



Heterogeneous labour market trajectories in the EU: convergence, divergence and stagnation across regions

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Abstract

The scientific objective of this study is to analyse and compare the convergence, divergence, or stagnation of selected regional labour markets indicators in the European Union, employing beta and sigma convergence concepts and the convergence club approach. By analysing seven labour market indicators from the Regional Competitiveness Index, we uncover a complex and heterogeneous landscape of labour market dynamics. Significant beta convergence is observed in three of the seven indicators, while the remaining four display stagnation. However, sigma convergence is not detected in any of the indicators; instead, two show divergence and five exhibit stagnation. Recognizing that these mixed results may stem from the fact that regions belong to distinct “convergence clubs” shaped by path dependency, we separately analyse post-socialist and capitalist regions. The convergence club approach proves useful in interpreting these varied patterns of convergence, divergence and stagnation in EU regional labour markets. Our findings suggest that while certain regions are converging on specific labour market indicators (e.g. gender balance in unemployment, long-term unemployment), others, particularly in terms of overall unemployment rates and labour productivity, are diverging. This underscores the high degree of heterogeneity within EU regional labour markets, driven by structural, institutional and historical factors.

The study highlights that labour market convergence is not an automatic process but one that necessitates strategic, long-term interventions. Policy responses must be tailored and sensitive to the unique circumstances and historical trajectories of each region, aiming not only to reduce immediate disparities but to foster sustainable development that aligns with the overarching goals of economic convergence across the European Union.

JEL Classification P52 · R11 · R23

1 Introduction

Regional inequalities are still among the major challenges in regional science. The centre of attention has been the study of the causes of the convergence or divergence related to conditions of life in different economic areas (Barro 1991; Barro and Sala-i-Martin 1991, 1992; Blanchard and Katz 1992; Durlauf and Johnson 1992; Fischer and Stumpner 2008; Mankiw et al. 1992; Mas et al. 1995). Therefore, the topic of regional economic convergence has generated considerable interest in recent decades. In the European Union, this interest has been enhanced by the deepening and widening of the integration processes and striving for a reduction of regional disparities across EU economies (see, e.g. Cuadrado-Roura and Maroto-Sánchez 2009; Lopez-Bazo et al. 1999; Naveed and Ahmad 2016). As highlighted by Cuadrado-Roura (2001), achieving convergence in real terms—not merely in nominal variables—was identified as a fundamental objective in the Treaty of the European Union. The widely used convergence concepts are based on GDP per capita (see, e.g. Abramovitz 1986; Baumol 1986; Dollar and Wolff 1988; Barro and Sala i Martin 1992; Dollar 1993; Quah 1993, 1996; O’Leary 1997), structural changes (see, for example, Kuznets and Murphy 1966; Dowrick 1989; Dollar 1993; Van Ark 1995; Doyle and O’Leary 1999), sectoral and technological gaps and labour productivity (Melachroinos and Spence 1999; Filippetti and Peyrache 2013). Most studies have tested convergence separately between countries, regions and industries and have reached different conclusions (Naveed and Ahmad 2016). Bernard and Jones (1996) observed significant convergence at the aggregate (country) level. In contrast, Sondermann (2014) reported a lack of convergence at the same aggregate level yet identified robust evidence of convergence at the disaggregate level within specific sectors. Since the seminal studies on growth trajectories between rich and poor regional economies (see Baumol 1986; Barro and Sala-i-Martin 1991, 1992; Barro et al. 1991; Mankiw et al. 1992), convergence has become a relevant topic for regional science.

There are two approaches that are most commonly applied to study the convergence among regions, the so-called beta (β) and sigma (σ) convergence.

Sigma convergence quantifies the dispersion of income per capita or a similar variable at different moments along time, and convergence occurs if the dispersion decreases over time. It can be measured as the standard deviation of the logarithm of income per capita in different economies. This kind of analysis is usually conducted as an exploratory or preliminary analysis in the study of convergence (Dowrick and Nguyen 1989; Baumol 1986; Barro and Sala-i-Martin 1992; Mas et al. 1995).

The concept of beta convergence was introduced by Baumol (1986), and he assessed the relation between the growth rates of a particular economic variable during a period of time with the initial level of that variable in a set of territories (e.g. regions). Two types of beta convergence concepts are commonly used in the literature. The first type of beta convergence is based on the idea that poorer economies will grow faster than richer ones, regardless of whether they have

a common steady or not, until they have reached the same per capita income level. Poorer economies will 'catch up' richer economies over time. This type of convergence is known as absolute convergence, in the sense that all economies would converge to the same level of per capita income in the long run (see, e.g. Barro and Sala-i-Martin 1992; Mas et al. 1995; Magalhães et al. 2005; Dapena et al. 2016). The second type of beta convergence is based on the idea that every economy moves towards its own steady state under certain given conditions, and thus, different steady states are captured. This type of convergence is known as conditional convergence (see, e.g. Barro and Sala-i-Martin 1992; Magalhães et al. 2005). The difference between the two types of convergence can be traced to the fact that while the first, the absolute, would consider all economies converging to one unique steady-state, in the case of the second one (conditional), the possibility exists for different steady states for each economy (Obstfeld and Rogoff 1996; Magalhães et al. 2005).

Labour markets play a crucial role in the convergence and inclusive growth of regions. The study by Borsekova et al. (2024) revealed that the labour market efficiency pillar from Regional Competitiveness Index has the greatest impact on regional competitiveness. Each labour market possesses distinct regional features, shaped by the unique combination of labour composition, economic structures, cultural background, historical context and institutional frameworks that characterize each region (Storper 2013). Furthermore, these regional labour markets are influenced by local educational systems, industry presence and government policies, which further differentiate them (Rodrik 2007; Porter 1998). As such, understanding these complex and varied elements is essential for grasping how labour markets contribute to the broader dynamics of regional development and economic convergence. Flexible labour markets allow workers to move from declining firms and enable companies and the economy as a whole to respond to external shocks (Mortensen and Pissarides 1994). Consequently, the effectiveness of labour markets is a fundamental pillar of both global and regional competitiveness. This efficiency is not only crucial for driving economic performance but also serves as a key factor in determining the competitive edge of different regions and countries on the international stage. If measured, it generates a set of indicators that allow for an in-depth analysis of labour markets in regions of the European Union (Schwab and Porter 2007). Research consistently shows that efficient and productive human resources are crucial for regional competitiveness and have a significant impact on whether EU regions converge or diverge economically (Borsekova and Korony 2023; Clark and Bailey 2018; Dijkstra et al. 2011; Krugman 1994; McCann 2020). The capability and productivity of the workforce determine the economic vitality of regions, influencing both growth and the ability to respond to economic challenges. Regions with highly skilled and adaptable workforces are more likely to experience economic convergence, while those with less developed human capital may face stagnation or divergence, underscoring the importance of investing in education and training to enhance regional competitiveness (Moretti 2012; Florida 2014).

Several studies have examined the convergence of selected labour market indicators. Perugini and Signorelli (2004) analysed employment convergence at the national and regional levels for EU countries using three indicators: total

employment rate, female employment rate and older worker employment rates. The results of their study revealed a national convergence for all employment rates. Additionally, their study showed that the diverging trend for the total employment rate started in 1999 for the new EU member states, including Central European countries. The research conducted by Monfort et al. (2018) delved into the convergence of income inequality, absolute redistribution and unemployment rates. Their findings reveal that the economic integration process in Europe has not led to substantial convergence regarding unemployment and inequality among EU member states. This suggests that despite the theoretical benefits of economic integration, such as increased market efficiencies and resource allocation, practical outcomes like equitable income distribution and uniform employment levels across different regions remain elusive. These disparities highlight the challenges in harmonizing economic policies and conditions across diverse economic landscapes, necessitating targeted interventions to address these divergences (Acemoglu and Robinson 2012; Piketty 2014). Monfort et al. (2018) also reported a diversity of clubs despite the expectation that after years of EU integration, countries would converge into a single cluster. This can also be interpreted in a way that economic integration did not lead to real economic convergence, which is consistent with the findings of the study by Obadic et al. (2023) oriented towards convergence of labour market institutions in the EU. The results of their study suggest no convergence in labour market institutions between EU member states. The main reason is substantial differences between the labour market institutions across the EU that are changing and integrating too slowly to converge. Another study by Estrada et al. (2013) explored the patterns of convergence and divergence in various economic metrics such as unemployment rates, inflation, relative prices and account balances within Eurozone countries. Their findings indicated that during the initial nine years of the Eurozone's existence, there was significant convergence in unemployment rates among the member states. However, this trend of convergence was disrupted and ultimately reversed by the financial crisis. This suggests that while economic integration can initially reduce disparities, external economic shocks, such as the financial crisis, have the potential to exacerbate existing inequalities, challenging the stability and uniformity of economic convergence across the Eurozone (Baldwin and Wyplosz 2019; Crafts and Toniolo 1996). Furthermore, Dvoroková (2014) analysed the impact of the financial crisis on real convergence among the EU member states by applying beta and sigma convergence. Her study revealed the beta convergence between the EU Member States in the 2001–2012 period and confirmed that the process of economic convergence has been substantially influenced by the financial crisis. She also tested and verified the hypothesis that the approach of beta convergence and the concept of sigma convergence lead to a different result.

