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ABSOLUTE AND CONDITIONAL CONVERGENCE: A STORY ABOUT CONVERGENCE CLUBS AND DIVERGENCE IN THE EU[3]

We examine beta and sigma convergence in the European Union in 2000-2019. Our study shows that the hypotheses for both beta and sigma convergences are not rejected. While the process of convergence is occurring in the EU it is not fast enough, and it is much more concerned with convergence clubs' formation instead of community convergence. Our estimations of speed and years of convergence show that some countries, mostly from Eastern and Southern Europe, will need higher growth rates to catch up with the average level of income. Since the global economic and financial crisis of 2008 divergence process in the EU is underway and it threatens the functioning of the euro area. Facing such challenges, the EU needs an Investment Deal to carry out the fundamental idea of the Single Market and foster the process of convergence.
JEL: O47; R11; F43

Introduction

Economic convergence is a process that depends on and is determined by the macroeconomic performance of both developed and developing countries. The core of income convergence between the two country groups is economic growth that makes the cohesion processes inherently macroeconomic in their nature. However, the level of convergence is an emanation of all ongoing economic processes both at a national and regional level that reflect cyclical changes in the economy; catching-up development and labour market conditions; poverty and social inequality; efficiency of institutions, and political stability. In this vein, the observed differences in groups of the Member States of the European Union (EU) – between

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the growth rate of GDP per capita, its levels and the degree of balance/imbalance of the economy – give us reason to assess the degree of convergence in the EU in 2001-2019. The period is chosen due to specificities of macroeconomic processes in clearly distinguished stages of the economic cycle in the EU.[4]

Our study focuses on identifying the factors that have influenced the convergence to the average EU income levels by groups of countries based on an econometric assessment of beta and sigma convergence. In line with the vast body of literature, we analyse the distribution of the GDP per capita to determine if sigma convergence has occurred for the period under review. Additionally, we employ a cross-sectional regression to check for the presence of unconditional and conditional beta convergences between countries in the EU. Our results show that both beta and sigma convergences occurred, but the convergence process is much more concerned with convergence clubs' formation instead of community convergence.

Absolute and Conditional Convergence: Theories and Empirics

To lay a foundation for the current analysis, we will first give the definitions for the different types of convergence. The hypothesis for the existing of sigma (σ) convergence states that the standard deviation for some income distribution should become smaller over time. The hypothesis for the existence of beta (β) convergence implies that countries with high per-capita income in some initial period will exhibit slower future economic growth than countries with low per-capita income. The β convergence can then be expressed as an absolute convergence and conditional convergence. Absolute convergence means that the hypothesis for β convergence is not rejected without the presence of other factors that affect economic growth while conditional convergence indicates the same hypothesis is not rejected when controlling for other factors that affect economic growth.

Sigma convergence was first studied by Easterlin (1960) and Borts and Stein (1964). One of the first seminal papers that studied both conditional and absolute beta convergences was written by Robert Barro (1991). The author showed that both conditional and absolute beta convergences exist in a large sample that includes most major economies in the world. Mankiw (1992) again confirmed this result by deriving the main econometric equation from the Solow growth model and testing both hypotheses in different samples. From here on different studies and authors used the established methodology to study both σ and β convergences in different samples of countries. For example, Xavier Sala-i-Martin (1996) extends these results to the United States, Japan, and some European states. Quah (1996) also showed that convergence is observed across the United States by using a different methodology. More recent studies that explored the issue on two different types of

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[4] The impact of the COVID-19 pandemic on convergence assessment cannot be substantially covered yet. The main reason for this is the economic uncertainty caused by the development and duration of the epidemic, as well as the trajectory of its effects - whether they will be symmetrical or asymmetrical in countries. The limited availability of up-to-date statistics at present also narrows the possibilities for detailed analysis. For macroeconomic implications of the fight against COVID-19, see Yotzov, Bobeva, Loukanova, Nestorov (2020) and Tsvetkov, Georgieva (2021).

convergence were conducted by Higgins (2006), Villaverde and Maza (2011), Robert Barro (2016) and Battisti (2020). An overview of the methodology and the established literature can be found in Durlauf (2005) and Rangelova (2009).

