Eurofound

Promoting social cohesion and convergence

Human capital and income convergence in the EU

Role of human capital inequalities in social cohesion and convergence

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Abstract

This working paper analyses whether highly educated individuals have played a role in income convergence in the EU during the period 2008-2021. The focus is on beta convergence, which refers to a process in which countries with relatively low initial values of GDP per capita grow faster than countries that start with higher values. Results show a higher beta convergence when conditioning convergence on the share of graduates, suggesting that human capital has accelerated the catching up in income levels among the 27 countries in the EU.

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Introduction

Convergence in standards of living has been one of the main goals of the European Union (EU) since its foundation. Despite a process of convergence over the years (Barro and Sala-i-Martín, 1992; Gill and Raiser, 2012) there are still substantial disparities across EU countries and its regions. By way of illustration, in 2008, the average GDP per capita (in PPP constant dollars) was 49,479 (€ 44,218.89 as of 23/08/20241) in north western Europe, 36,649 (€ 32752.84) in southern Europe, and 26,611 (€ 23781.98) in central and eastern Europe. In 2021, the GDP per capita was 52,647 (€ 47050.10) in western Europe, 38,413 (€ 34329.31) in southern Europe and 34,465 (€ 30801.03) in central and eastern Europe. The rampant economic growth in central and eastern Europe has resulted in a convergence process in the EU members during this period. However, the modest growth rates in Southern European countries raise concern.

This working paper analyses whether highly educated workers have played a role in income convergence in the EU during the period 2008-2021. The focus is on beta convergence, which refers to a process in which countries with relatively low initial values of GDP per capita grow faster than countries that start with higher values. Using data for 27 European countries during the period 2008-2021, the evidence indicates a process of absolute beta convergence in income levels as poorer countries have unconditionally caught up with the richer economies.

Absolute convergence in the share of graduates is found, MS with lower levels of graduates in 2008 experienced, on average, a higher growth rate of graduates than those with higher levels. We analyse whether the convergence in the share of graduates influenced convergence in income levels by including the share of graduates in a standard income convergence equation. The difference between absolute beta convergence and convergence conditional on the level of graduates is the role of human capital. Results show a higher beta convergence when conditioning convergence on the share of graduates, suggesting that human capital has accelerated the catching up in income levels among the 27 countries in the EU.

The period of analysis covers the global financial crisis and the European sovereign debt crisis to check whether there has been any difference in the rates of convergence during the crises and after. The period into two subperiods, from 2008 to 2014 and from 2014 to 2021. Results show a rate of convergence of about 1.3 percent over the years 2008-2014, and an increase in the convergence rate up to 1.8 percent between 2014 and 2021. The evidence also shows the strong convergence in the share of graduates has contributed to increasing the speed of convergence to 2.4 percent in the post-crisis years.

 For the regional-level analysis, we employ data on 229 regions from 2014 to 2021. Results show absolute beta convergence in income levels across regions. Nevertheless, when we consider country-specific effects and study convergence among regions in the same country, the speed of convergence is lower, with a rate of about 0.47 percent. We assess whether the relationship between initial income and growth changes conditional on the proportion of graduates. Controlling for the share of graduates increases the beta convergence coefficient to 0.67, indicating that the population with tertiary education has also sped up convergence at the regional level.

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[1] Conversion rate applied on 23/08/2024 to all non-euro currency amounts.

The structure of the paper is as follows. Section 2 describes the econometric model to be estimated. Section 3 presents graphical evidence and the results of the econometric analysis at the country level. Section 4 analyses convergence at the regional level. Finally, Section 5 states the conclusions reached.

Econometric model

The question of whether poorer countries are converging to the income levels of richer countries has long captured the attention of researchers. For many years, no evidence was found of unconditional convergence, in the sense that poor countries unconditionally catch up to the income levels of rich economies (Baumol, 1986; De Long, 1988; Barro, 1991; Pritchett, 1997; Rodrik, 2013; Johnson and Papageorgiou, 2020). However, some indications of unconditional convergence are found from the 2000s onward in a broad sample of countries (e.g., Kremer et al., 2021). In this chapter, we focus on beta convergence in the EU economies and analyze the role of human capital in this process.

To evaluate absolute beta convergence in income we estimate the following econometric model:

$$ln\ (y_{i,t+\triangle t}) - ln\ (y_{i,t}) = \alpha + \beta_t\ ln\ (y_{i,t}) + \mu_t + \varepsilon_{i,t} \tag{1}$$

where y is the real GDP per capita in country i at year t, μ_t is a year fixed effect that controls for shocks that are common to all countries, and $\varepsilon_{i,t}$ is an error term that varies across countries and years. We assume that $\varepsilon_{i,t}$ is uncorrelated with the explanatory variables. The convergence coefficient β is allowed to vary over time. In this framework, the estimate of β will be a measure of unconditional or absolute convergence. We say there is unconditional convergence in GDP per capita if $\beta < 0$. When there is beta convergence, countries or regions in which the initial level of income is higher have a slower pace of growth. The magnitude of β gives an indication of the speed of the convergence process.

