implemented their obligations under their association agreements and subsequent accession treaties. During this period of gradual economic integration, the GDP per capita distance between them and the 15 old members states (EU-15) has been significantly reduced. In 1996, the average level of per capita GDP in the EU-13 group (calculated as unweighted average) amounted to about 46% of the level for the EU-15 group and about 61% of level for the entire group of 28 EU countries. Over the next twenty years, these proportions (relative income levels) have considerably increased and in 2017 they reached 62% and 75 % respectively (see Table 1).

Table 1

GDP per capita in the new EU member states (EU-28/EU-15 = 100) in 1996–2017

Against	1996	1998	2000	2002	2004	2006	2008	2010	2012	2014	2015	2016	2017
(EU-28 = 100)	60.9	60.9	59.9	62.1	64.7	68.0	71.0	69.9	71.9	73.0	74.3	74.3	75.5
(EU-15 = 100)	45.5	45.5	44.5	46.7	49.6	53.2	56.7	55.5	57.8	59.1	61.6	60.7	62.3

Note: GDP per capita based on PPP (2011, current international \$), unweighted average.

Source: IMF World Outlook Database; own calculations.

The success of the new member states in approaching the GDP per capita level of the richer EU member countries resulted from the fact that in the period 1997–2017 the average GDP per capita growth rate in the EU-13 group amounted to about 3.1% while in the EU-15 group it was only 1.6%.

Figure 1
Changes in GDP per capita in the new and old EU member states
(EU-13 and EU-15) in 1997–2017 (%)



Source: IMF World Economic Outlook Database; own calculations.

According to Figure 1, only in 1999 and 2009 the average GDP per capita growth rate (unweighted average) of the new EU members (EU-13) was lower than in the “former 15” (EU-15). In 1999, this was caused by the Russian financial crisis, which affected negatively economic growth of some CEE countries, such as Lithuania, Estonia, Slovakia and Romania. The significant decrease in the growth rate in 2009 was the consequence of the financial crisis of 2007–2009. It resulted in a decline in GDP per capita in all the EU countries (except Poland), but in particular in Lithuania, Latvia and Estonia, where the biggest (about 14%) drop was reported.

In 1996, the EU-13 group was considerably differentiated as to the levels of per capita income. The lowest level of GDP per capita was recorded in Bulgaria, Lithuania and Latvia, where it made up less than 30% of the average level of the EU-15 group. In the group of post-socialist countries, the highest GDP per capita level (amounting to about 60% of the average level seen in the EU-15) was observed in Slovenia and in the Czech Republic. At the same time, the relative income levels in Cyprus and Malta amounted to about 80% of the level of the

Table 2
GDP per capita in the new EU member states (EU-15 = 100)^a in 1996–2017

Country	GDP per capita in 1996 (EU-15 = 100)	GDP per capita in 2017 (EU-15 = 100)	Change in the period 1996–2017 (p.p.)	Average GDP per capita growth rate differential against the EU-15 (%) ^b
Bulgaria	26.25	43.61	17.35	2.58
Croatia	41.61	49.58	7.97	0.96
Cyprus	83.86	74.47	-9.39	-0.48
Czech Republic	60.47	71.19	10.72	0.88
Estonia	36.00	63.40	27.40	3.00
Hungary	46.79	59.21	12.42	1.23
Latvia	26.15	55.49	29.34	3.92
Lithuania	29.97	64.86	34.89	3.99
Malta	77.25	79.41	2.16	0.20
Poland	35.97	59.38	23.41	2.51
Romania	33.03	49.29	16.27	2.11
Slovakia	42.86	66.25	23.39	2.23
Slovenia	57.79	69.07	11.29	0.97

^a GDP per capita based on PPP (2011, current international \$), unweighted average.

^b Difference in the average yearly GDP per capita growth rates between the given country and the EU-15 group (p.p.).

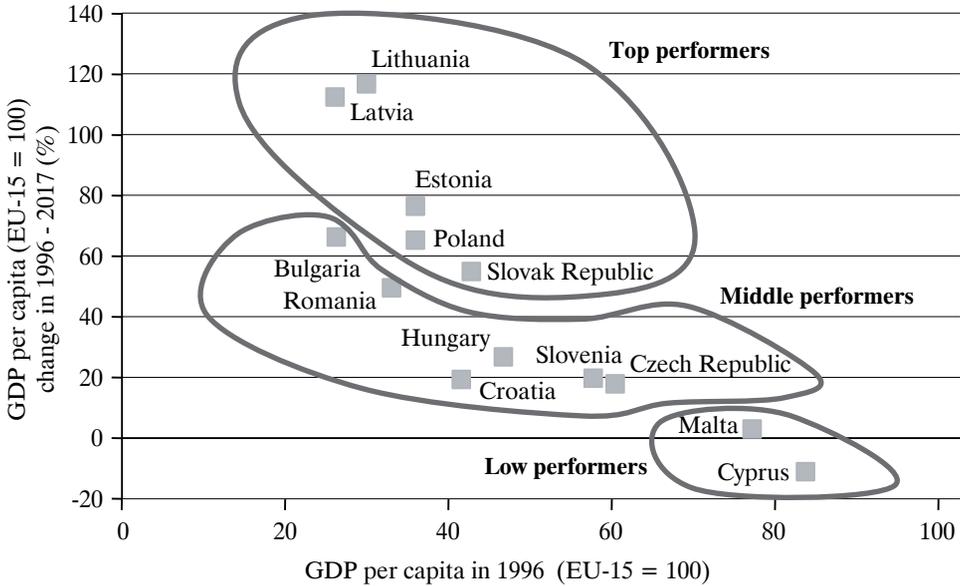
Source: IMF World Economic Outlook Database; own calculations.

Western European countries. GDP per capita of Cyprus and Malta was slightly higher than in Portugal and Greece, the poorest countries of the EU at that time (see Table 2).

During the period from 1996 to 2017, significant progress in the relative levels of GDP per capita can be observed in almost all of the EU-13 countries (except Cyprus and Malta). In 2017, when all the countries of the EU-13 group were already fully-fledged members of the EU, 11 of the 13 countries experienced a significant increase in GDP per head against the background of the old EU members. The most successful catching-up process was visible in Estonia, Latvia, Lithuania, Bulgaria, Poland, and Slovakia. In 2017 their GDP per head levels (compared to the average level of the old EU countries) were by 20–35 percentage points higher than in 1996. Interestingly, the above ratio decreased by 9.4 percentage points in the case of Cyprus and increased by only 2.2 for Malta.