Convergence in the EU was studied as a separate sample from the beginning of this century. Barry (2003) compares the economic performance of Greece, Spain, Portugal, and Ireland to identify the processes that have promoted or inhibited real convergence prospects at various points in time. Yin and Zestos (2003) confirmed both absolute and conditional β convergence and σ convergence in the EU using different subperiods in 1960-1995. Cappelen (2003) also showed that there is a tendency towards β convergence in the EU and that structural funds had a positive effect on the long-run growth. Cuaresma (2008) studied EU-15 countries and showed that the length of EU membership has a significant positive effect on economic growth and convergence. Simonescu (2015) shows that for the period 1960-1995, there is evidence of ongoing σ and β convergences among the EU apart from the period 1980-1985. Moreover, Simonescu (2017) used a panel data approach to show that in 2003-2016 there is evidence in favour of the convergence process, but the different countries do not have the same speed of convergence towards the steady state. Cabral and Castellanos-Sosa (2019) found evidence that the process of convergence in the EU was facilitated by the institutional integration and the creation of the EU itself. Battisti (2020) showed that β convergence cannot be viewed as a convergence between countries, but as convergence towards a country' own productivity level. Haller (2020) found evidence of slow σ and β convergences in 2012-2018.
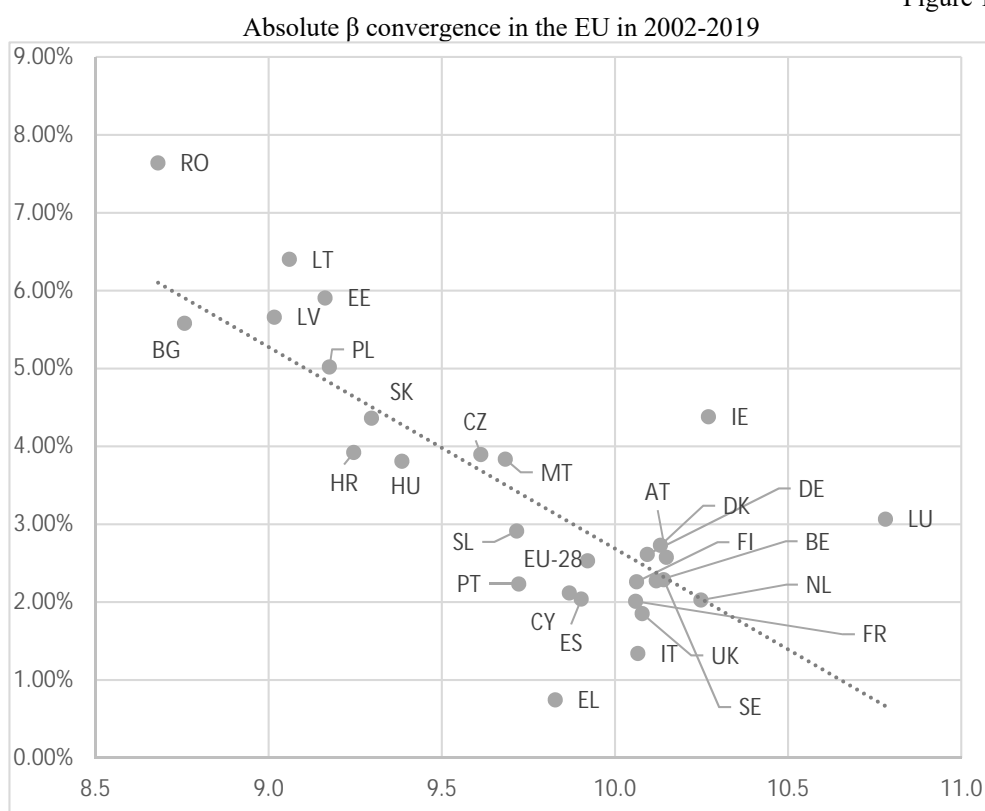
Assessment of Absolute Convergence in the EU

First, we study whether absolute β convergence is observed within the EU during the period under review. Following the hypothesis of absolute convergence lower-income countries should grow faster than high-income ones, i.e. to catch up with economic development, leading to convergence with the average income levels for a certain group of countries. To test the validity of this hypothesis for the EU we graphically represent the relation between economic growth between 2002 and 2019 on the ordinate and the logarithmic value of GDP in the initial period – 2002 on the abscissa (Figure 1). The established correlation coefficient is negative -0.78 and shows faster growth of low-income economies: the lower the level of income in the initial year, the higher the economic growth rates.

Graphically shown the absolute β convergence implies that Romania is the EU Member State that makes the strongest leap in its economic development, allowing it to move closer to the Baltic States as regards convergence that managed to quickly overcome the financial turmoil after 2008. The decisive measures taken in Romania to increase the average income in all age groups are yielding results in terms of accelerated catching up with the average European levels, as in 2020 Romania is already ranked by the World Bank as a high-income economy. In 2001 Romania was at the same level of GDP per capita as Bulgaria, but by 2019 the Romanian economy significantly surpasses the Bulgarian one, reaching the level of Latvia and ahead of Greece. In terms of economic growth in 2002-2019 Bulgaria (5.58%) ranks after Romania (7.64%), Lithuania (6.40%), Estonia (5.91%) and Latvia (5.66%). The three Baltic states are among the countries most affected by the global financial and economic

crisis of 2007-2008. This is especially true for Latvia, whose GDP has shrunk by 25% because of the crisis. The Baltic states are also interesting case due to the often highlighted similarities with Bulgaria, but the achieved results are markedly different: the GDP per capita in Lithuania increases by 42 p.p. compared to the EU-28 average for 19 years; Romania and Estonia recorded an increase of 40 p.p. in the period under review, while in Latvia the GDP per capita is higher with 31 p.p.