The aim is to analyze whether human capital has had any effect on income convergence in the EU. Castelló-Climent and Doménech (2022) show that convergence in human capital, approximated by a measure of the average years of schooling, has played an important role in explaining convergence in income levels in a broad sample of countries. Our focus, however, is on highly educated individuals. To assess the influence of skilled workers on the convergence rate, we include the share of graduates in the set of controls. Equation (1) is enlarged as follows:

$$ln\ (y_{i,t+\triangle t}) - ln\ (y_{i,t}) = \alpha + \beta^*_t\ ln\ (y_{i,t}) + \lambda_t\ ln\ (h_{i,t}) + \mu_t + \varepsilon_{i,t} \tag{2}$$

where $h_{i,t}$ measures the proportion of graduates aged 15-64 in country i at the beginning of the period. The coefficient β^* captures convergence conditional on controlling for the initial level of graduates. There is conditional convergence if $\beta^* < co0$. The role of human capital, as measured by the proportion of graduates, in the convergence rate is the difference between β^* and β.[2]

Data is sourced from the World bank database for the GDP per capita in constant terms PPP and from the Eusrosta labour force survey for the number of graduates 15-64 in each country, and for those living and working abroad (called 'outbound' in this paper) the indicator lfst_lmbpcited is used to select EU27citizens residing abroad as percentage of graduates aged 15-64 in country of citizenship.

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[2] See Castelló-Climent and Doménech (2022) for an explanation of the decomposition of absolute convergence into conditional convergence and the role of human capital through the omitted variable bias formula.

Beta convergence across countries

Beta convergence implies that lower income countries tend to grow faster than richer ones. Barro and Sala-i-Martin (1992) and Young et al. (2008) show that β-convergence is a necessary, but not a sufficient condition for σ-convergence, which happens when there is a decrease in the dispersion of per capita incomes across countries over time. In this section, we analyse β-convergence in a sample of 27 European countries from 2008 to 2021.

Figure 1 plots the level of GDP per capita in 2008 against its growth rate over the years 2008-2021.[3] The figure shows a negative relationship between the two variables, suggesting beta convergence in income levels. The countries that had higher income in 2008 experienced, on average, lower growth rates than those that had lower income levels. While most of the countries are close to the fitted line (blue dotted), Ireland´s growth rate (4.607 percent) was notably above the sample average (1.168 percent). On the other extreme, Greece displays a negative growth rate between 2008 and 2021 (-1.812 percent).

Figure 1 also shows a clear pattern in three different geographical areas.[4] At the bottom right of the figure are the countries in north western Europe (navy blue), which had the highest GDP per capita in 2008 and low growth rates. In the upper left-hand-side area are the Central and eastern European countries (maroon), which had, on average, the lowest GDP per capita in 2008 and the highest growth rates during the period 2008-2021. Convergence in GDP per capita is mainly driven by the Central and eastern European economies catching up with the income levels of richer countries. As depicted in Figure 1, Southern European countries (orange) had a poor performance over the period, with economies such as Greece, Italy and Spain showing negative growth rates between 2008 and 2021. In fact, as depicted on the right-hand side of the figure, once Central and eastern European countries are removed from the sample, convergence in the EU disappears.

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[3] The variable is GDP per capita in purchasing power parity (constant 2017 international $) from the World bank, WDI.

[4] North Western countries are Austria, Belgium, Germany, Denmark, Finland, France, Ireland, Luxembourg, the Netherlands and Sweden; Southern European countries are Cyprus, Greece, Spain, Italy, Malta and Portugal; and Central and Eastern European countries are Bulgaria, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia and Slovakia.

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Figure 1 Beta convergence in GDP per capita in the EU27, 2008-2021.

The period of analysis covers the global financial crisis that started around 2008, which was characterized by a huge reduction in economic growth rates. To see whether convergence differed during the years of the global financial crisis and the years thereafter, period is split into two subperiods, from 2008 to 2014 and from 2014 to 2021. During the years 2008-2014, the figures show the consequences of the crisis were particularly acute in the Southern European countries. Except for Malta, all countries in this area experienced negative growth rates. The crisis was also more pronounced in Croatia and Slovenia—both countries in Central and eastern Europe—and in Luxembourg, Finland, the Netherlands and Denmark, which are in North Western Europe.

During the post-crisis years, 2014-2021, all countries show positive growth rates, and the figure displays a steeper convergence line indicating a higher convergence rate. However, some Southern European countries remain well below the fitted line, hindering the process of catching-up with the richer economies. It has been pointed out that low growth rates in total factor productivity (TFP) are affecting this region. Ridao-Cano and Bodewig (2018) show a decline in TFP growth in all geographical regions in the EU, but most notably in Southern European countries. By way of illustration, the authors plot the performance of EU countries in opportunities for firms, measured by the Ease of Doing Business index in 2017, and the opportunities for people, approximated by the percentage of students with basic competence in the PISA reading assessment in 2015. Compared with most north western European countries, Southern European countries—with the exception of Portugal—have a higher share of students below basic competence level in reading, coupled with a business environment with more regulations and less support for innovation. As a result, the north western European economies are productivity leaders with a higher share of technology firms on the frontier, whereas their southern European counterparts are lagging behind.