Young et al. (2008, p.1084) argued that although “the literature’s stress on β -convergence, economists have acknowledged that it is not a sufficient condition for σ -convergence” (see also Barro and Sala-i-Martin 1992). Therefore, the results of their study demonstrated that “ β -convergence is a necessary but not a sufficient condition for σ -convergence” (Young et al. 2008, p.1092).

These are indeed interesting insights that inspire us to bring comprehensive beta and sigma convergence analysis of labour market across the EU (as defined by the

Regional Competitiveness Index, for more information, see Annoni and Kozovska 2010; Annoni and Dijkstra 2019). As is evident from the literature, there are only partial indicators of labour market covered by empirical studies and we miss the “whole” picture of convergence or divergence of labour market in Europe. The motivation behind this paper is to provide new insights into convergence studies through robust analysis using a wider spectrum of labour market indicators.

Therefore, the scientific objective of this study is to analyse and compare the convergence, divergence or stagnation of selected regional labour markets indicators in the European Union, employing both convergence concepts and applying the convergence club approach to selected labour market indicators. This objective builds upon the findings of Borsekova et al. (2024), who analysed key performance indicators (KPIs) of regional competitiveness. Their study indicates that the labour market efficiency pillar has the most impact on regional competitiveness. Additionally, three out of the five identified KPIs are belonging to this pillar. In the present paper, we aim to offer a more in-depth analysis of labour market indicators, focusing exclusively on them. With this targeted focus, we aim to offer insights that support the development of tailored, place-sensitive policies designed to foster more resilient labour markets.

The convergence club approach, rooted in economic growth theory (Solow 1956), extends beyond traditional frameworks such as β -convergence and σ -convergence. It posits that regions do not necessarily converge to a single global equilibrium but instead form “convergence clubs,” wherein groups of economies with similar characteristics converge towards their own distinct steady states. This approach is particularly valuable in analysing heterogeneous regions or economies, where differences in initial conditions, structural characteristics and institutional settings may result in distinct growth trajectories (Bartkowska and Riedl 2012; Durlauf and Johnson 1995; Greasley and Madsen 2016; Kremer et al. 2013; Phillips and Sul 2007). In this study, we employ a priori (exogenous) criteria to define the clubs, such as geographical proximity or similar initial conditions, reflecting the path dependency of post-socialist and capitalist regions (for more information, see Fischer and LeSage 2015) or regions with capital cities. We draw on the argument of Durlauf and Johnson (1995), who suggest that regions with similar initial conditions are more likely to follow similar developmental trajectories, while regions with divergent starting points are more likely to form distinct convergence clubs. However, we must emphasize that our primary goal is to test the convergence, divergence, or stagnation of selected labour market indicators by regressing the growth rate of a selected indicators on their initial value. This approach is grounded in the original concept of absolute convergence. The remainder of the paper is organized as follows: Section 2 provides details on the data and variables used in the study. Section 3 outlines the methods and empirical strategy. Section 4 presents the results, while Sect. 5 is dedicated to the discussion. Finally, Sect. 6 summarizes the key findings and offers concluding remarks.

2 Data and variables

For achievement of our objectives, we used all seven Labour Market Efficiency (LME) indicators from the Regional Competitiveness Index¹ (RCI) (for more information, see Annoni and Kozovska 2010; Annoni and Dijkstra 2019) that are common for both investigated periods: employment rate, long-term unemployment, unemployment rate, labour productivity, gender balance unemployment, gender balance employment and female unemployment. By “efficiency”, we are not referring to effectiveness; rather, we are using it as the full title of one of the RCI pillars, specifically named “Labour Market Efficiency”. Two additional indicators of LME were added later, and they are not included in the first RCI index (namely NEET and Involuntary part-time/temporary employment), and therefore, these are not included in our research. The first analysed reference period is as of 2010, and the second analysed reference period is 2019 which refers to first (2010) and latest (2019) versions of Regional Competitiveness Index from which we used the data. The labour market indicators used in our data sample, including their attributes, are presented in the following table. Given that the reference years for data collection differ for the two periods under investigation due to the methodology employed (for more details, see Annoni and Kozovska 2010; Annoni and Dijkstra 2019), using all of them might introduce confusion. Therefore, we will use further the RCI reference years associated with the RCI volumes, which not only enhances clarity but also ensures comparability. This approach will facilitate the use of the entire RCI dataset for policy purposes.

We categorized regions by fixed a categorical variable, based on path dependency corresponding to convergence club approach. This variable is based on whether the region has a history of capitalism or post-socialism. Regarding capitalist regions and post-socialist regions, the choice of this fixed categorical factor has its origins in a debate related to the problem of convergence between capitalist and post-socialist regions and countries, with reference to the character of market mechanisms, the functioning of labour market, the power of state systems and their mutual interplay (Hirt 2013). While in capitalism the labour market is free and characterized by a high level of competition, in socialism the labour market can be described as deformed or a quasi-labour market due to its interventions in terms of providing jobs for all and, along with central planning, to reach equilibrium on all markets (see, e.g. Šulc 2004; Coufalová and Žídek 2019). The socio-economic transition was closely related to the regional level (Hirt 2013; Malý et al. 2020; Soulsby and Clark 2007) and inequalities, the root of the regional problems, are likely to continue to increase (Rodríguez-Pose 2018), since differences in regional productivity are a source of the geography of discontent (McCann 2020). The selection of capitalist and post-socialist groups of regions in the EU has its origins in the path dependence argument (see, e.g. Stark 1991; Martin and Sunley 2006, 2006) and the thesis that fundamental elements of an era may persist from a previous regime (Sassen 2006). The collapse

¹ We are aware of that the appropriateness of some of the LME indicators might be questioned. Labour productivity is of course connected to the labour market's efficiency, but also to e.g. education.

of the Iron Curtain and the ensuing political, social and economic transformations have profoundly impacted the functioning of regional labour markets (Borsekova et al. 2021; Borsekova and Korony 2023; Hirt 2013; Malý et al. 2020; Soulsby and Clark 2007). The deployment of the development phase as a fixed categorical variable allows us to pay more attention to the economic-historical nature of the regions and to investigate the level of convergence, divergence, or stagnation among their labour markets over time.

Our dataset comprises data from 258 regions classified at the NUTS2 level, spanning 25 European Union (EU) countries. The EU NUTS classification system offers a standardized hierarchical structure of regions. Specifically, the NUTS 2 level delineates the regions targeted for the implementation of regional policies.

Before analyses, we made some necessary adjustments of data (aggregations and exclusions) because of incompatibility of several regions between initial period 2010 and final period 2019 (for more information, see Annoni and Kozovska 2010; Annoni and Dijkstra 2019). The details on data and regions are given in Online Annex 1.²

For the purpose of the present paper, we have also calculated differences of indicators' values: indicator in 2019 RCI volume and indicator in 2010 RCI volume. In such a way, we obtained changes of corresponding indicators during the investigated periods with three possible results: decrease (difference is negative), stagnation (zero difference) and increase—growth (difference is positive). Since we have seven LME indicators, there are also seven changes of them between investigated periods. The results are made separately for seven original LME indicators and for their changes between 2010 and 2019 RCI volumes.

3 Methods and empirical strategy

The scientific aim of this study is to analyse and compare the convergence, divergence, or stagnation of selected regional labour markets indicators in the European Union during the investigated period. To achieve this, we employ both the traditional concepts of beta and sigma convergence for each of the applied indicators one-by-one in an absolute convergence regression setting to identify convergence clubs in a growth-rate-initial-condition-diagram and based on regressions and correlations.

Our empirical approach is structured into two phases: In the first phase, we analyse sigma and beta convergence for all EU regions collectively. This initial analysis provides a broad overview of the convergence trends and allows for an assessment of general patterns across the European Union. However, given the heterogeneous nature of EU regions, a more granular analysis is warranted to account for potential differences in convergence dynamics (see Sect. 4.1).

² Due to changes in NUTS2 regional boundaries and differences in the classification of NUTS2 regions over time, we were unable to accurately classify the German regions that were part of East Germany as post-socialist regions. Consequently, in our study, these regions are classified as capitalist regions.

In the second phase, we apply the club convergence approach by dividing the regions into two groups: capitalist and post-socialist regions. This categorization is based on a fixed categorical variable that reflects the path dependency of each region's socio-economic and political development. By employing this convergence club approach, we aim to uncover distinct convergence patterns within these groups and provide a more nuanced understanding of regional labour market dynamics (see Sect. 4.2).