Figure 1

Absolute β convergence in the EU in 2002-2019

Source: Authors' calculations based on Eurostat data

The other group of countries that can be identified are the Member States with a lagging convergence rate below 2 p.p. on average during 2001-2019. These countries include Poland, Slovakia, Bulgaria, Czechia, Hungary, Croatia, and Slovenia. All these countries have gone through a transition to a market economy and although their absolute GDP per capita varies, their convergence rates are relatively similar. An exception here is Slovenia where the GDP increased by 7 p.p. over the period under review while in Poland, Bulgaria, Slovakia, Czechia, Hungary, and Croatia the change varied between 26 and 17 p.p.

On the other hand, the Member States that are in the group of high-income economies, fully in line with the hypothesis of absolute convergence, recorded significantly lower economic

growth rates during the period: Austria (2.58%), Germany (2.61%), Denmark (2.73%), and Luxembourg (3.07%). Austria, Denmark, and Germany have consistently recorded GDP per capita around the EU average over a 19-year period, which shows the economic stability they have achieved at various stages of the economic cycle. However, this cannot be said for Ireland, whose economic growth between 2002 and 2019 is 4.38% and illustrates the cyclical fluctuations that the country goes through during the global financial and economic crisis. In this way, we can distinguish Luxembourg, Ireland, Austria, and Germany as euro area Member States that are steadily increasing and maintaining their high economic level in the European Monetary Union.

The EU Member States that are steadily moving away from the average European levels of GDP per capita are Italy, Greece, Cyprus, Spain, and Portugal. These countries are the hardest hit by the euro area debt crisis, which clearly emphasises that the global financial and economic crisis had the most serious impact on the euro area, causing divergence. In this vein, Italy is particularly impressive. In 2001 Italy was ahead of the GDP per capita as compared with France and the United Kingdom while by 2019 the Italian GDP per capita decreased by 24 p.p. and amounts to 94% of the EU-28 average, on a par with the Czech Republic. Meanwhile, Greece (0.74%), Italy (1.34%) and the United Kingdom (1.85%) are the countries with the lowest economic growth in the long run across the EU. This process reiterates the strong cyclical effect of the global crisis on the economies under review, threatening them to become structurally incapable of catching up with previous levels of well-being.

The conclusions drawn can be illustrated by tracking the dynamics of economic growth in the long run for the period under review, as well as the assessment of the years assumed to reach a certain average income.

The economic growth calculations between two periods are made using the following formula:

$$economic\ growth = \frac{lnrealGDP_{t_1} - lnrealGDP_{t_0}}{n} \tag{1}$$

where the period t_1 is the final year we use – 2019, and t_0 is the initial year 2002 with a length of the time interval $n = t_1 - t_0$.

To estimate the years one country will reach the average EU income level we use the following formula:

$$years\ of\ convergence = \frac{100 - y_{t_1}^i}{n\sqrt{\frac{y_{t_1}^i}{y_{t_0}^i} * 100 - 100}} \tag{2}$$

where:

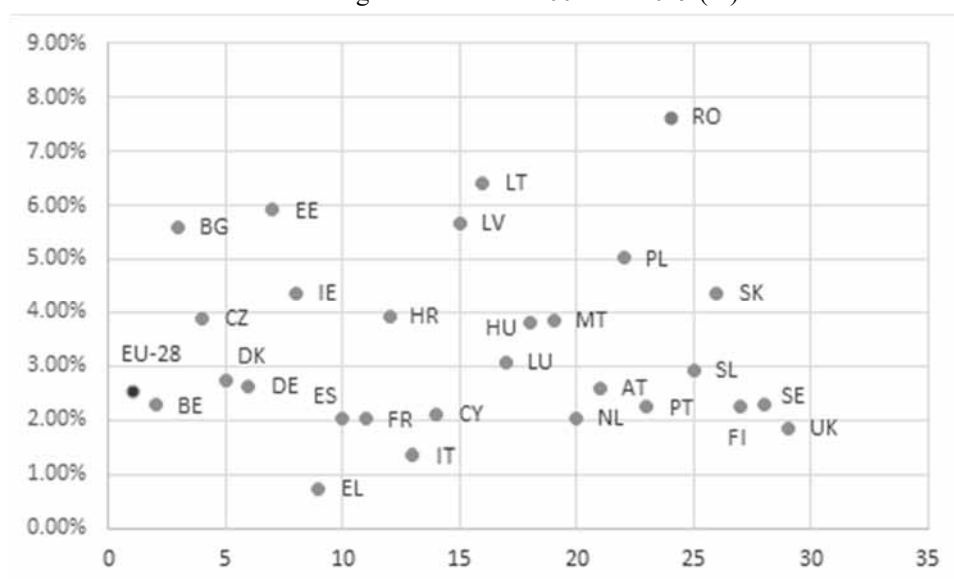100 is the average European income level;

$y_{t_1}^i$ is the value of GDP per capita in country i in period t_1;

the denominator shows the average annual rate of change of GDP per capita in country i between two periods, respectively t_1 and t_0.

The data on economic growth by country shows the relation between growth and convergence (Figure 2). The economies of the Member States that are growing fastest and approaching the average European income levels are Romania and the three Baltic countries, while the countries that were most affected by the 2008 crisis – Italy, Greece, Cyprus, Spain, and Portugal – registered lower rates of economic growth and showed divergence processes.