Convergence has mainly been used to refer to convergence in income levels. However, we can also assess whether there has been convergence in other economic outcomes. Figure 2 analyses convergence in human capital, approximated by the total number of graduates aged 15-64 years old.[5]

Figure 2 Beta convergence in total graduates in the EU27, 2008-2021.

The figure shows there is strong evidence of absolute convergence in human capital. Countries with a higher share of graduates in 2008 (e.g., Finland, Estonia, Belgium, Ireland, Cyprus) experienced, on average, lower growth rates in the share of graduates, as compared to those that started with relatively low levels (e.g., Malta, Portugal, Slovakia, Czechia). Moreover, convergence is not driven by the central and eastern European economies. Even when we remove these countries from the sample, convergence holds, as illustrated on the right-hand side of the figure.

There is also strong convergence in the share of graduates within geographical areas. The strongest convergence is found in north western countries. In this area, Finland has one of the highest shares of graduates in 2008 (30.2 percent) and the lowest growth rate between 2008 and 2021 (1.33 percent). At the other extreme, Austria shows one of the lowest shares of graduates in 2008 (15 percent) and the highest growth rate (5.95 percent), with remarkable growth of about 10 percent during the first half of the period. In the southern area, Italy stands out with a relatively low share of graduates in 2008 (12.7 percent) and a relatively low growth rate (2.73 percent).

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[5] Graduates refers to individuals with tertiary level of education corresponding to ISCED 5-8 (UNESCO). Level 5 is short-cycle tertiary education, level 6 is Bachelor´s degree or equivalent, level 7 is Master´s degree or equivalent, and level 8 is Doctorate or equivalent.

Figure 3 Beta convergence in outbound graduates in the EU27, 2008-2021.
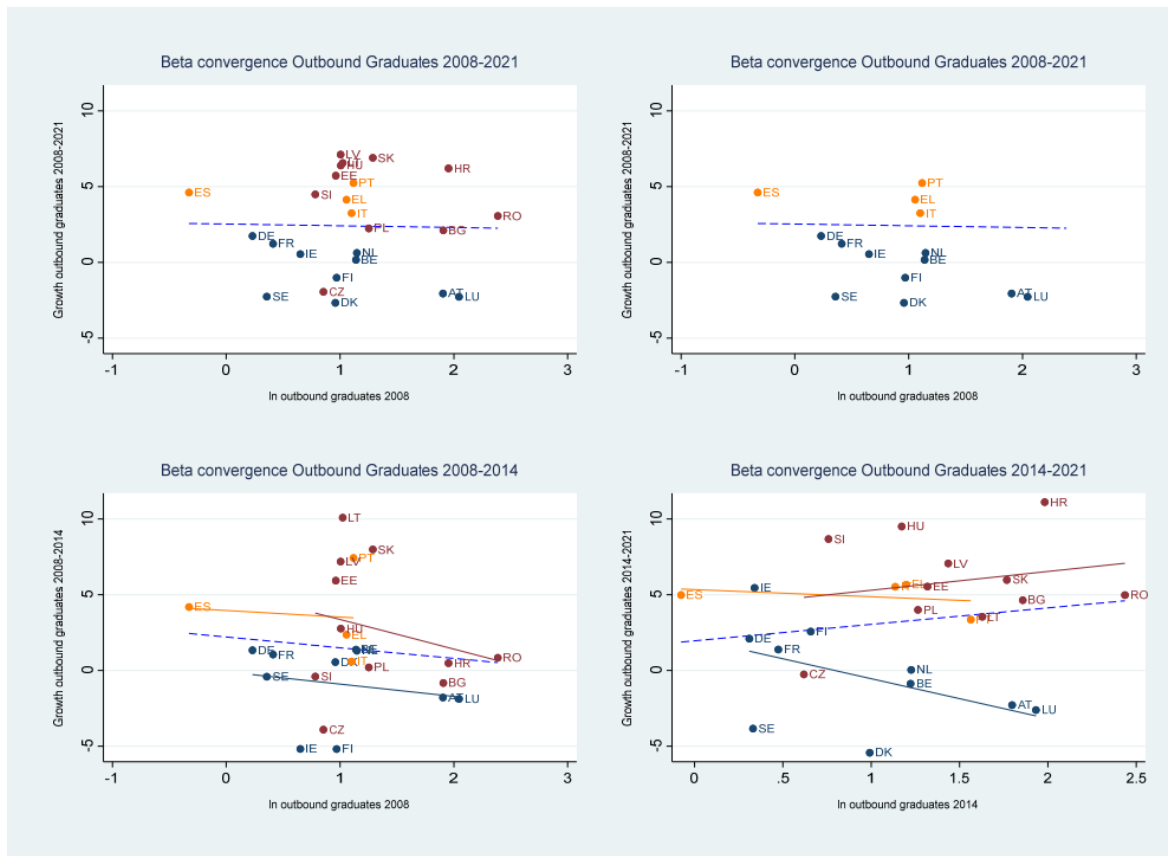
A lack of employment opportunities and low wages for university graduates in some countries have pushed highly skilled workers to seek professional opportunities in more favourable economies. Though mobility across the EU countries is low, there has been an increase in the mobility of highly educated workers since the financial crisis (Cavallini et al., 2018). Figure 3 plots the share of outbound graduates in 2008 against its growth rate.[6]