The analysed countries varied considerably in terms of their GDP per capita growth rates. Most of them grew at a rate higher than the average for the EU-15 group (amounting to about 1.5% per year). The highest average growth rate was observed in Estonia, Latvia, Lithuania, Poland, and Bulgaria. However, GDP per

Figure 2
Progress of the new EU countries (EU-13) in reducing their income gap to the EU-15 group in 1996–2017



Source: IMF World Economic Outlook Database; own calculations.

capita growth rate of Cyprus was lower by 0.5 p.p. than the average rate of the EU-15 group; therefore, the income gap between Cyprus and the EU-15 group has even increased. Malta grew at the rate of 1.7% per year (which was only by 0.2 p.p. higher than the average rate for the EU-15); consequently, it was also not able to reduce significantly its income gap to the EU-15.

On the basis of the above analysis, three subgroups can be clearly distinguished in the EU-13 group. The group of leaders (“top performers”) includes Lithuania, Latvia, Estonia, Poland and Slovakia. These countries, as shown in Figure 2, had the highest GDP per capita growth rates among the EU-13 countries, starting with a similar initial income level (in 1996). The group of “middle performers” contains countries that, with a given initial income level, showed much slower increase in GDP per capita (expressed as a percentage of the average level for the EU-15 group), i.e. Bulgaria, Romania, Croatia, the Czech Republic, Hungary, and Slovenia. The group of “low performers” includes Cyprus and Malta. In 1996 they were most similar to the EU-15 group in terms of their income per head, but till 2017 Malta has not improved its relative income status significantly, and in the case of Cyprus its position in relation to the EU-15 countries has even decreased.

Nevertheless, Figure 2 proves that the dynamics of overcoming the income distance to the EU-15 countries were related to the initial level of GDP per capita in the individual EU-13 countries. In general, the countries that in 1996 had the largest income gap to the EU-15 group were able to achieve the highest dy-

namics of the catching-up process in the period 1996–2017. Therefore, it can be assumed that a real convergence process occurred not only between 28 EU members (EU-28), but also among the countries of the EU-13 group. The verification of this hypothesis is conducted in the next part of the paper.

2. Real income convergence process in the European Union

2.1. Methodology

In order to examine the existence and speed of the convergence process in the mentioned groups of countries in 1996–2017, both β and σ convergence is analysed. The test for the presence of β -convergence is conducted with the use of averaged data for the entire period. When applying this traditional method (based on averaged data), one should be aware that a limited number of observations lowers the statistical credibility of the obtained results. But from the economic point of view, this approach seems to be appropriate, because it gives an opportunity to investigate the relation between initial conditions of economies and their long-term growth processes.

The method assumes that all countries in the analysed groups were moving towards the same long-term equilibrium point during the analysed period. It seems to be possible because the gradual integration processes, consisting in intensification of economic and institutional interconnections and the implementation of the same system changes forced by the membership, resulted in a higher degree of similarity in the functioning of the economies. Additionally, according to Solow's framework, it is assumed that supply factors played the most important role in shaping the growth processes of the analysed countries.

To verify the hypothesis of absolute β convergence in the EU-28 and EU-13 groups in 1996–2017, structural parameters of the following equation (Barro and Sala-i-Martin 2003) are estimated⁵:

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

The convergence rate is reflected by the coefficient β , defined by the following formula⁶:

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

⁵ The left side of the equation represents the average growth rate of GDP per capita of country i between 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.

⁶ The higher the coefficient β value (between 0 and 1), the higher the convergence rate; in other words, the higher the pace of the country's approach to the common steady state.

As the aim of the paper is to investigate income disparities between the new and old EU countries, additionally, the half-life coefficient is calculated. It is defined by the following formula:

$$HL = \frac{\ln 2}{\beta}. \quad (3)$$

The *HL* coefficient 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 sigma (σ) convergence hypothesis is verified by estimating the trend lines⁷ for the differentiation of income levels between countries, measured by the standard deviation of the GDP per capita logarithm:

$$sd(\ln Y_t) = \gamma_0 + \gamma_1 t + \omega_t. \quad (4)$$

For all the estimated equations, the Student's *t*-test is used to assess the significance of the parameters, and the determination coefficient (R^2) to measure the degree of conformity of the estimated models with reality (goodness of fit). In addition, the White's test for heteroscedasticity and the Jarque–Bera test for normality are conducted to confirm that the OLS estimator is efficient and unbiased. Data on GDP per capita at PPP (2011, international dollar) of EU member states in the period 1996–2017 was obtained from the International Monetary Fund World Economic Outlook Database, 2018.

2.2. Results

The estimation of structural parameters of equation (1) indicates the presence of β convergence both in the EU-28 and EU-13 (see results for model 1a and 1b contained in Table 3).

The estimated value of the structural parameter α_1 is -0.021 for the entire group of 28 EU countries and -0.031 for the EU-13. The negative value indicates a negative correlation between the initial level of income per capita in 1996 and economic growth rate in the period 1996–2017. The assessment of the significance of the parameters made using the Student's *t*-test indicates that parameters are significant at a 1% significance level. The level of the coefficient R^2 of about 80% indicates a quite satisfactory ability of the models to explain the variability of the dependent variables and quite a good statistical fit. The results of the White's and the Jarque–Bera tests are satisfactory.

The value of the β coefficient calculated according to formula (2) for the EU-28 and EU-13 amounts to 0.028 and 0.049 respectively. This means that, in the analysed period, the countries with lower GDP per capita (EU-13 group) approached the level of prosperity of the richer countries (from the EU-15 group)

⁷ The negative value of the estimated γ_1 coefficient indicates the existence of σ -convergence.

Table 3

Estimation results of the cross-sectional models describing absolute β and γ convergence in the European Union in the period 1996–2017 (estimator: OLS)

Coefficient/model diagnostics	β -convergence		σ -convergence	
	(1a)	(1b)	(4a)	(4b)
	EU-28	EU-13	EU-28	EU-13
α_0	0.22165 (0.03267)***	0.32487 (0.04003)***	–	–
α_1	–0.02092 (0.00327)***	–0.03064 (0.00419)***	–	–
γ_0	–	–	0.54129 (0.00850)***	0.3963 (0.01087)***
γ_1	–	–	–0.00993 (0.00065)***	–0.01087 (0.00043)***
Dependent variable	$\ln(\text{GDP}_t/\text{GDP}_0)/T$		$\text{sd}(\ln \text{GDP}_t)$	
Convergence	yes	yes	yes	yes
β coefficient	0.02756	0.04910	–	–
Half-life coefficient (years)	25	14	–	–
Number of obs.	28	13	22	22
Model diagnostics:				
R^2	0.8112	0.82967	0.92172	0.9689
Adjusted R^2	0.7973	0.81418	0.91781	0.9674
White's test1:				
test statistics	2.4597	3.52472	0.93941	0.16654
[p -value]	[0.2936]	[0.17164]	[0.6252]	[0.9201]
JB normality test2:				
test statistics	4.2530	0.38982	0.14922	1.7247
[p -value]	[0.1192]	[0.82291]	[0.9281]	[0.4222]

Note: The numbers in brackets denote the value of standard error; *** means significance at 1%.

