



Unemployment in EU Member States: Evidence on the Influence of Economic and Demographic Factors

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ABSTRACT

The European Union is marked by economic, social and demographic challenges and understanding the determinants of unemployment becomes important for the formulation of effective and sustainable public policies. The study aims to investigate the influence of the main economic and demographic factors on the unemployment rate in the 27 Member States of the European Union, based on a multiple linear regression model applied on panel data for the period 2012-2023. By integrating variables such as real GDP per capita, government spending on pensions, public investment in fixed capital, fertility, life expectancy and the number of pension recipients, the research explores both the structural dimension of the labor market and the impact of annual shocks on employment. The econometric results show that economic performance has a significant negative impact on unemployment, supporting the hypothesis that increases in GDP per capita contribute to reducing unemployment. It also confirms a negative relationship between the number of retirees and the unemployment rate, suggesting that the withdrawal of the older population from the labor force alleviates the pressure on the labor market. Based on the findings, the study provides recommendations for public policies aimed at strengthening economic growth, smoothing the demographic transition and strengthening institutional capacity to respond to crises. The paper contributes to the literature by taking an integrated approach to the relationship between the economy, demography and employment, providing a valuable comparative perspective for labor market policy-making in the European Union.

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1. Introduction

In recent decades, the European Union has undergone profound structural transformations marked by growing economic interdependencies, systemic crises and accelerated demographic transitions, all of which have a direct impact on the functioning of the labour market. In this context, reducing unemployment and increasing employment have become strategic priorities at EU level and have been integrated into major objectives of the European agenda, such as the Europe 2020 Strategy, the European Pillar of Social Rights and, more recently, in the post-pandemic recovery plans and the 2030 Agenda for Sustainable Development. These documents emphasize the need to build a more competitive, inclusive and resilient European economy, able to harness the potential of human capital and respond to emerging demographic and social challenges.

Despite progress in some periods and regions, unemployment rates continue to vary significantly across Member States and territorial and structural disparities persist, particularly among young people, women and the low-skilled. In parallel, ageing populations, declining fertility and pressures on public pension systems are putting new strains on economic and fiscal balances, calling for a deeper understanding of the interactions between economic, demographic and institutional factors influencing employment dynamics.

In this context, the novelty of the study lies in the integrated and comparative approach to the main determinants of unemployment in the European Union, by combining economic and demographic dimensions in an econometric model applied on an extended panel dataset covering the period 2012-2023 and including the 27 Member States. In contrast to one-sided or single-country or single explanatory factor approaches, this research proposes a comprehensive and cross-sectional perspective on unemployment, emphasizing the structural interactions between macroeconomic variables (GDP per capita, public investment, pension expenditure) and population dynamics (fertility, life expectancy, number of pension beneficiaries).

Thus, the main aim of the study is to empirically assess the influence of economic and demographic determinants on the unemployment rate in the European Union, using a multiple linear regression model applied on panel data, in order to identify statistically significant relationships and to provide the basis for

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public policies better adapted to the current European context. At the same time, the research aims to highlight whether and to what extent external shocks and time variations specific to the period under study, in particular those generated by the global health crisis, have contributed to the changes in European labour market trends. The study aims to contribute to a better understanding of the relationships between relevant macroeconomic and demographic indicators and the evolution of unemployment in the European Union, through an empirical approach based on comparable data and a rigorously applied econometric methodology. To this end, the research aims to achieve the following objectives:

- (1) To analyse the literature on how economic performance, as expressed by real GDP per capita, influences the unemployment rate in the 27 EU Member States.
- (2) The design of an econometric model investigating the influence of a set of economic and demographic factors on unemployment dynamics, using a linear regression approach based on panel data.
- (5) To identify, based on the results obtained, public policy recommendations to support the reduction of unemployment and the adaptation of the labour market to the demographic and structural challenges existing within the European Union.

By achieving these objectives, the study contributes to strengthening the empirical basis for the formulation of coherent employment and social protection strategies, fully in line with the European priorities of economic convergence, social cohesion and demographic sustainability.