Figure 2

Economic growth between 2002 and 2019 (%)

Source: Eurostat.

However, Bulgaria is an exception in this process. Although the country registers relatively high economic growth in the long run, the pace of convergence with the average European income level remains relatively low – 1.2%. Thus, Bulgaria remains the lowest-income country in the EU with real GDP per capita of 48% of the EU average in 2019. At these rates of catching-up, it will take 39 years Bulgaria to reach the average EU income level other things being equal. Only Croatia (64 years) and Portugal (54 years) are ahead of Bulgaria while their economies were more hardly hit by the global financial and economic crisis than Bulgarian one (Figure 3). Two factors have a serious impact on Croatia – the real integration within the EU began 6 years after Bulgaria because Croatia joined the EU in 2013 and the country experienced a 5-year recession that leads to a slower pace of convergence – 0.6% per year to the average EU level. Apart from the fiscal and financial problems in the country because of the crisis, Portugal has consistently lagged in the convergence process and for the whole period 2002-2019 the convergence rate is negative (-0.4% per year). This is due to the structure of the Portuguese economy, where tourism has a leading position and makes it cyclically vulnerable. The strong competition from Eastern European countries and China against which the level of wages in Portugal remains higher consequently leads to a reorientation of production and foreign investments. These factors also partly explain the low

rate of convergence in Hungary. We estimate Hungary will need 35 years to reach the average European level of real GDP per capita at an average convergence rate of 0.8% per year.

Figure 3

Number of years to reach the average European level of GDP per capita at the pace of convergence estimated in 2002-2019
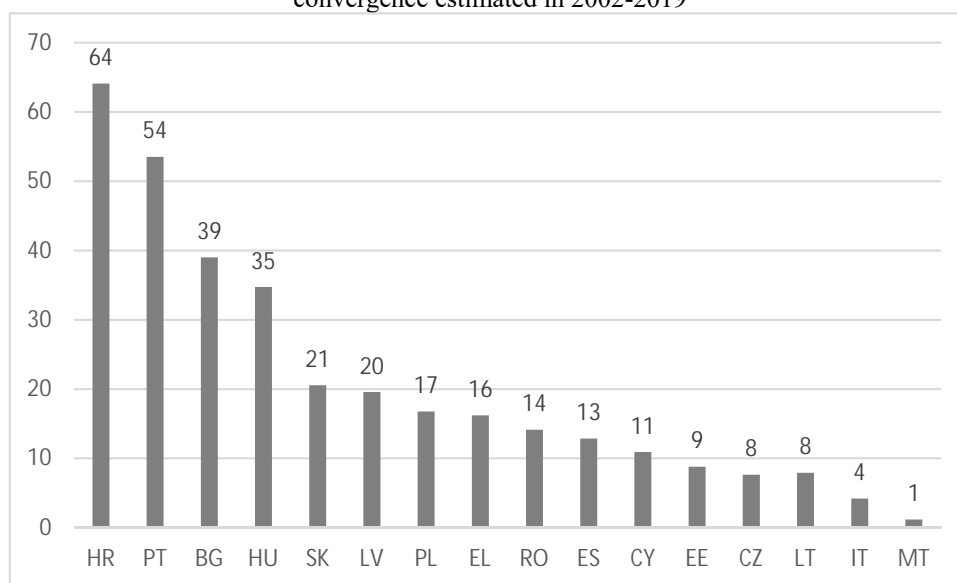
Source: Authors' calculations based on Eurostat data.

Two groups of countries should be exclusively highlighted in our study. In the first place, these are Romania and the Baltic States with intensified convergence to the average European income levels. It seems that Lithuania will achieve the average EU level of income within 8 years following the currently reported convergence rate of 2.3% per year; 9 years for Estonia at a convergence rate of 1.9% per year in 2002-2019; 14 years for Romania with a convergence rate of 2.2% per year, and 20 years for Latvia with 1.6% convergence per year. Therefore, accelerated economic growth in these countries, despite cyclical fluctuations, leads to a faster pace of income convergence at EU level and to sustainable convergence process. The other group of countries – Italy, Greece, Spain, and Cyprus – show the most serious signs of divergence. However, the already achieved higher level of income even with signs of divergence between -1% and -2% per year allows these countries maintain relatively close income levels around the Central European ones (except Greece). It also justifies the consideration of convergence in two points of view – absolutely in terms of achieved levels of GDP per capita and relatively as regards the convergence rate to a certain average level of GDP per capita.

Our estimation of years a country to reach the average European income level differs from the speed of convergence. The speed of convergence is assessed econometrically based on the following relation:

$$\frac{\Delta Y_t}{Y_t} = \beta \frac{\bar{Y}_t - Y_t}{\bar{Y}_t} \tag{3}$$

where:

$\frac{\Delta Y_t}{Y_t}$ is the economic growth for period t;

$\frac{\bar{Y}_t - Y_t}{\bar{Y}_t}$ is the difference between the GDP when the steady state of the economy is achieved and the value of the GDP in period t;

β is the speed of convergence.