^a White's test: null hypothesis H_0 : variance of error term is constant across observations (homoscedasticity).

^b JB normality test: null hypothesis H_0 : normal distribution.

Source: own calculations using GRETL.

at a rate of approximately 2.8% per year. In turn, the speed of the catching-up process among the new EU members was relatively higher and amounted to about 5% per annum. According to the obtained results, it will take about 25 years in the EU-28 and about 14 years in the EU-13 group to reduce income disparities by 50%.

In the light of the estimation results of equation (4) for the EU-28 (model 4a) and the EU-13 (model 4b), both groups of countries experienced the σ -convergence process. The level of diversification of per capita income expressed by standard deviation in the analysed groups decreased with time. It is shown by the

negative value of the structural parameters γ_1 amounting to -0.010 in the EU-28 group and -0.011 in the EU-13 group.

In all the models, the assessment of the significance of parameters made using the Student's t -test indicates that variable t is statistically significant (at 1% significance level). A high value of R^2 of about 90% and satisfying results of other diagnostic tests have been obtained.

The results indicate the presence of the catching-up process (β -convergence) between 28 EU countries, as well as among the new EU member states in the period 2006–2017. This confirms the results of many previous empirical studies on convergence process within these groups. The high rate of convergence within the EU-13 group probably resulted from including Cyprus and Malta in the analysis (i.e. countries with a much higher initial income level and its relatively lower dynamics). The existence of β -convergence resulted in a decrease of the differentiation of countries' GDP per capita levels (σ -convergence), which may indicate that in the future the new EU member states may be able to liquidate their income gap to the EU-15. However, taking into account their significant differences as to the initial and current income level as well as regards GDP per capita dynamics, it is obvious that their chances of closing the income gap are not even.

3. The prospects of closing the income gap – a preliminary simulation

In this part of the study, an attempt is made to estimate how much time individual new EU members would need to close the income gap to EU-15 group. Assuming a scenario that in the future both groups of countries will maintain the average yearly growth rates of per capita GDP recorded in the 1996–2017 period, one can state that the possibilities of closing the income gap by individual EU-13 economies are very diverse, and some of them may even widen their current distance. To confirm that, the approach proposed by Matkowski and Próchniak (2005) is applied. The aim of this simulation forecast is to calculate how many years (from 2017) particular countries would need to reach the average level of income of the EU-15 (while maintaining the current trends). In the simulation the following formula was applied:

$$GDP_{EU13(2017)}(1 + r_{EU13})^t = 100(1 + r_{EU15})^t \quad (5)$$

where:

- $GDP_{EU13(2017)}$ – GDP per capita at PPP of particular new EU member states (relative to the unweighted average for the EU-15 group = 100);
- r_{EU13} – the average GDP per capita growth rate of particular new EU member states in the period 1996–2017;
- r_{EU15} – the average GDP per capita growth rate in the EU-15 group in the period 1996–2017 (amounting to 1.5%);
- t – the number of years needed to reach the average level of income of the EU-15 area.

The value of t can be obtained by transforming formula (5) into the following form:

$$t = \frac{\ln(GDP_{EU13(2017)}) - \ln(100)}{\ln(1 + r_{EU15}) - \ln(1 + r_{EU13})}. \quad (6)$$

The results of the forecast are included in Table 4.

Table 4

The forecast of closing per capita income^a gap between individual EU-13 countries and the EU-15 group

Country	GDP per capita in 2017 (EU-15 = 100)	Average GDP per capita growth rate in 1996–2017 (%)	The number of years needed to achieve the average EU-15 GDP per capita level
Bulgaria	43.61	4.07	33
Croatia	49.58	2.45	74
Cyprus	74.47	1.01	–
Czech Republic	71.19	2.37	39
Estonia	63.40	4.49	16
Hungary	59.21	2.72	43
Latvia	55.49	5.41	15
Lithuania	64.86	5.48	11
Malta	79.41	1.69	110
Poland	59.38	4.00	21
Romania	49.29	3.60	34
Slovakia	66.25	3.72	19
Slovenia	69.07	2.46	38

^a GDP per capita at PPP.

Source: WDI database; own calculations.

In the light of this scenario, the new EU members would need from 11 to 110 years to reach the average level of GDP per capita of the EU-15 area. Assuming that the growth rates recorded in the period 1996–2017 are maintained, it can be stated that Estonia, Lithuania and Latvia may be the leaders in terms of the pace of closing the income gap. They would need only 11–16 years to reach the average income level of the EU-15. Poland and Slovakia would need 19 and 21 years respectively. The results obtained for Cyprus indicate that it is not able to catch-up with the EU-15 countries; in other words, a divergence process between Cyprus and the old EU members can be assumed. If Malta's GDP per capita growth rate, which has so far oscillated around the average rate of the EU-15,

continues in the future, it will not be able to reach the average income of the “former fifteen” over the next century.

It is worth adding here that the above simulation assumes a very optimistic scenario compared to the scenarios taken into account by other researchers. For example, simulations of closing the income gap conducted by Matkowski, Próchniak and Rapacki (2016) for 11 countries of the analysed group (i.e. without Cyprus and Malta), based on the medium-term GDP growth forecast prepared by the International Monetary Fund and the long-term demographic forecast of Eurostat, indicate that the process of catching up in individual countries may take several or even several dozen years longer compared to the implementation of the above continuation scenario. In turn, taking into account the most pessimistic scenario, based on the long-term economic forecast for EU countries until 2060 prepared on behalf of the European Commission (2015), where due to unfavourable demographic trends the future economic growth in the CEE countries and their convergence with the EU-15 was expected to be stopped, the authors argued that for most of these countries closing the income gap would be unattainable in the lifetime of one generation.