2. Literature review

To strengthen the scientific basis of the research, a rigorous analysis of the literature dealing with the relationships between unemployment dynamics and its main economic and demographic determinants in the European Union is necessary. Against the background of accelerated structural changes - globalization, demographic ageing, recurrent crises - research in recent years has highlighted the need to overcome one-dimensional approaches and develop integrated analytical frameworks that capture both economic and institutional variables, as well as demographic developments and exogenous shocks. Thus, in the following, the relevant contributions of the post-2021 literature are reviewed, highlighting the main theoretical and empirical directions, as well as the persistent gaps that justify the approach proposed in this research.

2.1. Theoretical framework

The literature on unemployment in the European Union reflects a diversity of theoretical and empirical perspectives that attempt to capture the complexity of the mechanisms through which economic, demographic and institutional factors influence employment dynamics. In a context marked by accelerated structural transformations - globalization, digitalization, ageing populations, health and geopolitical crises - the analysis of unemployment can no longer be separated from the broader processes of economic restructuring and demographic transition (International Labour Organization, 2023; International Monetary Fund, 2024; OECD, 2023a; Pascual-Saez et al., 2020).

After the 2008 financial crisis and the 2020 global health crisis, the recent literature has increasingly focused on understanding cross-state differences in labour market resilience, with an emphasis on the role of public spending, active employment policies, regional inequalities and demographic changes (Jia et al., 2023; Neuhuber & Schneider, 2024; Venner et al., 2024). At the same time, methodological advances have allowed a better capture of the dynamic, non-linear and potentially endogenous relationships between unemployment and its determinants, through the use of advanced panel models, quantile regressions, VAR analysis and machine learning-based estimations (Arkhangelsky & Imbens, 2024; Loria et al., 2025; Qadri et al., 2023; Rios-Avila, 2022; Shen et al., 2024).

The economic literature points to a fundamental link between economic performance - most commonly measured by real gross domestic product per capita - and the unemployment rate (Afonso & Blanco-Arana, 2024; Agu et al., 2022; Ali et al., 2022; Feng et al., 2024). Okun's hypothesis, supports the existence of an inverse relationship between economic growth and unemployment (Porrás & Martín-Román, 2023), a hypothesis confirmed in numerous empirical studies (Boğa, 2020; Mohamed, 2024; Peláez-Herreros, 2025). At the EU level, this relationship has been reconfirmed by recent research. For example, the authors Ando et al. (Ando et al., 2022) show that sustained economic growth in the post-pandemic period has been associated with a significant reduction in unemployment in most EU Member States, but also emphasize that the elasticity of unemployment to GDP is lower in Southern countries compared to Nordic countries, due to institutional rigidities. A seminal study by Adam & Alzuman (Adam & Alzuman, 2024) highlights that economic performance differentially influences labor force groups - especially young people and women - and that GDP per capita remains a robust predictor of structural unemployment reduction, especially in developed Western European economies. In addition, Țarcă et al. (Țarcă et al., 2024) analyses the interactions between productivity, digitization and employment in the EU, showing that technological advancement, while increasing economic efficiency, also generates risks of polarization in the labour market, affecting the middle-skilled segment and fuelling inequalities in the workforce. On the other hand, there is also work that problematizes this relationship. In other studies (Monaco, 2023; Seidl, 2023; Yarrow, 2022) attention is drawn to the fact that, in the absence of redistributive and retraining policies, GDP growth may coexist with stagnation or even an increase in

unemployment in certain regions or social groups. In this regard, the literature (Mitić et al., 2023; Usman et al., 2022; Zafar et al., 2022) reiterates the need to interpret economic performance in relation to the structure of the economy, the nature of investments and the quality of employment generated.