Another objective of this study is to estimate the speed of convergence for these regions in selected labour market indicators, particularly in terms of sigma and beta convergence. In regions exhibiting stagnation, we also seek to examine the distribution of regions within quadrants of scatter plots, based on the incremental changes from the initial values of the labour market indicators. Figure 1 outlines the empirical strategy for our study, detailing the objectives, methods and results involved in analysing and comparing patterns of convergence, divergence, or stagnation in regional labour markets across the European Union.

For measurement of dependence of one continuous variable, most often the well-known classical Pearson correlation coefficient is used as it measures linear relationship between two variables and as it is sensitive to outliers, which are often present in empirical data including EU region indicators, we instead chose Spearman rank correlation coefficient. It is designated for the test of monotonic relationships (positive or negative). The positive value of the coefficient indicates mainly larger values in both variables simultaneously and also smaller values in both variables. In case of negative values, the values in the first variable are more often larger than the values in the second variable.

To compute the Spearman rank correlation coefficient r_s , we first order the X observations from least to greatest and let R_i denote the rank of X_i , $i=1, \dots, n$. Similarly, we separately order the Y observations from least to greatest and let S_i denote the rank of Y_i , $i=1, \dots, n$.

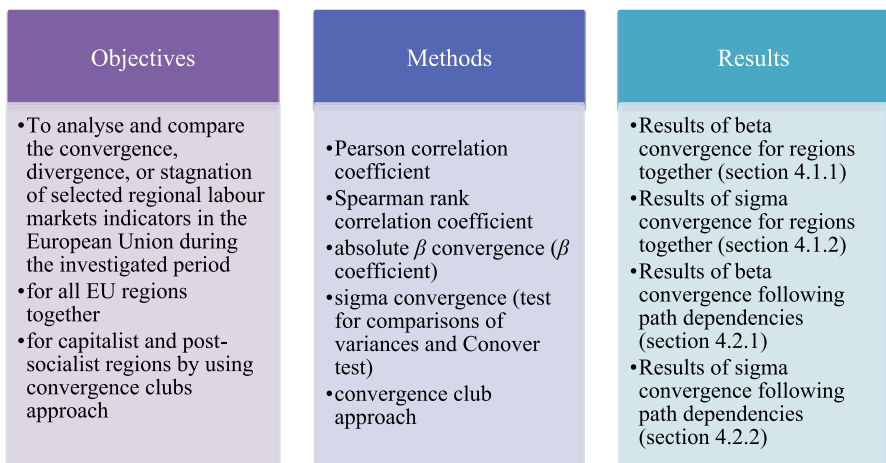


Fig. 1 Empirical strategy

Let the difference of the corresponding ranks be $D_i=R_i-S_i$, then the Spearman correlation coefficient is defined by the formula (Hollander et al. 2014):

$$r_s = 1 - \frac{6 \sum_{i=1}^n D_i^2}{n^3 - n} \tag{1}$$

For test of significance of Spearman correlation coefficient, we used the most accurate available tables (Ramsey 1989).

For the test of absolute β convergence, we used a simple equation for two groups of observations at the beginning and at the end of the time period (Monfort 2020):

$$\frac{1}{T} \ln \left(\frac{y_T}{y_0} \right) = \alpha + \beta \cdot \ln y_0 + e_i \tag{2}$$

where Y_T is the indicator at the end time point, Y_0 is the indicator at the initial time point,

e_i is an error term.

The dependent variable is the ‘average’ annual growth rate of the indicator between the initial year and the final year of observation T for each region (Marelli and Parisi 2019). In this case, we used the reference years for all indicators (see Table 1), so the initial period is 2008 and the last period is 2016³ (or 2007 and 2015 for labour productivity), $T=8$. If the linear regression coefficient $\beta < 0$, then the regions converge from the point of the given indicator during the analysis time interval; if $\beta > 0$, then the regions diverge.

Coefficient β is defined by the formula:

$$\beta = - \frac{(1 - e^{-b \cdot T})}{T} \tag{3}$$

where b is the ‘speed of convergence’.

$$b = - \frac{\ln(1 + \beta \cdot T)}{T} \tag{4}$$

The so-called half-life parameter is:

$$T_{1/2} = \frac{\ln(0.5)}{\ln(1 + \beta)} \tag{5}$$

which is the number of years necessary to reach halfway between the initial level and steady-state level. For sigma convergence, we used a robust test for comparisons of variances. To the best of our knowledge, we have not found any paper on testing sigma convergence in contrast to papers about beta convergence, which are full of various regression equations. Maybe this is caused by the fact that most of the papers use the coefficient of variation (ratio of standard deviation to the arithmetic

³ Count as a mean of time series value.

Table 1 Common labour market efficiency indicators for both investigated periods

RCI reference year	Indicator	Unit of measurement and description	Reference years for data collection	Source
2019 2010	Employment rate (excluding agriculture)	Persons employed aged 15–64 (excl. agriculture) as % of population same age cohort	Average 2015–2017 2008	Eurostat Regional Labour Force Statistics (LFS)
2019 2010	Long-term unemployment	Percentage of labour force unemployed for 12 months or more	Average 2015–2017 2008	Eurostat Regional LFS
2019 2010	Unemployment rate	% of active population	Average 2015–2017 2008	Eurostat Regional LFS
2019 2010	Labour productivity	GDP(ml euro PPS)/hours worked (thousand)—EU28 = 100 GDP/person employed in industry and service (Euros), Index, EU27 = 100	2015 2007	Eurostat and DG REGIO
2019 2010	Gender balance unemployment	Distance to equilibrium: absolute value of (rate women—rate men) % Difference between female and male unemployed	Average 2015–2017 2008	Eurostat and DG REGIO
2019 2010	Gender balance employment	Distance to equilibrium: absolute value of (rate women—rate men) % difference between female and male employed	Average 2015–2017 2008	Eurostat and DG REGIO;
2019 2010	Female unemployment	% of female unemployed	Average 2015–2017 2008	Eurostat Regional LFS

Source: Annoni and Kozovska (2010), Annoni and Dijkstra (2019)

All LME indicators have got relative per cent unit (e.g. in case of labour productivity the value of region equal to 120 means that its value is 20 per cent above EU average)

mean) as a measure of dispersion, but there is no available test for comparison of variation coefficients. It is not enough to observe that the variance in the second period is larger or smaller than the variance in the initial period. The classic *F* test is sensitive to outliers. That is why we used the Conover squared ranks test (Conover 1999). It is not a well-known test, so we present it more closely. The Conover test is a nonparametric test of homogeneity (equal variance) based on ranks. The test does not assume that all populations are normally distributed.

Suppose *k* groups that each has a normal distribution with possibly different means and standard deviations $\sigma_1, \sigma_2, \dots, \sigma_k$. Let n_1, n_2, \dots, n_k denote the number of subjects in each group, Y_{ij} denote the response values, and *N* denote the total sample size of all groups. The test assumes that the data are obtained by taking a simple random sample from each of the *K* populations. The formula for the calculation of the Conover test is as follows.

$$T = \frac{1}{D^2} \left(\sum_{i=1}^k \frac{S_i^2}{n_i} - n\bar{S}^2 \right) \tag{6}$$

where

$$Z_{ij} = |Y_{ij} - \bar{Y}_i| \tag{7}$$

$$R_{ij} = \text{rank}(Z_{ij}) \tag{8}$$

$$S_i = \sum_{j=1}^{n_i} R_{ij}^2 \tag{9}$$

$$\bar{S} = \frac{1}{N} \sum_{i=1}^k S_i \tag{10}$$

$$D^2 = \frac{1}{N-1} \left[\sum_{i=1}^k \sum_{j=1}^{n_i} R_{ij}^4 - N\bar{S}^2 \right] \tag{11}$$

If the assumptions are met, the distribution of this test statistic approximately follows the chi-squared distribution with degrees of freedom *k*−1.

4 Results

The results section is divided into two main subsections corresponding to two phases of our empirical strategy.

4.1 Results of beta and sigma convergence for European regions together

In this section, we will analyse the sigma and beta convergence of all EU regions together.

4.1.1 Results of beta convergence for all regions together

For the nonparametric test of beta convergence, we used Spearman correlation coefficients (SCC) between LME indicators in the initial time point reported in the RCI 2010 index and their corresponding average annual growth rates during the investigated period. Table 2 presents results for all EU regions together (column 2). Critical values of Spearman coefficients (see Ramsey 1989) for two-sided probabilities are 0.122 ($p=0.05$), 0.160 ($p=0.01$) and 0.204 ($p=0.001$). The results of the beta convergence using the Spearman correlation test can be interpreted as follows. Absolute beta convergence of the regions was found for three LME indicators, namely long-term unemployment ($p<0.001$), unemployment rate ($p<0.05$) and gender balance unemployment ($p<0.001$). Therefore, the EU regions converge in the field of these three LME indicators mentioned above.

Stagnation of the EU regions can be observed in the remaining four indicators, namely employment rate, labour productivity, gender balance employment and female unemployment. For further information about beta convergences parameters, we applied linear regression models based on formula (2). The results are presented in Table 2. In columns 3–5 are estimates of constant terms (α), their standard errors (SE), and significance (p). Similarly, in columns 6–8 are estimates of beta coefficients and the corresponding statistics. Column b (%) contains the values of the corresponding speeds of convergence. In the last right column are the values of the half-life parameter in years.