Kaitila, Alho and Nikula (2007) in their study of the above 11 countries (and other emerging markets of Central and Eastern Europe), assuming a real GDP growth rate in the EU-15 and emerging market economies at the level of 1.9% and 3.7% respectively, predicted that in 2050 the new EU members could achieve per capita income (at PPP) amounting to 81–82% (Bulgaria, Romania) or 92–94% of the EU-15 average (Lithuania, Estonia, Hungary and Slovenia). In other words, their full catching up with respect to the EU-15 till 2050 was not anticipated. According to the forecasts conducted by Halmai and Vasary (2010) for 10 new EU countries (without Bulgaria, Romania and Croatia), where authors based on the results of studies carried out for the European Commission (2006, 2008, 2009) indicating a decline in the potential GDP growth rate in 2020–2060 that is expected to be greater in the EU-10 countries than in the EU-15 states, it is possible that the new member states will reach around 75% of the per capita GDP level of the EU-15 by 2030, but after 2030 the catching-up process is expected to be stopped (divergence may appear) and the EU-10 countries will constitute a stagnating “convergence club”.

4. GDP per capita determinants in the new EU member states

4.1. Methodology

Considering the above analyses, which provide evidence of significant diversification of the new EU countries in closing their income gap to the EU-15 until now, searching only for the factors determining GDP per capita of the entire EU-13 group seems to be insufficient. Therefore, at the beginning the factors that shaped GDP per capita levels in the EU-13 in 1996–2017 were identified and investigated and then the importance of these determinants for “top perform-

ers” (EU-5), “middle performers” (EU-6) and “low performers” (EU-2) was accessed. It was examined whether and how strongly these factors influenced GDP per capita levels in individual groups. In this way, I try to verify the hypothesis that the analysed countries differed significantly in terms of their per capita income determinants, which, in turn, influenced their progress in catching up with the richest EU countries.

For this reason, it was important to include Cyprus and Malta in the analysis. According to the results presented in this paper, divergence tendencies towards the EU-15 were observed in these two countries in the analysed period. Therefore, it is justified to examine (despite some difficulties in conducting econometric analyses) whether Cyprus and Malta differed from other EU-13 countries in terms of the factors shaping their GDP per capita levels.

In order to examine the impact of individual determinants on the level of per capita income of the mentioned groups in the period 1996–2017, panel data regression models in the following general form were used⁸:

$$\begin{aligned} Y_{i,t} &= \delta_i + \beta' X_{i,t} + \varepsilon_{i,t}, & (7) \\ i &= 1, \dots, N; t = 1, \dots, T; \\ \varepsilon_{i,t} &\sim IID(0; \sigma_\varepsilon^2); \forall i = 1, \dots, N \forall t, s = 1, \dots, T E(X_{i,t} \varepsilon_i) = 0; \end{aligned}$$

where: δ_i – individual (non-random, constant in time) effect of country i ; β – a vector of structural parameters; $Y_{i,t}$ – the explained variable (GDP per capita of country i in period t); $X_{i,t}$ – a vector of variables representing determinants of GDP per capita; $\varepsilon_{i,t}$ – random term.

The dependent variable in the models was the natural logarithm of GDP per capita expressed at PPP (2011, international dollar) in country i and period t (data obtained from the IMF World Economic Outlook Database, 2019). Despite conducting the study separately for the mentioned groups, the existence of individual effects (δ_i) of countries was also assumed.

To identify GDP per capita determinants (elements of X vector), a wide range of 14 variables was taken into account⁹. They were proxies of traditional (Solow’s approach) and deep (Rodrick’s concept) determinants of per capita income proposed by the theory, as well as variables suggested in economic literature as sig-

⁸ The set of explanatory variables does not include the lagged values of GDP per capita. The choice of such a specification (and consequently – estimation method) results from the fact that growth regressions in the form of dynamic models are usually applied for testing the real convergence hypothesis. The main objective of this study is to identify factors that determine GDP per capita levels of the new EU members, not to assess the rate of convergence within the EU-13 group.

⁹ The following explanatory variables were considered in the study: population growth, savings (investment) rate (gross fixed capital formation, % of GDP), total exports and imports (% of GDP), school enrolment (secondary) ratio, school enrolment (tertiary) ratio, institutional quality index (Worldwide Governance Indicators, summary index), high-technology exports (% of total manufactured exports), foreign direct investment net inflows (% of GDP), foreign direct investment net outflows (% of GDP), ICT goods imports (% of total goods imports), research and development expenditure (% of GDP), medium and high-tech industry (% of manufacturing value added), Index of Economic Freedom (The Heritage Foundation database), employment in high and medium-high technology manufacturing (% of total employment).

nificant in the context of the middle-income trap phenomenon. This phenomenon may affect the analysed countries and undermine their chances of closing the income gap to the EU-15 group in the future, so including these variables in the analysis seemed to be justified. A dozen or so models with alternative sets of explanatory variables were tested. The models were assessed with particular focus on a satisfactory number of regressors as well as statistical quality. Finally, the following explanatory variables (logarithmised values) were used (data obtained mainly from the World Bank WDI Database, 2019):

- 1) $N_{i,t} + g + \delta$ – population growth of country i in period t increased by 0.05 (where 0.05 represents the sum of the technical development rate common for all countries g and depreciation rate δ ¹⁰);
- 2) $S_{i,t}$ – investment rate of country i in period t (reflecting the accumulation of physical capital), approximated as gross fixed capital formation in relation to GDP;
- 3) $TRADE_{i,t}$ – international trade of country i in period t , an indicator showing the degree of openness of economies (the sum of exports and imports of goods and services measured as a share of GDP);
- 4) $INST_{i,t}$ – Worldwide Governance Indicators (WGI) summary index (a proxy of the quality of institutions) for country i in period t (indicator calculated as a simple average of the regulatory quality, government effectiveness, control of corruption, rule of law, political stability and voice and accountability sub-indicators), data obtained from the World Bank Governance Indicators Database (2019);
- 5) $H_EDU_{i,t}$ – enrolment ratio at the tertiary level of country i in period t , a proxy of the accumulation of human capital (indicator calculated by dividing the number of students enrolled in tertiary education regardless of age by the population of the age group which officially corresponds to tertiary education);
- 6) $GERD_{i,t}$ – R&D expenditure (% of GDP) of country i in period t , an indicator reflecting government and private sector efforts to obtain competitive advantage in science and technology;
- 7) $H_TECH_EX_{i,t}$ – high technology exports (as % of total manufactured exports) in country i in period t , a ratio expressing the share of products with high R&D intensity (aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery) in exports.