The figure shows no evidence of absolute convergence, as several countries with similar levels of outbound graduates in 2008 display widely differing growth rates. Nor is there any indication of convergence when the central and eastern European countries are removed from the sample, as displayed on the right-hand side of the graph. By contrast, within geographical areas, the figure shows convergence in the share of outbound graduates within Western European countries, mainly during the years 2014-2021. In this region, Austria and Luxembourg display a higher share of outbound graduates in 2014, as opposed to countries such as Denmark, France and Finland with lower levels and higher growth rates. In central and eastern Europe there are indications of divergence during the second half of the period. In the Southern area, Spain stands out with low initial levels of outbound graduates and a relatively high growth rate.

In Table 1, the statistical significance of the slopes in Figures 1, 2 and 3 is analysed. The dependent variable is the growth rate of each variable, and the explanatory variables include the corresponding

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[6] Outbound graduates are measured by the number of graduate citizens residing abroad as a percentage of the graduates residing in the country of citizenship for the population aged 15-64 years old.

variable at the beginning of the period, and a dummy that controls for year fixed effects. Columns (1) and (2) display the results for GDP per capita.

Table 1 Unconditional beta convergence

	GDPpc		Graduates		Outbound graduates	
	(1)	(2)	(3)	(4)	(5)	(6)
2008-2021	-1.512[a]		-3.071[a]		0.215	
	(0.536)		(0.704)		(0.786)	
2008-2014		-1.267[b]		-4.077[a]		-0.710
		(0.546)		(0.954)		(0.719)
2014-2021		-1.782[c]		-1.565[c]		1.084
		(0.934)		(0.826)		(1.282)
Constant	18.227[a]	21.064[b]	13.024[a]	8.136[a]	2.976[b]	1.957
	(5.470)	(9.602)	(2.357)	(2.764)	(1.194)	(1.658)
R^2	0.440	0.442	0.367	0.407	0.049	0.067
Obs	54	54	54	54	50	50
Year FE	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parenthesis. a, b and c denote statistically significant coefficients at 1,5 and 10 per cent probabilities, respectively. The dependent variable is the annual growth rate of GDP per capita in columns (1)- (2), annual growth rate of total graduates aged 15-64 in columns (3)-(4), and the annual growth rate of outbound graduates aged 15-64 in columns (5)-(6). The explanatory variables include the corresponding variable at the beginning of each period and a year fixed-effect.

The pooled OLS regression shows the coefficient of initial income is negative and statistically significant at the 1 percent level, confirming unconditional beta convergence in income levels. Licchetta and Mattozzi (2023) show a convergence rate in the EU-27 of about 2.4 percent during the period 1995-2008. The financial crisis and the subsequent sovereign debt crisis resulted in a reduction in the convergence rate. Column (1) shows an absolute beta convergence coefficient of around 1.5 percent over the years 2008-2021.

To ascertain whether convergence was different in the crisis and post-crisis years, column (2) includes interaction terms between the level of GDP per capita at the beginning of each period, 2008 and 2014, and a year dummy (yr_t). This specification provides the same result as estimating cross-section regressions individually for each period. The evidence shows there is absolute convergence in GDP per capita across the 27 EU countries in both periods, though the convergence rate is larger during the years 2014-2021.

Columns (3) and (4) also confirm unconditional convergence in the share of total graduates. The convergence coefficient is negative and statistically significant at the 1 percent level. Unlike GDP per capita, absolute convergence in graduates is greater in the first period (-4.077 percent) than during the second one (-1.565 percent). Columns (5) and (6) indicate there is no evidence of absolute convergence in the share of outbound graduates. The estimate is even positive for the whole period 2008-2021, albeit not statistically significant at the standard levels.

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To evaluate whether the convergence process in the share of graduates has had any effect on the convergence coefficient in per capita income we estimate equations (1) and (2). Results are displayed in Table 2. Column (1) presents the estimated values of equation (1), which replicates the results in column (2) of Table 1. The evidence shows absolute convergence in GDP per capita in the two subperiods of analysis. During the years 2008-2014, the results indicate unconditional β convergence at a rate of about 1.3 percent a year, a coefficient that increases to 1.8 percent during the period 2014-2021.

How do the results change when we condition on the initial level of graduates? The estimates of equation (2) are displayed in column (2). The coefficient of $β*$-convergence, conditional on the share of graduates, is negative and statistically significant in both periods. The conditional convergence coefficient is greater than that of absolute convergence only in the second period, suggesting that convergence in the share of graduates has only influenced income convergence during the years 2014-2021. The difference between absolute and conditional convergence is the role of human capital. During the years 2014-2021, the coefficient of convergence increased from 1.78 percent to 2.45 percent, indicating that the share of graduates increased beta convergence in GDP per capita by about 0.67 percent a year.