Table 2 Test of beta convergence of EU NUTS 2 regions together by Spearman correlations and by linear regressions

Indicator	SCC	α (SE)	p	β (SE)	p	b (%)	$T_{1/2}$
Employment rate	-0.118	0.037 (0.018)	0.035	-0.00889 (0.004)	0.036	0.92	77.6
Long-term unemployment	-0.373***	0.078 (0.008)	0	-0.04542 (0.007)	0	5.64	14.9
Unemployment rate	-0.152*	0.063 (0.014)	0	-0.02288 (0.008)	0.003	2.53	30
Labour productivity	0.008	0.008 (0.019)	0.662	-0.00183 (0.004)	0.668	0.18	377.7
Gender balance unemployment	-0.438***	-0.014 (0.007)	0.047	-0.05631 (0.006)	0	7.48	12
Gender balance employment	-0.074	-0.031 (0.013)	0.02	-0.00387 (0.005)	0.456	0.39	178.9
Female unemployment	-0.104	0.036 (0.013)	0.007	-0.01249 (0.06)	0.056	1.32	55.1

For Spearman correlation coefficients (SCCs): * $p<0.05$ (least significant result); ** $p<0.01$ (more significant result); *** $p<0.001$ (the most significant result); α —constant term, SE=standard error of estimate, p —significance, β —beta convergence coefficient, b —speed of convergence (in %), $T_{1/2}$ —half-life (in years)

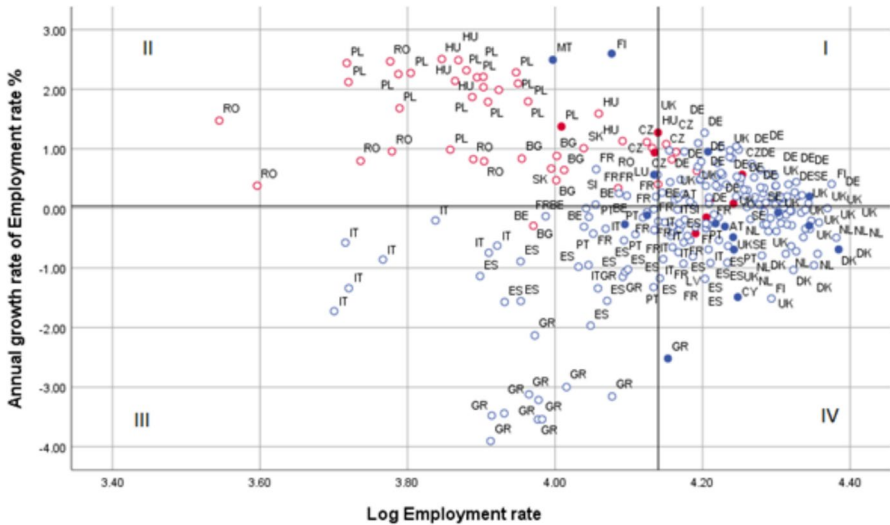


Fig. 2 Scatterplot of the average annual growth rate of the employment rate (2010–2019) versus the employment rate in 2010. *Notes* Full blue circles—capitalist regions with capital, empty blue circles—other capitalist regions, full red circles—post-socialist regions with capital, and empty red circles—other post-socialist regions (color figure online)

The results of the beta convergence using linear regressions can be interpreted as follows:

The regions in all LME indicators have a negative beta coefficient ($\beta < 0$), but it is not significant for all indicators. Three significant cases of beta convergence of regions are in the following LME indicators: long-term unemployment with speed of convergence 5.64% per year and half-life 14.9 years; unemployment rate with speed of convergence 2.53% per year and half-life = 30.0 years; and gender balance unemployment with highest speed of convergence 7.48% per year and shortest half-life 12 years.

We can assume that the situation in the regions in the field of these three indicators should be improved in a foreseeable time. The coefficients of determination are relatively small. It is caused by relatively large spreads of values around the corresponding regression lines. In case of employment rate and of female unemployment, there are no significant trends by nonparametric test but the regression beta coefficients are slightly significant ($p = 0.036$ and $p = 0.056$). Nevertheless, their half-life parameters for regional convergence are too long (77.6 and 55.1 years) from a practical point of view.

Indicators without significant regional trends (employment rate, labour productivity, gender balance employment and female unemployment) have relatively small speeds of convergence and also very long half-life and can therefore be labelled as stagnating. These are the indicators of labour market where greater efforts must be made so that the regions begin to converge more significantly. Therefore, in the next part of this section, we will pay more attention to them in order to bring a deeper insight into the situation in the regions.

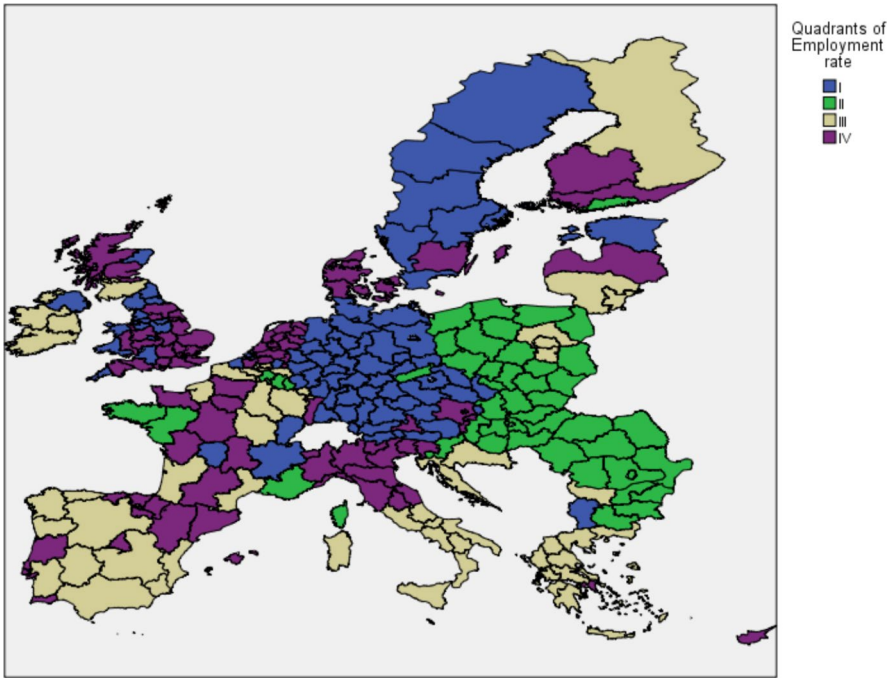


Fig. 3 Map of employment rate quadrants. Note blue—winning regions, green—catching-up regions, sand—losing regions, violet—falling-behind regions (color figure online)

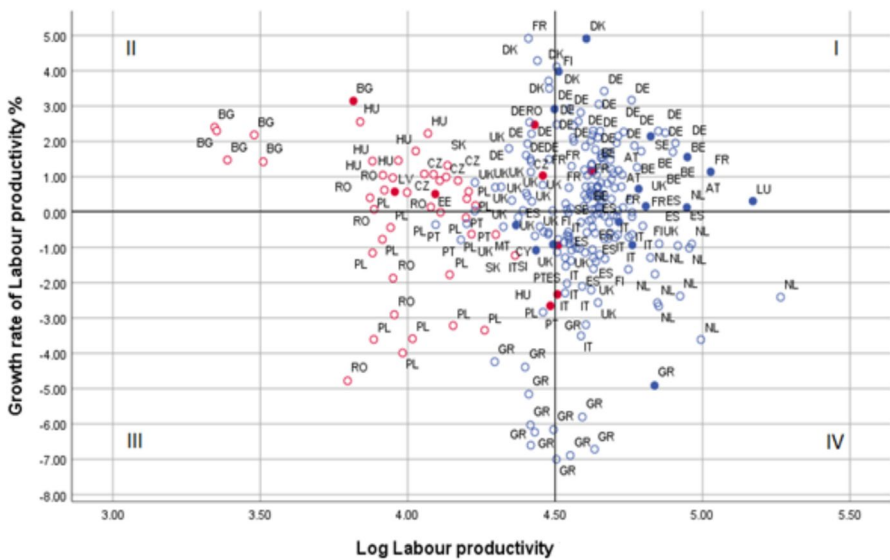


Fig. 4 Scatterplot of the average annual growth rate of labour productivity (2010–2019) versus labour productivity in 2010. Notes full blue circles—capitalist regions with capital, empty blue circles—other capitalist regions, full red circles—post-socialist regions with capital, and empty red circles—other post-socialist regions (color figure online)

Figures 2 and 4 display scatterplots of regions for two of the stagnating indicators. For these two indicators, employment rate in Fig. 3 and labour productivity in Fig. 5 there is the classical interpretation; the higher the value of the indicator, the better is the region (Rodríguez-Pose et al. 2005; Monfort 2020). For better interpretation of these results, we will also use maps associated with these Figs. 3 and 5 that allow us to identify possible convergence clubs and so take mitigation measures to eliminate or reverse negative situation in losing and falling-behind regions.