In the first step of the study, models for the EU-13, EU-5, EU-6 and EU-2 groups were estimated on the basis of annual data ($t = 1, 2, \dots, 22$). In this case, assuming that the impact of some factors on per capita income level can be spread over time, time lags of the selected variables were taken into account. Finally, the following specification was applied:

$$\begin{aligned} \ln(GDP_pc_PPP)_{i,t} = & \delta_i + \beta_1 \ln(N_{i,t} + g + \delta) + \beta_2 \ln(S)_{i,t-1} + \\ & + \beta_3 \ln(TRADE)_{i,t} + \beta_4 \ln(INST)_{i,t} + \beta_5 \ln(H_EDU)_{i,t} + \\ & + \beta_6 \ln(GERD)_{i,t-1} + \beta_7 \ln(H_TECH_EX)_{i,t-1} + \varepsilon_{i,t}. \end{aligned} \quad (8)$$

¹⁰ The value of 0.05 is consistent with the theory of R. Solow and is confirmed by empirical studies.

However, since the included explanatory variables illustrate to some extent medium-term and even long-term factors shaping GDP per capita, it was decided to estimate models with the use of averaged data from several sub-periods. The analysis was considered for 5-year and longer sub-periods, but estimation results of models with a small number of observations (and degrees of freedom) did not give satisfactory results. Finally, it was decided to estimate models using data from seven (three-year) sub-periods ($t = 1, 2, \dots, 7$)¹¹. The regression equations estimated separately for the four analysed groups of countries had the following form:

$$\begin{aligned} \ln(\text{GDP_pc_PPP})_{i,t} = & \delta'_i + \beta'_1 \ln(N_{i,t} + g + \delta) + \beta'_2 \ln(S)_{i,t} + \\ & + \beta'_3 \ln(\text{TRADE})_{i,t} + \beta'_4 \ln(\text{INST})_{i,t} + \beta'_5 \ln(H_EDU)_{i,t} + \\ & + \beta'_6 \ln(\text{GERD})_{i,t} + \beta'_7 \ln(H_TECH_EX)_{i,t} + \varepsilon'_{i,t}. \end{aligned} \quad (9)$$

The selection of the appropriate estimator for individual models was made after prior diagnostic tests. As a standard, in this type of panel models, the Breusch–Pagan test is carried out indicating the legitimacy of considering individual effects of panel units (countries) in the model¹² and F -test, which confirms the existence of the fixed effects and validity of using the *within* (FE) estimator¹³. Additionally, the Hausman test may be conducted when the random effect model and RE (GLS) estimator are taken into account. The above tests have been applied to all models based both on annual (8) and average data (9). Despite some difficulties in carrying out the tests for models based on average data¹⁴, their results suggested that models for the EU-13, EU-5, EU-6 groups should be estimated as *fixed effect* models. Therefore, the *within* (FE) estimator was used. Additionally, robust standard errors were calculated (the option of computing an estimate of the covariance matrix that is robust with respect to heteroscedasticity and autocorrelation). The models for Cyprus and Malta (based both on annual and average data) were estimated with the use of a pooled OLS estimator. The validity of using this estimator was confirmed by the mentioned diagnostic tests that undermined the legitimacy of including individual effects in these models. In addition, for these models the tests for heteroscedasticity and normality were performed in order to confirm that the OLS estimator was efficient and unbiased.

Of course, one should be aware that the models estimated for two countries (Cyprus and Malta) or even for several countries, i.e. the EU-5 and EU-6 groups (especially models based on averaged data, where seven sub-periods are taken into account), have some shortcomings. Regression equations are estimated on a small number of observations and, as a result, with a small number of degrees

¹¹ Sub-periods: 1996–1998, 1999–2002, 2003–2005, 2006–2008, 2009–2011, 2011–2013, and 2014–2017; unweighted averages were used.

¹² In the case when the hypothesis about the error variance = 0 is rejected.

¹³ In the case when the hypothesis about a common constant in panel units is rejected.

¹⁴ Due to the low number of observations and degrees of freedom, the Breusch–Pagan test could not be carried out. But as that test is regarded as a counterpart to the F -test, its presence is not mandatory.

of freedom. When interpreting the results, it should be remembered that the results may not reflect a stable relationship between variables, and the results of some diagnostic tests may not be reliable. However, it is not possible to increase the number of observations because the economic relevance of modelling would be different then. It is necessary to rely on the results obtained for these specific groups of countries, regardless of their size because, as mentioned earlier, they are essential considering the hypothesis being verified.

4.2. Results

Estimation results and diagnostic tests of the models for the EU-13, EU-5, EU-6 and EU-2 groups, where annual data were used, are presented in Table 5. The estimated structural parameters of model 8a for the entire group of the 13 new EU member states show that all the variables taken into account influenced significantly their GDP per capita level. It is proved by positive values of the coefficients β_i and positive results of the Student's t -test¹⁵. The impact of particular variables was diversified. The degree of countries' openness to trade, investment rate as well as their human capital resources exerted the greatest influence on GDP per capita level in this group. The increase in the share of trade in GDP, investment rate and tertiary enrolment ratio (*TRADE*, *S* and *H_EDU* variables) by 1% brought, *ceteris paribus*, an increase in GDP per capita by 0.65, 0.25 and 0.20 % respectively. A significant impact of the variables approximating quality of institutions and R&D expenditure (*N*, *INST* and *GERD* variables) was also proved. The estimated parameter values for these variables were rather similar (about 0.11). In model 8a a very small but positive and statistically significant influence of the variable approximating the share of high technology goods in exports (*H_Tech_EX*) was also observed. The estimates suggest that 1% increase in the share of high-tech goods in total exports caused GDP per capita to increase on average by 0.04% per year.

Estimates of the structural parameters of the model for "top performers" (model 8b) turned out to be to some extent similar to those obtained for the whole group (especially in terms of the impact of the so-called traditional determinants, i.e. population growth and investment rate). Although some differences are also visible. Above all, in the case of Lithuania, Latvia, Estonia, Poland and Slovakia one can observe a much greater impact of the variables approximating the efficiency of functioning of institutions, resources of qualified personnel and R&D spending. The estimated coefficients (twice as large as the corresponding parameters β_4 , β_5 and β_6 in model 8a) suggest that a 1% increase in the Worldwide Governance Indicators (WGI) summary index, tertiary enrolment ratio and the share of R&D expenditure in GDP contributed a 0.27, 0.44 and 0.23% increase in GDP per capita per year respectively. The results also indicate a higher,

¹⁵ When calculating p -values based on robust standard errors the Student t -distribution was used.