In econometric form, the speed of convergence (β) is estimated following the relation between the average economic growth by a country in 2000-2019 (γ) and the logarithmic value of real GDP for 2000 (Y). The results are presented on Table 1.

Table 1

Absolute convergence in the EU-28 for the period 2000-2019

Dependent variable – long run economic growth for the period 2000-2019				
	Coefficient	Std. error*	t-statistic	p-value
Intercept	16.40	1.75	9.39	0.000
$\ln Y_{t_0,i}$	-1.49	0.18	-8.12	0.000
$Adj. R^2$	0.69			
F-statistic	61.45			
p-value	0.000			

White heteroskedasticity-consistent standard errors

We correct the heteroskedasticity by the White heteroskedasticity-consistent standard errors and covariance.

For the EU, the speed of convergence amounts to 1.49% per year with the negative sign in the regression equation illustrating the absolute convergence hypothesis. This result is lower than the widely known coefficient of 2% in the literature (Barro, Sala-i-Martin, 1992). However, it corresponds to more recent studies where the speed of convergence varies between 1% (Fernandez, Ley, Steel, 2001) and 1.3% (Doppelhofer, Miller, Sala-i-Martin, 2004). The estimated speed of convergence in the EU of 1.49% per year reflects cyclical fluctuations and divergence processes, especially in some countries of the so-called core of the euro area. Moreover, it points out the already achieved high average European income levels that lead to a slowdown in growth rates and approaching to the steady state. If we apply the dependence that if a variable increases by X% per year, its doubling will take 70/X years, it follows that it will take 47 years to eliminate 50% of the income disparities by Member State. This result supports *the view of "Europe at several speeds" or more precisely of "Europe of convergence clubs" that demonstrates the insufficient focus of the EU economic governance framework and priorities on cohesion and economic integration.*

Assessment of Conditional Convergence among EU Member States

The results achieved in terms of absolute convergence draw attention to the impact of specific factors causing the observed processes. In the economic literature, such an analysis implies an assessment of conditional β convergence. One of the main methods for studying conditional convergence is the static one which seeks to answer the question how certain economic variables affect economic growth in the long run, and hence have an impact on speed and state of convergence. The standard equation in econometric form has the following form (Durlauf, Johnson, Temple, 2005):

$$\gamma_i = \alpha + \beta_1 lnY_{t_0,i} + \beta_2 lns_i + \beta_3 lnSOLOW_i + \boldsymbol{\varphi X} + u_i \tag{5}$$

where:

γ_i is the long-term economic growth based on equation (1);

$lnY_{t_0,i}$ is the logarithm of GDP in the initial period of our study for country *i*;

lns_i is the logarithm of long-run savings rate in country *i*, which is calculated by the average share of gross capital formation at the constant price GDP;

$lnSOLOW_i$ is the so-called the Solow variable, which is the sum of population growth in country *i*, technological growth and the rate of depreciation of fixed capital. The last two are generally assumed to be 5% (Mankiw, Romer&Weil, 1992);

X is a vector that reflects all other variables that may be added to the conditional convergence equation.

We employ the standard cross-sectional growth regression estimated with ordinary least squares (OLS) knowing its limitations. We believe that while the panel variation of the growth regression will solve the problem of potential endogeneity, it will estimate a misleading coefficient of convergence due to the way average growth rates between two years are constructed. Because of the nature of panel data models, the period under review will need to be divided into multiple subperiods. Then the closer to each other the two years are, the shorter the periods for which the average growth rate will need to be calculated is. This means that if the two years are one after another, the average growth rate will be calculated for one year. Then it is only natural to assume that there will be a very strong relation between the GDP per capita in a year and the growth rate associated with the following period. However, we don't believe that this relationship can be interpreted as a (or the lack of) beta convergence due to the reason that we will be looking at a short run (or in the best-case a medium run) dynamics.

In the process of selecting economic variables when assessing the equation (5) the statistical significance of various variables was tested:

- *openness of the economy* – intra-EU trade and foreign direct investments[5] in order to capture the effect of functioning of the Single Market in the EU as a convergence tool following the official EU doctrine;

- *structure of budget revenues and expenditures, and government debt* – the role of government in stabilising but also hindering the sustainable convergence;

- *social factors* stemming from the new dimensions of Europe's economic convergence processes in line with the EU's Annual Sustainable Growth Strategy – education; energy intensity of the economy; poverty and income inequality; migration; technology and innovation; efficiency of institutions[6], and corruption.

We find statistical significance for the following variables within the vector X:

- openness of the economy calculated as a share of foreign trade balance in GDP ($lnopenness$);

- government debt as a share of GDP ($lngdebt$);

- percentage of population age 15-19 with tertiary schooling (edu) which allows us to consider the impact of human capital on economic growth following the endogenous growth theory.