By division of the figures into four quadrants, we can observe four groups of regions. In Fig. 2, in quadrant I, so-called winning regions are located and this quadrant corresponds to regions with initial values of employment rate and its growth rate above average. We can observe on the map in Fig. 3 that most of the regions located in quadrant I are capitalist regions, but also several post-socialist regions, mainly those with capital city (e.g. from Czech Republic, Estonia, Slovakia). In quadrant II, catching-up regions are located with low starting values of employment rate, but with an above-average annual growth rate. In this quadrant are clustered mainly post-socialist regions (including capital of Poland), but also the capital of Malta, Finland, and several regions in France. Quadrant III locates losing regions with initial value of employment rate and growth rate below average.

As the map in Fig. 3 shows, this quadrant includes mainly peripheral regions and coastal regions. Surprisingly, this quadrant also includes two regions with capital cities from capitalist countries, namely Portugal and Italy. Quadrant IV includes

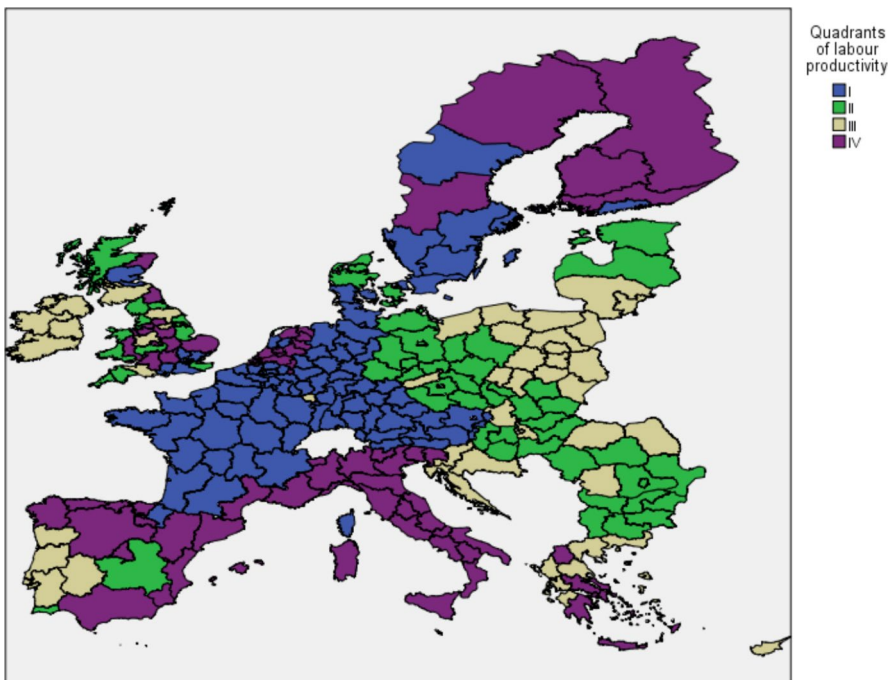


Fig. 5 Map of labour productivity quadrants. *Note* blue—winning regions, green—catching-up regions, sand—losing regions, violet—falling-behind regions (color figure online)

falling-behind regions with initial value of the employment rate above average and growth rate below average. Interestingly, this quadrant includes only regions from capitalist countries, with the exception of the two capital regions of Slovenia and Latvia.

Similarly, in Fig. 4, quadrant I contains the so-called winning regions, and this quadrant corresponds to regions with initial values of labour productivity and its growth rate above average. In this quadrant are solely located capitalist regions with the only exception of one post-socialist region, the region with capital city of Slovakia.

The map in Fig. 5 provides a clearer interpretation of the results. Quadrant II contains catching-up regions with low starting values of labour productivity, but with an above-average annual growth rate. In case of labour productivity, this quadrant includes the mixture of capitalist and post-socialist regions, including several post-socialist regions with capital cities (Bulgaria, Czech Republic, Estonia and Latvia). Quadrant III locates losing regions with initial value of labour productivity and growth rate below average. As visible in the map in Fig. 7, this quadrant includes mainly regions in peripheries, both in capitalist and post-socialist countries. Quadrant IV includes regions falling behind with initial value of labour productivity above average and growth rate below average. Similarly, as in the previous case, this quadrant includes mainly regions from capitalist countries with the exception of capital region of Slovenia. The map of the quadrants of labour productivity shown in Fig. 5 uncovered interesting pattern of regions in quadrants I and IV clustering regions with labour productivity above average. This cluster is relatively homogeneous as it includes a large group of capitalist regions, the exception being on post-socialist region with capital city in Slovakia and Slovenia.

Several studies showed that external economic shocks such as the financial crisis often exacerbate existing inequalities, thereby challenging the stability and uniformity of economic convergence across the EU (Baldwin and Wyplosz 2019; Crafts and Toniolo 1996). Dvoroková (2014) further demonstrated the significant impact of the financial crisis on real convergence among EU member states to reveal that the financial crisis substantially influenced the convergence process during the 2001–2012 period. Considering Greece's severe financial crisis during the investigated period, we conducted additional analysis of EU NUTS 2 regions, both including and excluding 13 NUTS 2 Greek regions. The results, detailed in the Online Annex 2, show that Greek regions negatively influence convergence by increasing the significance (lowering p-values) in most labour market efficiency indicators. Notably, convergence is stronger without Greek regions, except in labour productivity and gender-balanced employment, where the results remain significant regardless of their inclusion. These findings highlight how Greek regions weaken the overall convergence of EU NUTS 2 regions, underscoring the importance of addressing region-specific economic shocks to achieve sustainable economic integration.

Table 3 Test of sigma convergence of all regions together using the Conover test

Variable	Variance 2019	Variance 2010	<i>p</i>
Log employment rate	0.032	0.027	0.467
Log long-term unemployment	0.721	0.656	0.118
Log unemployment rate	0.364***	0.233	0.001
Log labour productivity	0.117***	0.092	0.001
Log gender balance unemployment	1.035	1.215	0.217
Log gender balance employment	0.320	0.232	0.057
Log female unemployment	0.424**	0.288	0.005

*(Significant)— $p < 0.01$, ***(very significant)— $p < 0.001$, for the rest— $p < 0.05$ (not significant result) without specific mark

Table 4 Synthesis of results of both β and σ convergences

Indicator/Type of convergence	β convergence	σ convergence
Employment rate	Stagnation	Stagnation
Long-term unemployment	Convergence***	Stagnation
Unemployment rate	Convergence*	Divergence***
Labour productivity	Stagnation	Divergence***
Gender balance unemployment	Convergence***	Stagnation
Gender balance employment	Stagnation	Stagnation
Female unemployment	Stagnation	Divergence**

*Least significant result; **more significant result; ***the most significant result

4.1.2 Results of sigma convergence for EU regions together

Another approach to convergence is based on dispersion measures, which consists of variances in two consecutive periods. Variances or variation coefficients are usually used. We chose variances because they can be tested by several tests, in contrast to variation coefficients for which a test is not available. In Table 3 are the results of the nonparametric Conover test, which tests the equality of indicator variances for two periods tested.

We can see that the equality of variances is rejected in the case of three indicators: unemployment rate, labour productivity and female unemployment. Needless to say, these results are not desirable as in all three indicators there is a divergence of regions while their variances in 2019 are significantly larger than variances in 2010. For other indicators, there is stagnation in the development of regions. The case of the gender balance employment indicator is uncertain; its other parametric variance tests are slightly significant.

If we take all selected EU NUTS 2 regions together, then significant absolute beta convergence was found in the case of three LME indicators: long-term unemployment, unemployment rate and gender balance unemployment. From the viewpoint of their sigma convergence, only opposite cases of significant divergence were found in unemployment rate, labour productivity and female unemployment.

Synthesis and comparison of results for both β and σ convergences are presented in Table 4.

For employment rate, both β -convergence and σ -convergence indicate stagnation, meaning that no significant convergence or divergence is observed in the employment rate across EU regions during the study period. This suggests that regions with differing initial employment rates did not experience significant changes in their relative positions over time. For long-term unemployment results show strong evidence of β -convergence, but stagnation in σ -convergence. This means that while there is a tendency for regions with higher long-term unemployment rates to decrease faster than those with lower rates (β -convergence), the overall dispersion or variability across regions remains constant (σ -convergence). Thus, the long-term unemployment rate may have improved in relative terms, but it has not resulted in uniform progress across regions. For unemployment rate, the β -convergence suggests weak evidence that regions with higher unemployment rates tend to experience faster reductions. However, σ -convergence indicates significant divergence, meaning that disparities between regions in terms of unemployment have increased over time. This reflects a scenario where some regions improve while others continue to lag, contributing to greater variability.