Table 5
Estimation results of model (8) for the EU-13, EU-5, EU-6 and EU-2 groups in the period 1996–2017 (annual data);
dependent variable: $\ln(GDP_{pc_PPP})$; estimators: FE/OLS

Variables/ model diagnostics	8a	8b	8c	8d
	EU-13 FE (robust HAC)	EU-5 (top performers) FE (robust HAC)	EU-6 (middle performers) FE (robust HAC)	EU-2 (low performers) OLS
<i>const</i>	5.4558 (0.3643)***	5.5472 (0.3191)***	5.7201 (0.2736)***	11.7366 (0.6516)***
$N_{i,t} + g + \delta$	0.1112 (0.0666)*	0.1253 (0.0484)**	0.1229 (0.0360)***	0.5174 (0.0449)***
$S_{i,t-1}$	0.2485 (0.0416)***	0.2076 (0.0134)***	0.2628 (0.0385)***	0.1394 (0.0323)***
$TRADE_{i,t}$	0.6526 (0.0463)***	0.5371 (0.1052)***	0.6017 (0.0700)***	-0.0899 (0.1185)
$INST_{i,t}$	0.1291 (0.0224)***	0.2738 (0.0960)***	0.0755 (0.0080)***	0.1444 (0.1047)
$H_EDU_{i,t}$	0.2015 (0.0308)***	0.4492 (0.0731)***	0.1672 (0.0362)***	0.1296 (0.0627)**
$GERD_{i,t-1}$	0.1085 (0.0242)***	0.2309 (0.0079)***	0.0645 (0.0713)	0.1020 (0.0408)**
$H\text{-}TECH_EX_{i,t-1}$	0.0422 (0.0157)***	0.0938 (0.0229)***	0.0144 (0.0615)	-0.0167 (0.0120)
Number of obs.	262	105	115	42

Model diagnostics:				
LSDV R^2	0.9119	0.9406	0.9576	0.9234
Within R^2	0.8025	0.9343	0.8778	0.9076
Adj. R^2				
Breusch-Pagan test ^a				
test statistics	333,4310	111,4900	31,1798	1,0336
[p -value]	[0.0000]	[0.0000]	[0.0000]	[0.3093]
F - test for diversification				
of the constant in groups ^b				
test statistics	31.6971	18.2796	6.3715	0.3511
[p -value]	[0.0000]	[0.0000]	[0.0001]	[0.5576]
White's test ^c :				
test statistics				39.6385
[p -value]				[0.2707]
JB normality test ^d :				
test statistics				3.1978
[p -value]				[0.2021]

Note: The numbers in brackets denote the value of standard error; **** / ** / * mean significance at 1%, 5% and 10% (t -Student test).

^a Null hypothesis H_0 : error variance in a unit = 0.

^b Robust test (Welch's F) for models 8a, 8b and 8c; null hypothesis H_0 : groups have a common constant.

^c Null hypothesis H_0 : variance of error term is constant across observations (homoscedasticity).

^d Null hypothesis H_0 : normal distribution.

Source: own calculations using GRETL.

Table 6
Estimation results of model (9) for the EU-13, EU-5, EU-6 and EU-2 groups in the period 1996–2017 (average data, 3-year sub-periods); dependent variable: $\ln(GDP_{pc_PPP})$; estimators: FE/OLS

Variables/ model diagnostics	9a	9b	9c	9d
	EU-13 FE (robust HAC)	EU-5 (top performers) FE (robust HAC)	EU-6 (middle performers) FE (robust HAC)	EU-2 (low performers) OLS
<i>const</i>	6.1706 (1.2858)***	5.7854 (0.5234)***	7.3741 (0.9227)***	12.0310 (1.4663)***
$N_{i,t} + g + \delta$	0.2024 (0.1467)*	0.1165 (0.0643)*	0.3350 (0.1738)*	0.5768 (0.2274)**
$S_{i,t}$	0.2182 (0.0999)**	0.1178 (0.0631)*	0.1662 (0.09233)*	0.1449 (0.0707)*
$TRADE_{i,t}$	0.6140 (0.1184)***	0.4146 (0.1556)***	0.5229 (0.0416)***	0.1568 (0.0658)*
$INST_{i,t}$	0.0800 (0.0443)*	0.3068 (0.1110)***	0.0617 (0.0351)*	0.0139 (0.01246)
$H_EDU_{i,t}$	0.1790 (0.0602)***	0.4461 (0.0786)***	0.1313 (0.0721)*	0.1080 (0.1080)
$GERD_{i,t}$	0.1504 (0.0830)*	0.2946 (0.0310)***	0.0855 (0.1118)	0.1179 (0.0875)
$H\text{-}TECH_EX_{i,t}$	0.0776 (0.0413)*	0.0368 (0.0199)*	0.0644 (0.0572)	0.0031 (0.0036)
Number of obs.	87	35	38	14

Model diagnostics: LSDV R^2 Within R^2 Adj. R^2	0.9175 0.8222	0.9663 0.9629	0.9656 0.9094	0.9434 0.8773
F test for diversification of the constant in groups ^a test statistics [p -value]	7.0523 [0.0000]	5.8480 [0.0054]	5.2117 [0.0051]	0.0554 [0.8232]
Test for groupwise heteroscedasticity ^b : test statistics [p -value]				2.3438 [0.3098]
JB normality test ^c : test statistics [p -value]				2.3031 [0.3162]

Note: The numbers in brackets denote the value of standard error; ***/**/* mean significance at 1%, 5% and 10%.

^a Robust test (Welch's F) for models 9a, 9b and 9c; null hypothesis H_0 : groups have a common constant.

^b Null hypothesis H_0 : variance of error term is constant across units (homoscedasticity).

^c Null hypothesis H_0 : normal distribution.

Source: own calculations using GRETL.

but still low impact of the technological advancement of the EU-5 countries' export offer on their GDP per capita level (β_7 amounted to only 0.09).

The estimation results of model 8c for "middle performers" indicate a slightly different impact of individual variables on their GDP per capita level. In Bulgaria, Romania, Croatia, the Czech Republic, Hungary and Slovenia capital accumulation and intensity of international trade turned out to have a very large and positive influence, even larger than in the "top performers" group. A one percent improvement in the share of exports and imports in GDP as well as in the investment rate is estimated to raise GDP per capita by 0.60 and 0.26% per year respectively. In contrast to the EU-5 group, per capita income of the EU-6 countries was to a lesser extent shaped by institutions as well as by human capital resources. Estimates suggest that the increase in the WGI summary index and tertiary enrolment ratio by 1%, *ceteris paribus*, resulted in the increase in GDP per capita only by 0.08 and 0.16%. According to the obtained results, R&D expenditure and high-tech exports turned out to be an irrelevant determinant of GDP per capita in the "middle performers" group. In model 8c, structural parameters for the *GERD* and *H_TECH_EX* variables were insignificant from the statistical point of view.