In column (3) we additionally control for the share of outbound graduates. The results indicate that, while the estimate of the share of outbound graduates is not statistically significant in any period, its inclusion enhances the effect of graduates on economic growth and increases the conditional beta convergence coefficient during the years 2008-2014. Conditioning on the share of graduates and outbound graduates, the evidence shows conditional convergence in income levels at a rate of about 1.4 percent during the period 2008-2014, and a rate of around 2.5 percent during the years 2014-2021. The increase in the convergence coefficients suggests the share of skilled workers has played a key role in increasing convergence in income levels among the EU countries, especially during the years after the crisis.

Table 2 Beta convergence in GDP per capita in the EU27

|	(1)	(2)	(3)
	Unconditional convergence	Conditional convergence	
	β	β^*	β^*
$lnGDPpc * yr_{2008}$	-1.107[b]	-1.438[b]	-1.475[b]
	(0.513)	(0.596)	(0.554)
$lnGDPpc * yr_{2014}$	-1.784[c]	-2.509[a]	-2.455[a]
	(0.940)	(0.606)	(0.585)
$\ln Grads * yr_{2008}$		0.873	1.149
		(0.656)	(0.702)
$\ln Grads * yr_{2014}$		1.712	1.876[c]
		(1.250)	(0.950)
$\ln Outb\ Grads * yr_{2008}$			0.280
			(0.418)
$\ln Outb\ Grads * yr_{2014}$			0.246
			(0.570)
Constant	21.065[b]	23.116[b]	21.725[a]
	(9.651)	(8.539)	(7.155)
Obs.	51	51	51
R^2	0.453	0.479	0.484
Year FE	YES	YES	YES

Robust standard deviation error in parenthesis. A, b and c denote statistically significant coefficients at 1, 5 and 10 per cent probabilities, respectively. The dependent variable is the annual growth rate of GDP per capita. The sample is divided between two periods: 2008-2014 and 2014-2021.

Beta convergence across regions

Using data at the NUTS 2 level for 242 regions from 2014 to 2021, in this section we analyse whether there has been convergence in GDP per capita across regions, and if so, what has been the role of the population with tertiary education in the convergence process. Given the available data at the regional level, we measure GDP per capita with the regional GDP in purchasing power standards (PPS) per inhabitant7. The share of graduates is measured through the tertiary education attainment for population aged 15-64 years old.[8]

Figure 4 displays the relationship between level of income per inhabitant in 2014 and its growth rate over the period 2014-2021 in 242 regions in the EU.

Figure 4 Regional beta convergence in GDP per capita in the EU , 2014-2021.
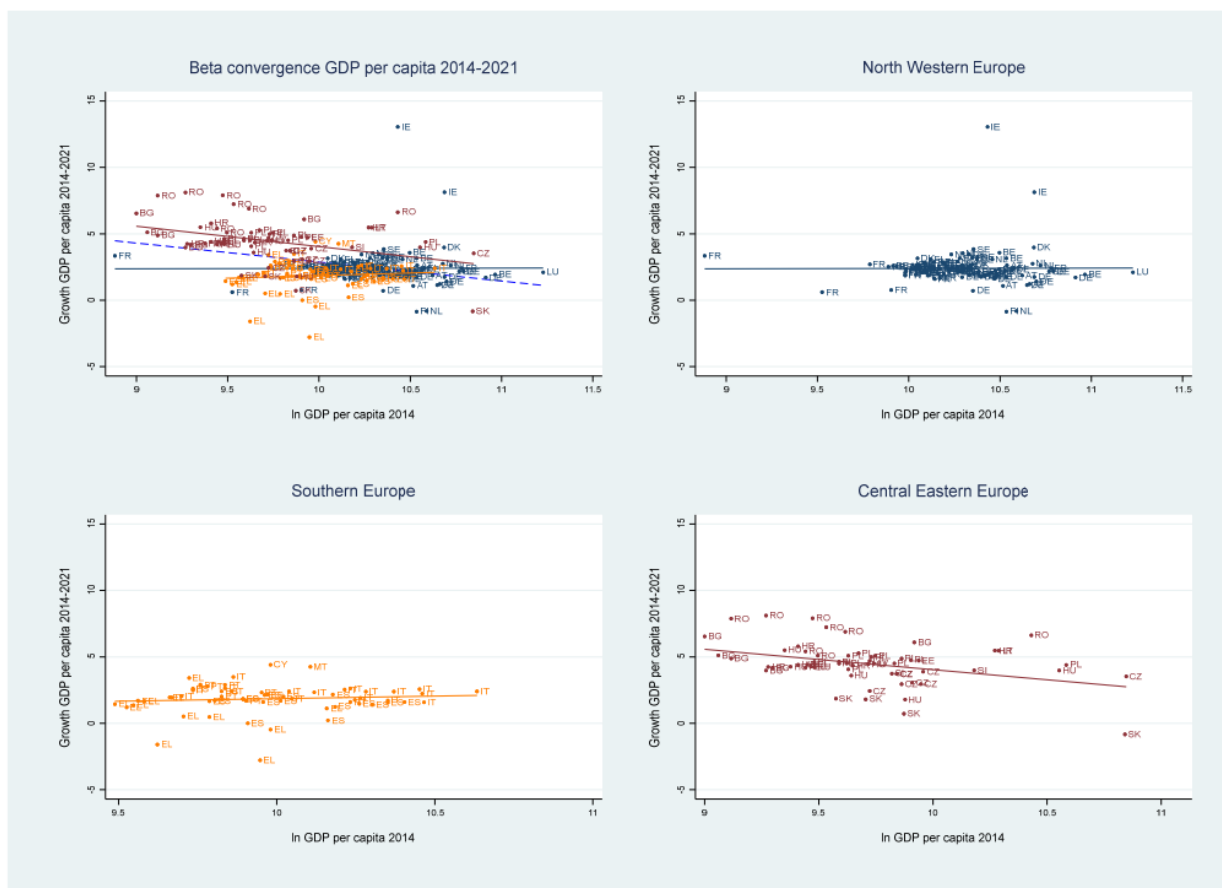
Source: Eurostat, EU-LFS.