Although migration proved to be statistically insignificant, in our assessment its effect is indirectly captured by the long-run population growth, a part of the Solow variable. The impact of technology and innovation is visible through two other variables – the long-run savings rate and the proxy for human capital we use. The effect of labour productivity, which is an important indicator when assessing real economic convergence, is indirectly considered through total factor productivity (TFP) despite all the limitations of this indicator (Rangelova, 2008). Based on research by William Easterly and Ross Levine (Easterly, Levine, 2001) about 60% of the increase in labour productivity is due to improvements in TFP.

Following the abovementioned assumptions, we econometrically estimate the following equation:

$$\gamma_i = \alpha + \beta_1 lnY_{t_0,i} + \beta_2 lns_i + \beta_3 lnSOLOW_i + \beta_4 lnopenness_i + \beta_5 lngdebt_i + \beta_6 edu_i + u_i \tag{6}$$

Using data in 2000-2019 for all 28 EU Member States we obtain the results shown on Table 2.

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[5] Aspects of geographic sustainability and geographic concentration of international trade also matter as shown by Nestorov (2019).

[6] The economic and social risks of institutional instability in different aspects are studied by Shalamanov (2018).

Table 2

Conditional convergence in the EU-28 for the period 2000-2019

Dependent variable – long run economic growth for the period 2000-2019					
	Coefficient	Std. error*	t-statistic	p-value	VIF
Intercept	17.04	4.48	3.80	0.001	-
$\ln Y_{t_0,i}$	-1.25	0.21	-5.93	0.000	3.62
lns_i	0.14	0.94	0.15	0.885	1.99
$lnSOLOW_i$	-2.65	1.70	-1.56	0.134	7.88
$lnopenness_i$	0.64	0.25	2.55	0.019	2.15
$lngdebt_i$	-0.54	0.14	-3.93	0.001	1.38
edu_i	0.86	0.30	2.92	0.008	2.13
$Adj. R^2$	0.85				
F-statistic	27.49				
p-value	0.000				

White heteroskedasticity-consistent standard errors

We find that four variables have an impact on long-run economic growth as follows:

- initial value of GDP whose change by 1% leads to 0.0125 p.p. higher economic growth, and respectively affects the degree of convergence;

- openness of the economy – 1% increase in the trade openness resulted in 0.00637 p.p. higher economic growth in the long run;

- government debt – its increase with 1% has a negative effect of 0.0054 p.p. on the long-run economic growth;

- the impact of human capital – when the percentage of the population age 15-19 with tertiary schooling increases with 1 p.p. the estimated effect on long-run growth is 0.86 p.p. The estimated significant effect of this indicator stems from its specificities – for the EU 1% share of the population age 15-19 with tertiary schooling is reported only in Ireland (2.15% as of 2005), Croatia (1.81% as of 2010), and Slovakia (1.68% as of 2010). Given these data, the increase in the young population with professional skills by 1 p.p. will be a significant step forward for the EU so it is not surprising that it would also have a significant effect on economic growth.

The four factors identified are among the most important for economic development in general. They also emphasise the structural problems not only of the convergent process itself, but also of the functioning of the EU – we find that the long-run savings rate and the Solow variable, which includes technological progress, are not statistically significant. Having in mind all the restrictions of our study, this result shows *a lack of long-run potential for economic development in the EU and a permanent loss of competitiveness under the transition to the Industry 4.0 and digital transformation of economic processes*. From this point of view, the Investment Plan for Europe or the so-called the Juncker Plan should be seen not only as a strategy for tackling the cyclical fluctuations in the European economy after the global economic and financial crisis in 2008 but also as a foundation of the EU's long-run economic strategy. Unfortunately, currently the Investment Plan for Europe has

limited results and the priority focus on green policies is an additional constraint on accelerating economic growth, especially for catching-up economies.

Higher energy efficiency would create more jobs and increased competitiveness in developed Western EU countries such as Finland, France, the Netherlands, Spain, and Sweden (Wijkman, Skånberg, 2016). However, for countries like Bulgaria and Poland fossil fuels replacement with biofuels would lead to a significant change in the energy mix, the shutdown of coal-fired power plants and increased costs for electricity. In 2018, the slowdown in economic growth in Germany was due to the restrictions on some diesel vehicles in certain districts of the country and the new carbon emissions standards to be met by the automotive industry. These processes gave some experts reason to talk about signals of recession in the euro area, and hence – inevitably a slowdown in highly dependent economies through international trade and financial flows such as the Bulgarian one. These examples illustrate that *the EU does not see convergence as a starting point for economic policy and is much more focused on fostering convergence clubs with a focus on high-income Member States. In other words, instead of a Green Deal, the EU needs an Investment Deal to carry out the fundamental idea of the Single Market.*[7]