The estimates of individual parameters in the model for Cyprus and Malta were quite different. The variables reflecting countries' involvement in international trade, quality of institutions and high technology exports did not influence the dependent variable. The estimated β_3 , β_4 and β_7 coefficients in model 8d were statistically insignificant (additionally parameters for the *TRADE* and *H_TECH_EX* variables had negative values, suggesting even a negative impact on the *GDP_pc_PPP* variable). Compared to the rest of the new EU members, GDP per capita of Malta and Cyprus was much more dependent on the changes in population. A one percent increase in the population growth contributed to a 0.52% increase in GDP per capita per year (coefficient β_1 in other groups amounted to only about 0.12). Other explanatory variables, i.e. investment rate, R&D expenditure and enrolment ratio at the tertiary level, showed a similar, positive impact on per capita income. Their one percent change resulted in the average annual GDP per capita growth of about 0.10–0.14%.

As already mentioned, the impact of individual variables on the level of GDP per capita in the analysed country groups was also examined by using models (9) based on averaged data (three-year averages). This approach, which gives the opportunity to investigate the medium-term relationships between variables, can also be applied as a robustness check tool.

The estimation results of these models (9) for the EU-13, EU-5, EU-6 and EU-2 groups, contained in Table 6, generally seem to confirm the previously obtained results presented above. Both in the entire group of the new EU entrants and in the "top performers" subgroup, evidence of the positive and statistically significant impact of all the analysed explanatory variables on the dependent variable in the medium run was found. The strength of this influence was similar to that estimated for annual data models (8).

Considering all the EU-13 countries (model 9a), their per capita income in the medium term was also mainly shaped by the degree of openness of the economy, capital accumulation and human capital resources (*TRADE*, *S*, and *H_EDU* variables). When 3-year sub-periods were taken into account, a one percent increase in the trade/GDP ratio, investment rate and tertiary enrolment ratio contributed to a 0.61, 0.22 and 0.18% increase in GDP per capita of the new EU members respectively. Estimates suggest, however, a slightly stronger impact of population growth on per capita income level (regression coefficient for *N* variable is 0.20 while in the model (8) it was estimated at 0.11).

Comparing the estimation results of models 8b and 9b for Lithuania, Latvia, Estonia, Poland and Slovakia, it can be stated that they are quite similar. In the medium run GDP per capita of these countries was also shaped by the *TRADE*, *N*, *S* and *H_EDU* variables. However, a bit stronger impact of the variables approximating the quality of institutions and total spending on innovations (*INST* and *GERD*) was proved. An increase in the WGI summary index and in the share of R&D expenditure in GDP by 1% brought about an increase in GDP per capita by 0.31 and 0.29% respectively (while in model 8b these regression coefficients were estimated at 0.27 and 0.23).

Estimation results of model 9c for Bulgaria, Romania, Croatia, the Czech Republic, Hungary and Slovenia (EU-6) point to the same set of factors shaping their GDP per capita as suggested by the results obtained from model 8c. First of all, no evidence of the statistical significance of the *GERD* (expenditure on R&D) and *H-TECH_EX* (trade in high-tech goods) variables was found. Secondly, comparing the corresponding values of β_i and β'_i coefficients in both models, one can conclude that the impact of other variables on GDP per capita was rather similar. It should be noted, however, that in this group of countries a higher impact of population changes (*N* variable) and a slightly lower impact of the investment rate (*S* variable) in the medium run were observed. A one percent improvement in population growth and investment rate resulted in a 0.33 and 0.16% increase in GDP per capita (the respective regression coefficients β_1 and β_2 in model 8c were estimated at 0.12 and 0.26).

The results for Cyprus and Malta (model 9d), confirmed the key importance of the traditional growth determinants, i.e. changes in population and investment rate in shaping their per capita income level. When 3-year sub-periods were taken into account, a one percent improvement in population growth and investment rate contributed to a 0.57 and 0.14% increase in GDP per capita of countries respectively. Comparison of the estimation results for models 9d and 8d shows that the impact of the above variables was slightly higher in the medium term. The estimation results of model 9d also indicate a significant medium-term impact of trade intensity on Cyprus' and Malta's income levels. In both models an absence of any relationship between other variables and GDP per capita was proved.

Generally, taking into account the results obtained from both types of models (8 and 9), it can be stated that the strength and direction of the impact of

individual determinants on GDP per capita of the EU-13 group are in line with the preliminary assumptions on both the theoretical concepts known in the literature and the results of empirical research in this field conducted for the CEE countries so far¹⁶. However, the results of the study carried out for the EU-5 and EU-6 and EU-2 subgroups shed more light on the causes of the new EU member states' income disparities. Defining certain subgroups due to their different pace of catching up with the richest EU countries has already taken place in empirical studies (e.g. Borsi and Metiu 2013 or Cuestas et al. 2012), but the factors determining these differences have rarely been examined. The results of estimations of above models indicate that GDP per capita in individual subgroups was shaped by a different set of factors. More precisely, GDP per capita of countries with little success in closing the income gap was mainly shaped by population growth, capital accumulation and intensity of trade. This concerned, for example, Cyprus and Malta (showing even divergence tendencies in the analysed period); *nota bene*, these countries are rarely included in such empirical surveys. GDP per capita of countries that showed the greatest progress in levelling income disparities (especially EU-5 countries) was affected by additional factors, i.e. human capital resources, institutions or R&D expenditure.

Conclusions

According to our analysis, in the period from 1996 to 2017, the majority of the new EU members experienced a high GDP per capita growth rate compared to the group of the old member states. However, they were significantly diversified in terms of their speed of moving towards the average GDP per capita level of the EU-15 countries. Taking into account the successes of the individual EU-13 countries in closing their income gap to the richest EU members, they can be clearly divided into three subgroups: “top performers” (Lithuania, Latvia, Estonia, Poland, and Slovakia), “middle performers” (Bulgaria, Romania, Croatia, the Czech Republic, Hungary, and Slovenia) and “low performers” (Cyprus and Malta). Countries from the first group had the highest GDP per capita growth rate in relation to other EU-13 countries with a similar initial income level in 1996. In the light of our forecast, they would need from 11 to 21 years to reach the average level of prosperity of “the former 15” if they sustain their dynamics observed so far. The group of “low performers” did not improve (Cyprus even worsened) their income position in relation to the EU-15 countries in the period 1996–2017.