The fitted line (blue dots) shows a negative correlation between the two variables, indicating that those regions that had lower income levels in 2014 experienced, on average, higher economic growth rates during the years 2014-2021. In line with previous findings, the figure paints a different picture when we look within geographical areas. While there is convergence in income levels across

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[7] (the variable code at Eurostat statistics is tgs00005).

[8] There are no available data on the share of outbound graduates at the regional level.

the regions located in central and eastern Europe, the figures indicate a slight divergence across regions within north western Europe as well as within Southern European economies.

Figure 5 zooms in and looks at convergence in income levels within countries in each area. In north western Europe, most of the countries show convergence across regions within the same country, with it being particularly strong in countries such as Austria and Germany. Conversely, divergence is observed in Denmark and Ireland. In Southern European countries, there is slight divergence across regions, yet there is within-country convergence in Greece, Italy, Portugal, and Spain. By contrast, in Central and Eastern countries there is convergence across regions, but divergence within some countries in this area. Specifically, there is divergence in Bulgaria, Czechia, Croatia, and Poland, whereas Hungary, Romania and Slovakia display regional convergence.

Figure 5 Beta convergence in GDP per capita within countries, 2014-2021.
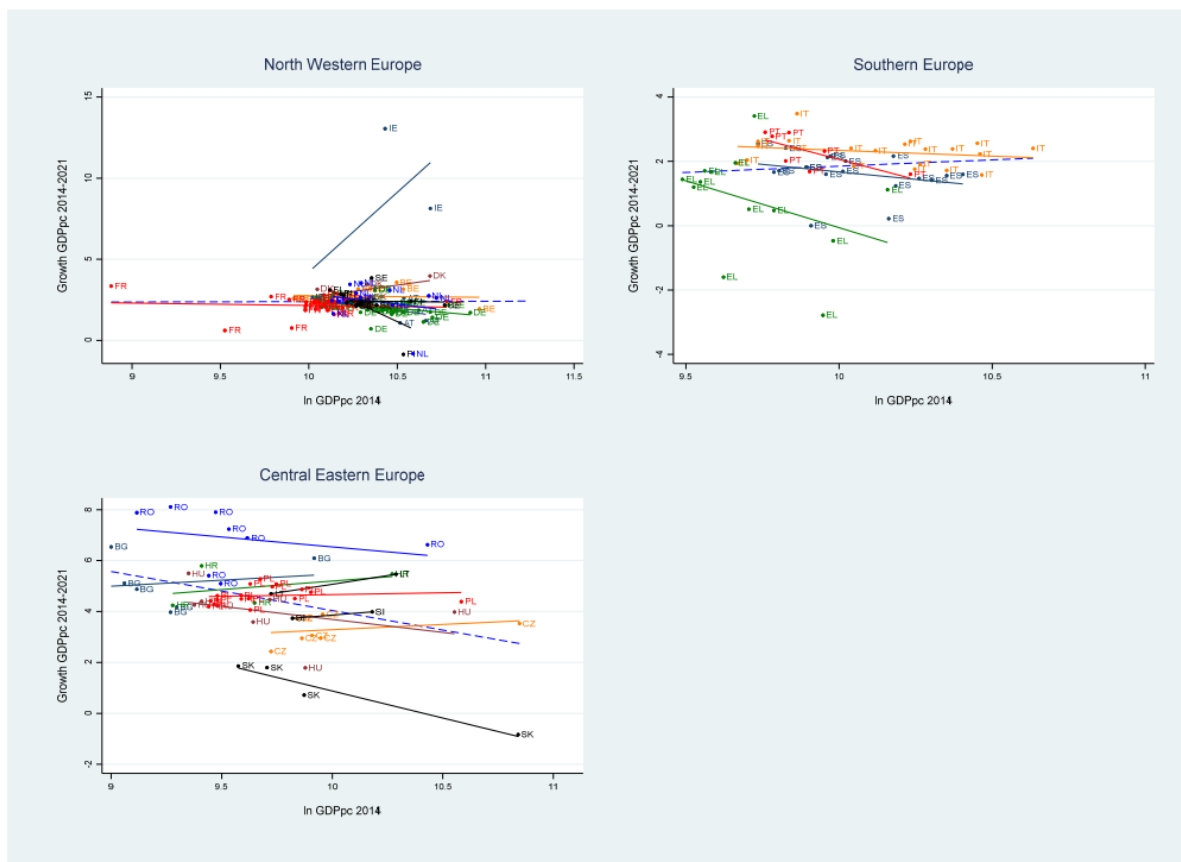
Source: Eurostat, EU-LFS.