For labour productivity, both indicators point to stagnation in β -convergence and divergence in σ -convergence. This shows that there has been no meaningful catch-up effect in labour productivity across regions, with the gaps in productivity widening. The divergence suggests increasing disparities between high and low-productivity regions, further emphasizing the structural challenges in achieving uniform productivity growth. In case of gender balance unemployment, our study reveals strong β -convergence. This suggests a robust tendency for regions with higher gender unemployment imbalances to catch up with those with lower imbalances. However, σ -convergence indicates stagnation, implying that while individual regions may have improved in terms of reducing gender disparities in unemployment, overall variability across the EU remains relatively unchanged. For gender balance employment stagnation in both β - and σ -convergence implies that there has been little progress in terms of convergence or divergence in gender employment balance across EU regions. This stagnation could reflect persistent structural barriers that continue to limit progress in achieving gender equality in employment. In case of female unemployment, the stagnation in β -convergence suggests that regions with higher levels of female unemployment have not consistently improved relative to those with lower levels. However, σ -convergence indicates moderate divergence, meaning that differences in female unemployment rates across regions have increased. This widening gap could highlight persistent challenges specific to gendered labour market outcomes in certain regions.

These results support the use of the convergence club approach, as they reveal heterogeneous patterns across different labour market indicators. The evidence of divergence in unemployment rates and labour productivity, for instance, suggests that certain regions—likely those with distinct structural conditions, such as post-socialist or peripheral regions—are diverging from more developed or central regions. This aligns with the convergence club hypothesis, which posits that regions

with similar initial conditions or structural characteristics form distinct growth paths (Durlauf and Johnson 1995; Phillips and Sul 2007).

Therefore, we have chosen to present our results in two distinct groups of regions, categorized by a fixed categorical variable, to delve deeper into the convergence patterns in the European labour market, highlighting differences between post-socialist and capitalist regions following convergence club approach based on the path dependence argument. This approach will enable us to provide a deeper understanding of convergence patterns across Europe and deliver more insightful results for policymakers.

4.2 Results of beta and sigma convergence for EU25 NUTS 2 regions following convergence club approach based on path dependency

In this section we will analyse the sigma and beta convergence for EU regions divided based on fixed categorical factor following path dependency.

4.2.1 Results of beta convergence following convergence club approach based on path dependency

Already in Figs. 2, 3, 4, 5, we could observe a possible indication of differences between capitalist and post-socialist regions. Table 5 shows the values of Spearman correlation coefficients among LME indicators and their growth rates separately for post-socialist regions and capitalist regions.

In the group of post-socialist regions, we can observe beta convergence for employment rate, long-term unemployment, unemployment rate, labour productivity, gender balance unemployment and female unemployment. Stagnation can be observed for gender balance employment. So, convergence of post-socialist regions was found in all indicators with the exception of gender balance employment (stagnation).

In the group of capitalist regions, we can observe beta convergence in three indicators: long-term unemployment, gender balance unemployment and gender balance employment. The employment rate, in contrast, showed a diverging development. Stagnation of regions was observed in the remaining three indicators:

Table 5 Test of beta convergence of regions in two groups by Spearman correlations

Indicators/Group	Post-socialist	Capitalist
Employment rate	-0.613***	0.327***
Long-term unemployment	-0.341*	-0.341***
Unemployment rate	-0.415**	-0.114
Labour productivity	-0.289*	0.042
Gender balance unemployment	-0.555***	-0.409***
Gender balance employment	-0.185	-0.139*
Female unemployment	-0.529***	-0.045

* $p < 0.05$ (least significant result); ** $p < 0.01$ (more significant result); *** $p < 0.001$ (the most significant result)

Table 6 Test of beta convergence of regions by linear regressions (by development phase)

Group	Post-socialist				Capitalist				Equality of slopes	
	β	p	b (%)	$T_{1/2}$	β	p	b (%)	$T_{1/2}$	p	Slope
Employment rate	-0.027	0.000	3.04	25.3	0.033	0.000	-2.91	-21.5	0.000	PS < Cap***
Long-term unemp	-0.035	0.005	4.11	19.4	-0.043	0.000	5.32	15.7	0.721	PS = Cap
Unemployment rate	-0.044	0.000	5.39	15.5	-0.019	0.026	2.11	35.3	0.262	PS = Cap
Labour productivity	-0.018	0.058	1.93	38.5	stag	stag	stag	stag	0.114	PS = Cap
Gender balance unemp	-0.095	0.000	18.02	6.9	-0.050	0.000	6.35	13.6	0.009	PS < Cap**
Gender balance emp	Stag	Stag	Stag	Stag	Stag	Stag	Stag	Stag	0.991	PS = Cap
Female unemployment	-0.049	0.000	6.19	13.8	Stag	Stag	Stag	Stag	0.034	PS < Cap*

β —estimate of beta convergence coefficient, p —its significance, b —speed of convergence (%), $T_{1/2}$ —half-life (years), stag. = stagnation of regions in indicator; * $p < 0.05$ (least significant result); ** $p < 0.01$ (more significant result); *** $p < 0.001$ (the most significant result); PS < Cap—slope β in post-socialist regions is smaller than β in capitalist regions, PS = Cap—slopes do not differ

unemployment rate, labour productivity and female unemployment. Our results show that the cause of the stagnation of the employment rate for all regions together is found in opposite significant trends in post-socialist regions compared to capitalist regions.

Table 6 shows the results of the beta convergence tests by linear regression models separately for post-socialist regions and for capitalist regions. The necessary condition for the convergence of post-socialist regions by significant absolute beta convergence is fulfilled in the following indicators: long-term unemployment, unemployment rate, labour productivity, gender balance unemployment and female unemployment. The highest speed of 18.02% per year and half-life of 6.9 years was reached by gender balance unemployment.

In the group of capitalist regions, the employment rate was the only one of the LME indicators where the regions diverge. Absolute convergences were in the following indicators: long-term unemployment, unemployment rate and gender balance unemployment. Gender balance employment was the only indicator of stagnation in both groups of regions.

In the first case (employment rate indicator), there is an apparent difference between post-socialist regions and capitalist regions. While in the group of post-socialist regions, there is a clear case of convergence with a speed of convergence of 3.04% per year and a half-life of 25.3 years, in the group of capitalist regions there is the opposite significant divergence. It means that in the group of post-socialist regions the less developed regions were catching up with more developed regions with speed of 3% per year. The distance between less developed and more developed regions in the group of post-socialist regions should be reduced to half by 25 years.

The sign for capitalist regions is negative, the half-life value is -21.5 , which indicates that capitalist regions are diverging. In capitalist regions, the distance between less developed and more developed regions increased. This was the only case of divergence in all LME indicators.

Similarly, the group of post-socialist regions showed significant convergence also in the cases of long-term unemployment (speed 4.11% per year), unemployment rate (speed 5.39% per year), labour productivity (speed 1.93% per year), gender balance unemployment (speed 18.02% per year) and in the case of female unemployment (speed 6.19% per year).

In the group of capitalist regions, convergence was found in the following indicators:

Long-term unemployment (5.32% per year), unemployment rate (2.11%) and gender balance unemployment (6.35%).

Two columns on the far right of Table 6 present the test of equality of slopes for regions divided by their development phase. In the case of three LME indicators, there are different slopes of the beta coefficient: employment rate ($p < 0.001$), gender balance unemployment ($p = 0.009$) and female unemployment ($p = 0.034$). In all three indicators, slopes are significantly smaller in post-socialist regions in comparison with capitalist regions. Thus, post-socialist regions converge significantly 'faster' than capitalist regions. The effect of indicators on their

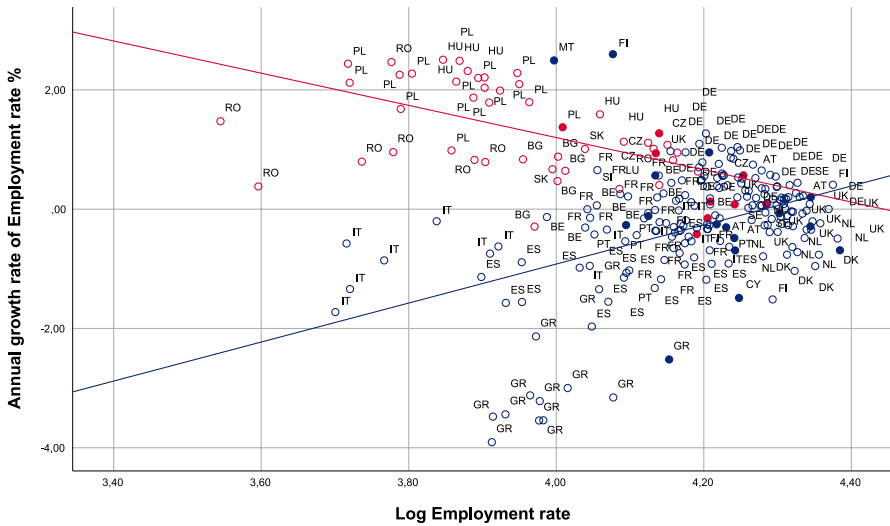


Fig. 6 Scatterplot of the average annual growth rate of the employment rate (2010–2019) versus the employment rate in 2010 for both groups of regions, including their regression lines. *Notes* full blue circles—capitalist regions with capital, empty blue circles—other capitalist regions, full red circles—post-socialist regions with capital, and empty red circles—other post-socialist regions, red line—regression line for post-socialist regions, blue line—regression line for capitalist regions (color figure online)