Despite the presence of divergence trends in Cyprus, evidence for the existence of the β - and σ -convergence processes in the entire EU-28 group was found. In the analysed period the convergence rate amounted to 2.8%. According to the

¹⁶ See examples of empirical research conducted for CEE countries discussed in the introduction to this study.

obtained results (the half-life coefficient), it will take about 25 years to reduce income disparities by 50% in the European Union. Moreover, a significantly higher catching-up rate within the EU-13 group was proved. The speed of convergence in this case was almost double the rate for the entire European Union and it amounted to approx. 5% per annum.

The results of the empirical study seem to confirm the hypothesis that the progress of individual new EU members in closing their income gap to the richest EU countries was related to the factors that shaped their GDP per capita level in the analysed period. Significant differences in the impact of individual determinants in the three mentioned subgroups were observed. Comparing the groups of “top performers” and “middle performers”, one can conclude that the latter clearly showed a much smaller impact of institutional factors and highly qualified personnel resources on GDP per capita level. Importantly, in contrast to the EU-5 countries, in the group of “middle performers” no change in the level of per capita income resulting from R&D expenditures and technological advancement of exports was observed.

In the case of Cyprus and Malta, a stronger influence of the so-called traditional growth factors (population growth, capital accumulation) on the level of per capita income was proved. On the other hand, changes in human capital resources as well as R&D spending affected GDP to a lesser extent than in the other new EU countries (especially in the EU-5 group). There was also no evidence of any impact of the quality of institutions or trade in high-tech goods on per capita income of those two countries.

Taking into account the above insights, it can be stated that the resources of human capital, the efficiency of institutions in the economy as well as the technological advancement of exports might have the greatest impact on the successes of individual countries in reducing their development distance to the richest European Union members. In the “top performers” group, a significantly stronger impact of these determinants was observed, while in the other groups their influence was much lower or nonexistent.

It should be also emphasised that changes towards increasing human capital resources, improving the quality of institutions or increasing the share of high-tech goods in exports are regarded as crucial for the avoidance of the middle income trap in the future. Therefore, it can be assumed that Cyprus and Malta, where an over-reliance of GDP per capita on traditional determinants (population growth and capital accumulation) was observed, are most at risk of this phenomenon. In turn, “top performers” have a chance of avoiding this trap (and, as a consequence, closing their per capita income gap to the richest EU economies). This hypothesis, however, requires deeper research and analysis, which may be the subject of another study.

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INCOME GAP BETWEEN THE NEW AND OLD EU MEMBER STATES AND ITS DETERMINANTS IN THE PERIOD 1996–2017

Summary

In the period 1996–2017 there was a significant progress in reducing income disparities between the new member countries of the EU (EU-13) and the old EU member states (EU-15). The successes of individual new EU members in overcoming their income distance to Western Europe were diversified. It can be assumed that the catching-up process depends on the differentiated set of GDP per capita determinants. The main purpose of this paper is to verify this hypothesis. The examination confirms that the growth of GDP per capita in the countries that have diminished their income gap to the greatest extent (Lithuania, Latvia, Estonia, Poland, and Slovakia) was mainly shaped by their human capital resources, the degree of technological advancement of exports and quality of institutions, while the countries where divergence tendencies were observed (Cyprus, Malta) revealed much stronger influence of traditional growth factors (population growth, capital accumulation). The study uses econometric methods, especially cross-sectional and panel growth regression models.

Keywords: GDP per capita, income gap, convergence process, GDP per capita determinants, growth regression

JEL: O11, O43, F02, F43

LUKA DOCHODOWA MIĘDZY NOWYMI I STARYMI KRAJAMI CZŁONKOWSKIMI UNII EUROPEJSKIEJ I JEJ UWARUNKOWANIA W OKRESIE 1996–2017

Streszczenie

W okresie 1996–2017 nastąpił znaczny postęp w zakresie zmniejszania się różnic poziomu PKB per capita między nowymi krajami członkowskimi UE (UE-13) i starymi krajami członkowskimi (UE-15). Sukcesy poszczególnych nowych krajów członkowskich w pokonywaniu dystansu dochodowego do Europy Zachodniej były jednak zróżnicowane. Można przypuszczać, że zależały one w dużej mierze od zróżnicowanego zestawu czynników determinujących poziom ich PKB per capita i jego wzrost. Głównym celem artykułu jest weryfikacja powyższej hipotezy. Przeprowadzone badania potwierdzają, że PKB per capita krajów, które w największym stopniu zmniejszyły swój dystans do najbogatszych krajów UE (Litwa, Łotwa, Estonia, Polska i Słowacja), kształtowały głównie zasoby kapitału ludzkiego, stopień zaawansowania technologicznego eksportu i jakość instytucji. Natomiast kraje, w których zaobserwowano tendencje dywergencyjne (Cypr i Malta), ujawniają znacznie większy wpływ tradycyjnych czynników wzrostu gospodarczego (tj. wzrostu liczby ludności i akumulacji kapitału). W pracy zastosowano metody ekonometryczne, w szczególności przekrojowe i panelowe regresje wzrostu.

Słowa kluczowe: PKB per capita, luka dochodowa, proces konwergencji, determinanty PKB per capita, regresja wzrostu

JEL: O11, O43, F02, F43

РАЗНИЦА В ДОХОДАХ МЕЖДУ НОВЫМИ И СТАРЫМИ СТРАНАМИ-ЧЛЕНАМИ ЕВРОСОЮЗА И ЕЕ ОБУСЛОВЛЕННОСТИ В ПЕРИОД 1996–2017 ГГ.

Резюме

В период 1996–2017 гг. произошел значительный прогресс в плане сокращения разницы в уровне ВВП на душу населения между новыми странами-членами ЕС (ЕС-13) и старыми странами-членами (ЕС-15). Однако успехи отдельных новых стран-членов в преодолении разницы в доходах по отношению к Западной Европе были неодинаковы. Можно полагать, что они серьезно зависели от разного рода факторов, определяющих уровень ВВП per capita и его рост. Главной целью статьи является проверка этой гипотезы. Проведенный анализ подтвердил, что ВВП на душу населения тех стран, которые в наибольшей степени сократили свое отставание по отношению к самым богатым странам ЕС (Литва, Латвия, Эстония, Польша и Словакия), формировалось главным образом благодаря ресурсам человеческого капитала, степени технологического продвижения экспорта и качеству институтов. Страны, в которых наблюдались дивергентные тенденции (Кипр, Мальта), добивались успехов с помощью традиционных факторов экономического роста (т.е. рост количества населения и аккумуляции капитала). В работе были применены эконометрические методы, особенно сквозные и панельные регрессии роста.

Ключевые слова: ВВП на душу населения, разница в доходах, процесс конвергенции, детерминанты ВВП на душу населения, регрессия роста

JEL: O11, O43, F02, F43