Figure 6 shows the correlation between the share of graduates aged 15-64 years old in 2014 and the growth rates of the share of graduates during the period 2014-2021 in 225 regions in Europe. Unlike GDP per capita, the evidence indicates there was convergence in tertiary educated individuals in almost all samples of analysis. The figure shows convergence in the share of graduates across regions in the whole sample of countries as well as within north western, southern and central eastern European countries. There is also convergence across regions within countries, as displayed in Figure 7. Except for Austria, Czechia, and Hungary, all countries show convergence in tertiary education across their regions.

Figure 6 Regional beta convergence in total graduates in teh EU, 2014-2021.
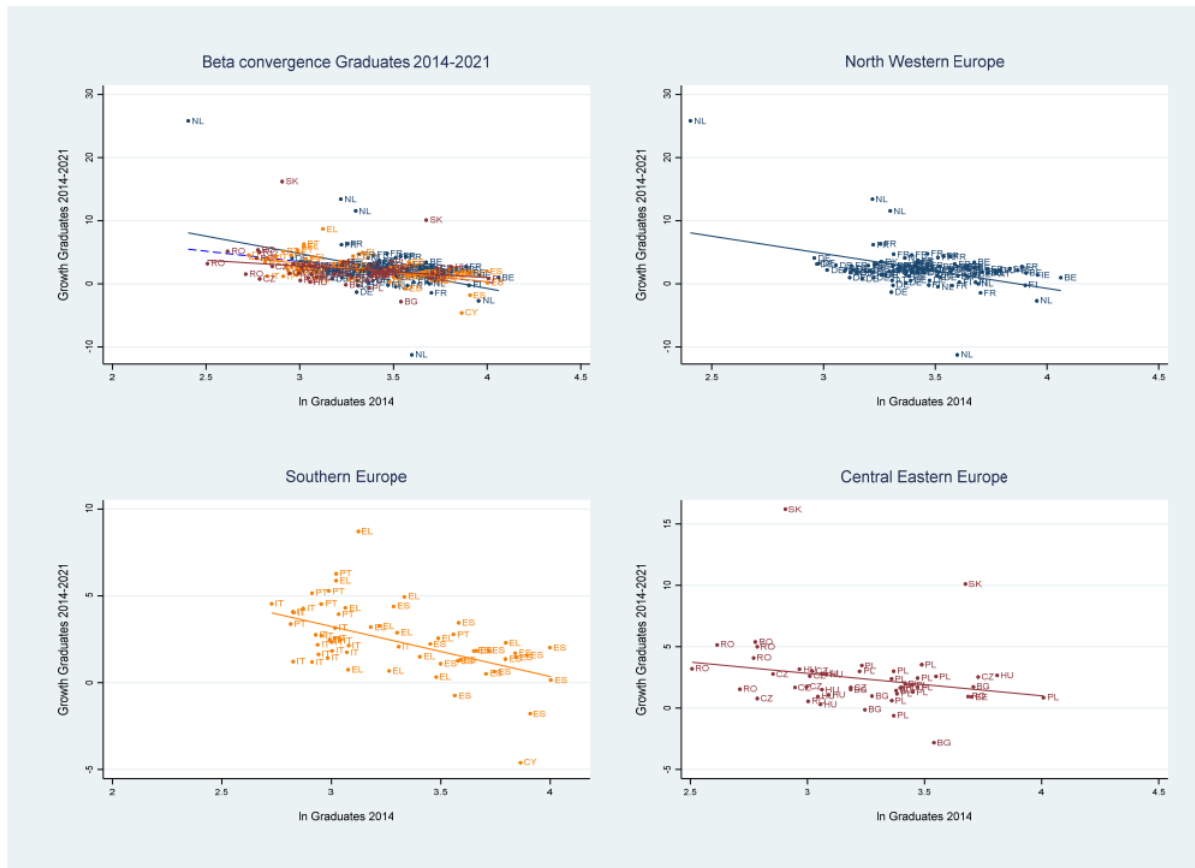
Table 3 displays the estimates of β convergence at the regional level. The dependent variable is the annual average growth rate of regional GDP (PPS per inhabitant) over the period 2014-2021. We estimate β convergence at the regional level in different scenarios: across the full sample of regions, across regions within geographical areas, and across regions within countries.