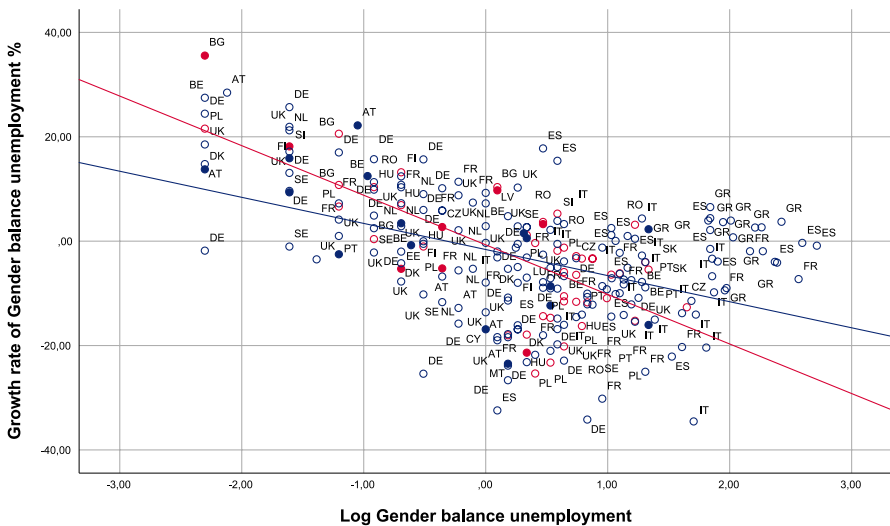


Fig. 7 Scatterplot of the average annual growth rate of gender balance unemployment (2010–2019) vs gender balance unemployment (2010) for both groups of regions. *Notes* full blue circles—capitalist regions with capital, empty blue circles—other capitalist regions, full red circles—post-socialist regions with capital, and empty red circles—other post-socialist regions, red line—regression line for post-socialist regions, blue line—regression line for capitalist regions (color figure online)

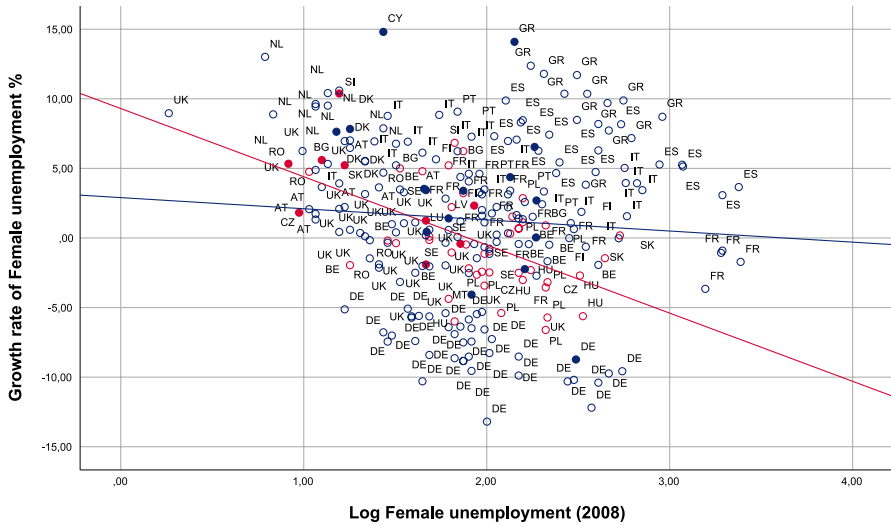


Fig. 8 Scatterplot of the average annual growth rate of female unemployment (2010–2019) vs female unemployment (2010) for both groups of regions. *Notes* full blue circles—capitalist regions with capital, empty blue circles—other capitalist regions, full red circles—post-socialist regions with capital, and empty red circles—other post-socialist regions, red line—regression line for post-socialist regions, blue line—regression line for capitalist regions (color figure online)

corresponding growth rates is smaller in the group of post-socialist regions in the case of employment rate, gender balance unemployment and female unemployment.

Figures 6, 7, 8 show the corresponding scatterplots with annual growth rates in per cent (red circles denote post-socialist regions and blue circles denote capitalist regions).

In the case of employment rate, there is a significant difference between slopes for post-socialist regions and for capitalist regions (negative in the group of post-socialist regions (- 2.70) vs. positive in capitalist regions (3.27)). It is clear from the figure that the dispersion of regions along the regression lines is relatively wide for both capitalist and post-socialist regions.

From the point of gender balance unemployment (Fig. 7), there is a significant difference caused by different values of regression coefficients (however, both with negative signs), the slope of post-socialist regions (-9.54) is steeper than the slope (-4.98) of capitalist regions. Compared to the previous case, we do not observe significant outliers in the group of regions with capital cities; also, the dispersion of regions along the regression lines is more homogeneous in both capitalist and post-socialist regions.

In the field of female unemployment (Fig. 8), the situation is different. Post-socialist regions have a significant negative slope (-4.88) but capitalist regions stagnate. For female unemployment, we can observe outliers from capitalist regions with capital cities, positive outlier in case of Germany and negative outliers in Cyprus and Greece.

Table 7 Test of sigma convergence of regions using the Conover test (by development phase)

Group Variable	Post-socialist		Capitalist	
	Variance	<i>p</i>	Variance	<i>p</i>
Log employment rate (2010)	0.030		0.017	
Log employment rate (2019)	0.021	*	0.034	***
Log long-term unemployment (2010)	0.297		0.730	
Log long-term unemployment (2019)	0.291	–	0.831	*
Log unemployment rate (2010)	0.158		0.253	
Log unemployment rate (2019)	0.136	–	0.417	***
Log labour productivity (2010)	0.080		0.028	
Log labour productivity (2019)	0.081	–	0.058	***
Log gender balance unemployment (2010)	0.843		1.311	
Log gender balance unemployment (2019)	0.535	–	1.164	–
Log gender balance employment (2010)	0.102		0.265	
Log gender balance employment (2019)	0.150	–	0.337	–
Log female unemployment (2010)	0.179		0.316	
Log female unemployment (2019)	0.128	–	0.496	***

* $p < 0.05$ (least significant result); *** $p < 0.001$ (the most significant result)

4.2.2 Results of sigma convergence following convergence club approach based on path dependency

The differences between post-socialist and capitalist regions are also clear from the point of view of sigma convergence (Table 7).

The only case of convergence in the group of post-socialist regions is in the field of the employment rate indicator. For the other indicators, the development of post-socialist regions is stagnating from the viewpoint of variance changes. Regarding the capitalist regions, their development is not positive from the point of view of sigma convergence. Of the seven LME indicators, five indicators show significant divergence. In all these indicators, the variances in 2019 are significantly greater than the variances in 2010. Stagnation of the development of the regions was found in two indicators—gender balance unemployment and gender balance employment.

5 Discussion

Unlike many traditional convergence studies, our paper does not focus on the convergence of economic growth. Instead, our methods have been expressly tailored to provide a more in-depth analysis of labour market indicators, aligning with the central objective of our research. During the investigated periods, EU NUTS 2 regions demonstrated absolute beta convergence in long-term unemployment, unemployment rate and gender balance unemployment, with gender balance unemployment achieving the highest convergence rate. In contrast, sigma convergence analysis revealed significant divergence in unemployment rate, labour

productivity and female unemployment, indicating stagnation in these areas. While gender balance unemployment showed significant beta convergence, sigma convergence was non-significant, and gender balance employment stagnated in both measures. These results correspond with studies arguing that beta convergence is not a sufficient condition for sigma convergence (Barro and Sala-i-Martin 1992; Young et al. 2008).

In post-socialist regions, the employment rate showed the most significant convergence in both beta and sigma terms, confirming the necessary conditions for regional convergence. Indicators such as long-term unemployment, unemployment rate, labour productivity, gender balance unemployment and female unemployment exhibited significant beta convergence, with gender balance unemployment achieving the highest rate of 18.02% per year and a half-life of 6.9 years.

In capitalist regions, convergence was found in long-term unemployment, unemployment rate and gender balance unemployment, with the latter recording the fastest rate (6.35%) and a half-life of 13.6 years. However, the employment rate diverged in these regions. Gender balance unemployment stagnated across both post-socialist and capitalist regions.

In contrast to post-socialist regions, the worst development of capitalist regions was in the case of the employment rate that showed both beta and sigma divergence. Interestingly, in capitalist regions our results showed beta convergence but sigma divergence for the long-term unemployment rate.