The other two variables that our econometric assessment identifies as significant for economic convergence are government debt and percentage of the population age 15-19 with tertiary schooling. The negative effect of government indebtedness was at the heart of the so-called vicious circle that implies the interplay between the euro area's financial and sovereign debt crises.[8] This negative effect should not be exaggerated, although it creates significant fiscal imbalances that require monitoring of debt dynamics (Ignatov, 2020). In 2010 the budget deficit in Ireland was -32% of GDP due to bank bailouts. However, in 2015 Ireland experienced 25.2% economic growth and succeeded in doubling its GDP per capita in 2001-2019. The "Irish Miracle" is also seen in the variable we use to assess the impact of human capital since Ireland is the only EU Member State that has sustainably maintained a share of over 2% of the population age 15-19 with tertiary schooling since 2000. All these prerequisites support the functioning of the real economy that can tackle any cyclical fluctuations and demonstrate that the negative effects of financial instability can have a limited long-run impact, which is not the case in France and the Netherlands, for example. Croatia has also been steadily increasing the population age 15-19 with tertiary schooling, but clear results have been still missing – Croatia is among the lowest income convergence club in the EU and has been in recession for 5 years in a row. In the field of economic policy, these examples are important because they broaden *the debate on the effectiveness of government over-indebtedness and draw attention to tertiary education among young people as a tool for building a functioning real economy that seems to be a powerful convergent tool, including in terms of structural policy.*[9]

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[7] The smooth functioning of the Single Market that foster convergence process within the EU have different aspects, including in the field of Common Agricultural Policy. See Beluhova-Uzunova, Hristov, Shishkova, 2020.

[8] The behavioral finance perspective on debt issues in public and corporate sector are studied by Nedev (2019).

[9] The importance of structural reforms in sustainable economic development model are studied by Petranov (2016).

Graphically, the level of conditional β convergence can be represented by subtracting all the estimated parameters in equation (7) except the initial value of GDP from the economic growth in 2002-2019 (Figure 4). Subsequently, a partial correlation between the residual (unexplained by the other factors) economic growth and the initial value of GDP is calculated. The strongly negative correlation (-0.9) illustrates the hypothesis of convergence that countries with higher GDP grew at lower rates other things being equal. The variance of the residual economic growth between 9.5 and 14% shows that about 4.5% of the economic growth is explained by the variables included in equation (6). A similar result – approximately 5% – was obtained by Robert Barro (1991) in a study of 98 countries using data between 1960 and 1985.

Figure 4

Conditional β-convergence in the EU in the period 2002-2019
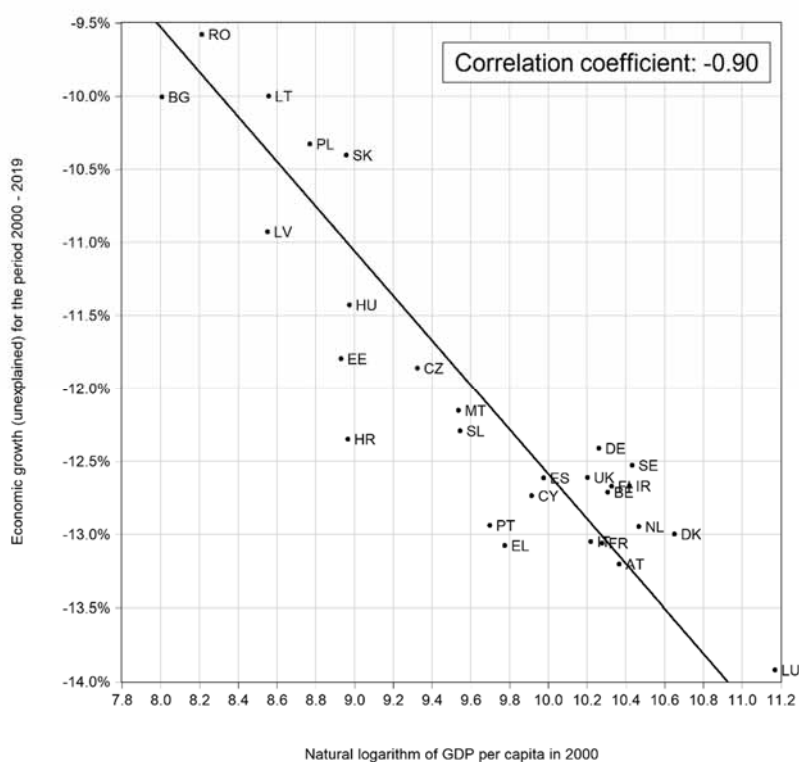
Source: Authors' calculations based on Eurostat data.

Having considered the presence of absolute and conditional β convergence, next we estimate the σ convergence which is a necessary condition for β convergence. In essence, σ convergence reflects the trend of convergence or divergence in each sample of countries.