Columns (1) and (2) display the estimates of β-convergence across 229 regions in the EU. The coefficient of absolute convergence, displayed in column (1), is negative and statistically significant at 1 percent. Poorer regions in 2014 experienced, on average, higher economic growth rates than the richer ones. The rate of convergence across regions (1.4 percent) is slightly lower than that across countries (1.8 percent) for the same period. However, caution should be exercised when comparing the two coefficients as the number of countries differs in the two samples. In column (2) we control for the share of graduates and the conditional convergence coefficient increases to 1.5 percent.

In columns (3) and (4) we include dummies for geographical areas in the set of controls. In this specification the convergence coefficient indicates convergence across regions within geographical areas. Column (3) shows a clear reduction in absolute convergence. The coefficient drops to 0.58 and is not statistically significant at the standard levels. This result suggests that much of the regional convergence in income per capita has been among regions of different geographical areas (e.g., income levels in regions in Central and eastern Europe converging to the income levels of regions in north western Europe). The inclusion of the share of graduates in the set of controls increases the

convergence coefficient from 0.581 to 0.629 and makes the estimate statistically significant at the 10 percent level (column (4)).

Table 3 Regional beta convergence in GDP per capita, 2014-2021

| | Covergence conditional on the share of Graduates | | | | | |
| | Across regions | | Across regions within areas | | Across regions within countries | |
	β	β^*	β	β^*	β	β^*
$lnGDPpc$	-1.433^a	-1.500^a	-0.581	-0.629^c	-0.467^c	-0.671^b
	(0.326)	(0.286)	(0.375)	(0.354)	(0.253)	(0.321)
$\ln Graduates$		0.227		0.195		0.457
		(0.361)		(0.308)		(0.360)
$Constant$	17.138^a	17.057^a	10.075^a	9.920^a	6.827^b	7.408^a
	(3.297)	(3.382)	(3.596)	(3.732)	(2.641)	(2.746)
$Obs.$	229	229	229	229	229	229
R^2	0.111	0.112	0.351	0.352	0.729	0.731
Area dummies	NO	NO	YES	YES	NO	NO
Country dummies	NO	NO	NO	NO	YES	YES

Note: Robust standard deviation error in parenthesis. A, b and c denote statistically significant coefficients at 1, 5 and 10 per cent probabilities, respectively. The dependent variable is the average growth rate of regional gross domestic product (PPS per inhabitant) by NUTS 2 regions (tgs00005 Eurostat) over the period 2014-2021.

Source: Eurostat, EU-LFS.

In columns (5) and (6) we include country dummies. In this specification the convergence coefficient reflects convergence in income levels across regions within a country. There is an even bigger drop in the convergence coefficient (-0.467), though now it is statistically significant at the 10 percent level. Once we control for the share of graduates in column (6), the conditional convergence coefficient increases to -0.671. Thus, the share of individuals with tertiary education increased regional convergence within countries by 0.104 points, which is by no means a negligible increase.

Overall, the results confirm the existence of absolute convergence not only across countries, but also across regions in Europe. The estimate of beta convergence conditional on the share of graduates is higher than the estimate of unconditional convergence in all specifications, suggesting that countries and regions with a higher share of graduates have been able to speed up the process of convergence towards the income levels of their richer counterparts.

Conclusion

This working paper analyses the role of human capital in beta convergence in income levels across countries and regions in the EU. Results show the global financial crisis, and the subsequent sovereign debt crisis were detrimental to convergence in income levels. The beta convergence coefficient was smaller between 2008-2014 than during the aftermath, 2014-2021.

Convergence in income levels also differs depending on the Member States included in the sample, and whether convergence is estimated across countries, across regions or within countries. Cross-country convergence is greater than regional convergence. In both scenarios convergence has mainly been driven by poorer countries and regions in Central and eastern European countries growing faster than their richer peers, generating a process of catching up in income levels. Convergence across regions within countries is also found, but it occurs at a slower pace.

Human capital has played a role in the convergence process. Results indicate that controlling for the share of graduates aged 15-64 years old increases the convergence coefficient in all specifications, suggesting that highly educated individuals have helped the low-income countries and regions to catch-up with the income levels of their richer counterparts.

Most of the convergence process has been driven by the higher growth rates of the countries and regions in Central and eastern Europe. The integration of these countries into German-centered supply chains has been fundamental in allowing them to maintain or even increase the share of manufacturing in their GDP (Pina and Sicari, 2021). The highly skilled workforce in most of these countries might have helped them to take advantage of Foreign direct investment (FDI) and speed up the process of convergence with the richer countries and regions. By contrast, the growth rates in Southern European countries have been modest and the convergence they enjoyed in the 1990s and beginning of the 2000s has slowed down. The investment in human capital, especially in tertiary education, has helped them to speed up convergence. However, additional reforms need to be undertaken in this area to enable these countries to catch up with the income levels of their richer counterparts in North and Central Europe.

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