Regarding the performance of regions with capital cities based on their placement within four quadrants, determined by the initial values and growth rates of certain indicators, we observed several interesting patterns.

In terms of the employment rate indicator, winning regions with above-average initial values and growth rates mostly included capitalist regions, but also several post-socialist regions with capital cities (Czech Republic, Estonia, Slovakia). Catching-up regions with below-average initial values but above-average growth rates mainly consisted of post-socialist regions, including the capital of Poland, as well as the capital of Malta and Finland. Losing regions with below-average initial values and growth rates primarily consisted of peripheral and coastal regions, but also, surprisingly, two regions with capital cities from capitalist countries, namely Portugal and Italy. Falling-behind regions with above-average initial values but below-average growth rates consisted solely of regions from capitalist countries, except for the capital regions of Slovenia and Latvia.

Similarly, when analysing the labour productivity indicator, winning regions with above-average initial values and growth rates exclusively consisted of capitalist regions, except for one post-socialist region, the capital city of Slovakia. Our research results revealed a clustering of regions with above-average labour productivity, predominantly consisting of capitalist regions, with the exception of two post-socialist regions, the capital city of Slovenia and Slovakia.

In terms of the employment rate indicator, there is a noticeable difference between post-socialist and capitalist regions in terms of the regression coefficients. Post-socialist regions have a negative slope, indicating a convergence in unemployment rates, while capitalist regions show a positive slope, suggesting a divergence in

employment rates. Regions with capital cities generally align with the regression lines, with a relatively wide dispersion for both capitalist and post-socialist regions.

Regarding gender balance unemployment, post-socialist regions exhibit a steeper negative slope compared to capitalist regions. The dispersion of regions along the regression lines is relatively homogeneous for both groups, with no significant outliers observed among regions with capital cities. For female unemployment, post-socialist regions demonstrate a significant negative slope, indicating a convergence in unemployment rates, while capitalist regions show stagnation. Outliers from capitalist regions with capital cities include Germany as a positive outlier and Cyprus and Greece as negative outliers.

The differences in convergence behaviour between post-socialist and capitalist regions, especially regarding labour productivity and unemployment, underscore the need for tailored, region-specific policies. These patterns likely reflect institutional, economic and policy legacies that drive distinct growth trajectories. Furthermore, the convergence club approach explains the mixed results in gender-related indicators, where some regions show strong convergence while others stagnate, due to varying socio-economic and cultural factors.

We acknowledge several limitations in our study. We employed convergence models based on the available data from the European Commission RCI reports. While these models capture the overall convergence patterns, they lack the sophistication of conditional convergence models, which account for multiple steady states and additional variables such as population growth, capital depreciation and technological progress. We used data from two volumes of the RCI (2010 and 2019), allowing for a basic longitudinal analysis; however, a more advanced panel data analysis would have provided deeper insights into the dynamics of convergence over time.

Incorporating more advanced techniques, such as spatial analysis or seemingly unrelated regression, could address some of these interdependencies and represent interesting avenues for future research. Future studies should consider a more comprehensive approach by integrating additional variables, such as GDP growth, wage increases and labour force participation, to provide a more nuanced understanding of regional labour market dynamics.

6 Concluding remarks

From a convergence perspective, the post-socialist regions have generally performed better, which is encouraging given their need to catch up with the more advanced capitalist regions. However, our findings also point to a worrying stagnation or divergence in several key labour market indicators within the capitalist regions. This outcome resonates with the concept of the “development trap”, referring to regions facing persistent structural challenges that prevent them from regaining past dynamism or improving prosperity (Diemer et al. 2022; Iammarino et al. 2019). Many such regions have endured prolonged stagnation following the Great Recession of the early 2010s and continued to struggle under additional shocks,

such as shifts in global trade dynamics and the more recent economic disruptions caused by the COVID-19 pandemic.

Our study's mixed evidence of convergence, divergence and stagnation complements earlier research suggesting that financial crises may disrupt or reverse convergence trends in Europe (Estrada et al. 2013; Dvoroková 2014). Previous studies highlight how external economic shocks, such as the financial crisis, exacerbate inequalities and challenge economic convergence (Baldwin and Wyplosz 2019; Crafts and Toniolo 1996). Dvoroková (2014) demonstrated the substantial impact of the crisis on real convergence, emphasizing the vulnerability of certain regions. Building on this literature, our study examines the specific role of Greek regions, which were severely affected by the financial crisis, in influencing the convergence dynamics of EU NUTS 2 regions. Through additional analyses, we assessed convergence both with and without the inclusion of 13 Greek NUTS 2 regions. The results, detailed in the Annex 2, reveal that Greek regions negatively impact overall convergence, as their inclusion increases the significance (lowering p-values) in most labour market efficiency indicators. Notably, convergence is stronger when Greek regions are excluded, except in labour productivity and gender-balanced employment, where results remain significant irrespective of their inclusion. These findings underscore the critical role of region-specific economic shocks in shaping convergence dynamics and highlight the necessity of tailored policy responses.

Overall, our study suggests that labour market convergence does not emerge automatically from “free” labour markets. Several forces—cumulative causation, institutional structures and political choices—may reinforce initial advantages and hamper convergence (Krugman 1991; Myrdal 1957; Pred 1965). Furthermore, differences beyond a capitalist or post-socialist past, or being a capital region or not, can also shape regional developmental paths. As Myrdal (1944, 1957) emphasized, economic and political factors collectively influence how regional convergence unfolds.

This study highlights the value of the convergence club approach in interpreting the diverse patterns of convergence, divergence and stagnation in EU regional labour markets. While some regions converge on indicators like gender balance in unemployment and long-term unemployment, others diverge in areas such as overall unemployment rates and labour productivity. These patterns reflect the heterogeneity of EU labour markets, shaped by structural, institutional and historical factors, and call for targeted, club-specific policy interventions. Building on economic growth theory (Solow 1956), the convergence club approach moves beyond traditional β - and σ -convergence models, recognizing that regions with similar initial conditions—such as post-socialist or capital city regions—form distinct steady states rather than converging globally (Durlauf and Johnson 1995; Phillips and Sul 2007; Fischer and LeSage 2015). These findings underscore the importance of place-sensitive policies that respect the unique trajectories of each convergence club, offering a more effective pathway to reducing disparities and promoting sustainable growth across the European Union. This aligns with recent work by Dijkstra et al. (2020), Iammarino et al. (2019) and Rodríguez-Pose and Ketterer (2020), which advocate for place-sensitive policies as the optimal approach to addressing economic decline,

brain drain, low-skilled labour markets and limited employment opportunities. This study builds on and enriches the body of research that highlights how differences in initial conditions, structural characteristics and institutional settings shape distinct regional growth trajectories (Bartkowska and Riedl 2012; Durlauf and Johnson 1995; Greasley and Madsen 2016; Kremer et al. 2013; Phillips and Sul 2007).

Our findings emphasize that labour market convergence is not an automatic outcome but a complex process requiring strategic, long-term interventions tailored to the unique circumstances and historical trajectories of each region. Effective policies must go beyond addressing immediate disparities, focusing instead on fostering sustainable development that aligns with the overarching goals of economic convergence across the European Union.

In the light of these findings, policy measures should adopt a place-sensitive, club-specific orientation that acknowledges the complex interplay of structural, institutional and historical factors shaping regional labour markets. First, in regions approaching a “development trap,” resources must be directed towards addressing persistent structural deficits, including workforce upskilling and the cultivation of sectors with higher added value. Such interventions would help avert long-term stagnation by fostering inclusive, innovation-led growth. Second, to empower labour market convergence in regions severely affected by economic crises, such as Greek regions, policymakers should consider targeted financial support and tailored policies that account for local market conditions, industry specialization and demographic realities. The resilience of these regions depends on coordinated, multi-level governance that aligns European, national and regional measures, with a focus on mitigating external shocks that disproportionately exacerbate existing disparities. Finally, encouraging interregional collaboration, knowledge exchange and the formation of networks among regions with comparable development paths can help amplify best practices and success stories, enabling lagging regions to close structural gaps more effectively. By embracing these nuanced, region-specific approaches, policymakers can more effectively promote inclusive and sustainable labour market convergence across the European Union. From a future research perspective, it should be emphasized that our results constitute only a preliminary description of changes in various labour market indicators. Further investigation could extend these findings by employing more advanced methods, such as cluster analysis or other sophisticated quantitative techniques, to examine the observed convergence and divergence patterns in greater depth. Incorporating additional relevant variables would also enrich our understanding of regional labour market dynamics. We encourage future studies to explore these directions, as they hold considerable promise for advancing both theoretical and empirical perspectives on convergence clubs in labour markets.

In conclusion, this paper contributes to deeper understanding of labour market convergence patterns by utilizing seven different labour market indicators and examining the influence of path dependency. These insights are particularly valuable for policymakers as they underscore the complexity of convergence trends and the diverse outcomes across different regions but also different methods for convergence measurement. This paper underscores the importance of place-sensitive strategies

that are adaptable to the diverse socio-economic and institutional contexts of EU regions.

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