As the β convergence hypothesis states to reduce these differences (i.e. convergence of per capita income) relatively lower-income countries should grow faster than higher-income countries. The term σ convergence derives from the variance and is calculated by the following formula:
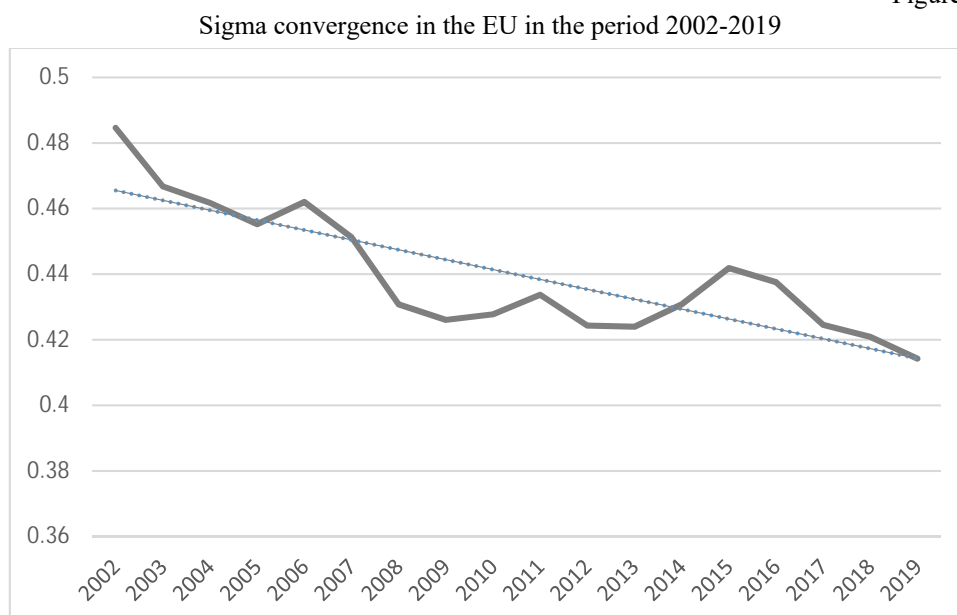
$$\sigma^2 = \frac{1}{n}\sum_{i=1}^{n}(y_i - \bar{y})^2 \tag{8}$$

where y_i is a level of income in country i, and $\bar{y}$ is the arithmetic mean of income against which the degree of convergence is estimated and amounts to:

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i \tag{9}$$

In this study we use the coefficient of dispersion to describe σ convergence calculated for each time period:

Figure 5

Sigma convergence in the EU in the period 2002-2019

Source: Authors' calculations based on Eurostat data.

$$D_t = \frac{\sigma_t^2}{y_t} \tag{10}$$

The results show that the coefficient of dispersion decreases on average by 0.92% annually and there is a strictly negative relation as postulated by the theory. However, between 2002 and 2008 the narrowing of the income gap, i.e. convergence, is much stronger (the coefficient of dispersion decreased by 1.68%) while in 2009-2016 this process slowed down, and the coefficient of dispersion changed by 0.52%. Since 2017 a sharper decline in coefficient of dispersion and a return to convergence processes began to be observed again. This data show

the divergence in the EU since the global economic and financial crisis of 2008 and outline the dependence of convergence processes on the stage of the economic cycle – *when economies grow the convergence processes are much stronger while under economic shocks the convergence slows down and the high-income countries even show divergence trends.* Divergence can be described as a process of income convergence but to a lower income level which in the context of club convergence is well observed for the Southern EU Member States – Italy, Greece, Cyprus, Spain, and Portugal. As we have already noted, in 2000-2019 Italian economy registered 24 p.p. decrease of GDP per capita relative to the EU average. Since 2010 Spain experienced 9 p.p. lower GDP per capita due to the serious financial problems in the country and the huge budget deficit. Cyprus was ahead of the average EU GDP per capita in 2005-2010. However, the strong cyclical dependence of the country's economy given its service-oriented profile and the transfer of financial flows caused a serious signal of economic divergence between 2015 and 2017. Greece and Portugal registered an increasing divergence with the average EU GDP per capita since 2010 due to the debt crisis in the euro area, which originally started from them. Thus, the assessment of σ convergence confirms the cyclical conditionality and dependence of the convergence processes in the EU.

Conclusion

The convergence processes within the EU are developing steadily but at a club level. Some EU Member States such as Romania and the Baltic States show a steady trend towards speed up convergence with average European income levels while others – Bulgaria and Croatia – lag significantly behind. Nevertheless, absolute β convergence is observed in the EU, which is indicative of faster growth of low-income economies. For Bulgaria, however, this growth is not sufficient, and the country continues to be the lowest income EU Member State. At this pace of catching up, Bulgaria will need 39 years to reach the average level of income in the EU other things being equal. Croatia (64 years old) and Portugal (54 years old) are ahead of Bulgaria due to the stronger effect of the global financial and economic crisis of 2008 on their economies. The econometric analysis we employed for the period 2000-2019 shows that the conditional β convergence in the EU is determined not only by the expected factors such as savings rate, technological growth, population growth but also by the openness of the economy, government indebtedness, and the percentage of the population age 15-19 with tertiary schooling.

It seems that the EU does not have a clearly defined strategy for promoting convergence processes and the EU economic governance is much more focused on fostering convergence clubs with a focus on the high-income Member States. Instead of a Green Deal, the EU needs an Investment Deal to build a long-run investment potential in the digital era. The sustainability of convergence processes would be achieved through the effective use of government debt and the development of vocational education, which facilitate the building of a functioning real economy that can be a strong convergence tool as the Irish experience shows. This is a way the deepening of divergence processes in the EU be overcome and the trend of convergence clubs' formation instead of community convergence to be reversed.

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