In parallel, recent academic studies are increasingly looking at the demographic implications for the labor market. Population ageing, declining fertility and rising life expectancy are demographic phenomena with a profound impact on employment in Europe (European Central Bank, 2024; Eurostat, 2024a; Lukács Gellérné et al., 2025). These processes change the structure of the working population, influence the sustainability of pension systems and put pressure on labour market equilibrium. According to the OECD report (OECD, 2023b), the shrinking working-age population in Central and Eastern Europe is expected to reduce economic growth potential and exacerbate labour shortages in certain sectors. These findings are confirmed by other expert analysis (Dumiter et al., 2025; European Commission, 2024a; Väänänen & Liukko, 2023; Vlandas, 2023), which have found an inverse relationship between the number of retirees and the unemployment rate, especially in countries with well-institutionalized pension systems. By contrast, in economies with early demographic transition, the withdrawal of older people from the labour force is often insufficiently compensated by the entry of new generations, leading to labour market tensions (Barrela, 2025; European Commission, 2023). Research on fertility and employment is less abundant, but various papers (European Commission, 2024b; Miles, 2023; MPDIR, 2024) argues that a low fertility rate coupled with out-migration of young labour significantly reduces the renewability of human capital, thus affecting long-term growth potential. Paradoxically, some countries with low fertility but with policies to attract immigration (e.g. Germany, the Netherlands) manage to mitigate the negative effects on the labour market, suggesting that demography should not be considered in isolation but in relation to institutional policies (Gathmann & Garbers, 2023; Lukács Gellérné et al., 2025; Milewski & Adserà, 2023; OECD, 2024).

Another key dimension addressed in the literature concerns the impact of public policies, through the lens of pension expenditure and government investment. Public spending can influence both aggregate demand and the ability of the state to implement policies to support employment (Jo & Zubairy, 2025; Klein & Linnemann, 2023; Morlin et al., 2024). According to analysis by Tiganasu & Lupu (Tiganasu & Lupu, 2023), public investment in infrastructure and digitization has had a multiplier effect on employment in the post-COVID period, particularly in those countries that have made efficient use of European funds under the various funding programmes. However, the effectiveness of these investments depends on administrative capacity and the quality of governance - a point also highlighted by the EIB Investment Report (European Investment Bank, 2025), showing that public investment can have no or even negative effects on unemployment when inefficiently targeted or delayed by red tape. As regards pension expenditure, the literature points to a two-fold effect: on the one hand, it can contribute to reducing unemployment by withdrawing older people from the labour market (Brydsten et al., 2025; Flek et al., 2024; Lee, 2024); on the other hand, they can represent a fiscal burden which limits the resources available for active employment policies (Eble, 2025; Ernst et al., 2025; Veldman et al., 2025). In this sense, some studies (Asllani & Schneider, 2025; Hoynes et al., 2024; Kühnhenrich, 2024) have shown that in countries with high pension expenditure, unemployment tends to be higher, especially in the absence of compensating tax reform.

Finally, the post-pandemic literature has paid particular attention to the effects of external shocks, especially those generated by the COVID-19 pandemic, on the labour market. The health crisis triggered a steep increase in unemployment in 2020, followed by an uneven recovery across states, sectors and social groups. According to specialized studies (Ando et al., 2022; Barsoum & Majbouri, 2025; Musolino et al., 2024; Sarafian et al., 2024), the pandemic has had a disproportionate impact on young people, temporary and low-income workers, accentuating structural vulnerabilities in the labour market. Studies have also shown (Bozani, 2024; Caleiras & Carmo, 2024; Pavelescu, 2024; Vaquero García, 2024) that the negative effects of the crisis have been mitigated in countries with effective employment protection mechanisms, while in countries without such instruments, unemployment has risen faster and remained persistent. These studies indirectly support the inclusion of time fixed effects in econometric models as a way of capturing exogenous influences on the labour market, without confounding them with the structural effects of the explanatory variables.

On the basis of the contributions reviewed, several common threads emerge: the negative relationship between GDP per capita and unemployment is widely supported but shows significant regional variations; the impact of demographic factors on employment is less studied and the interactions between fertility, life expectancy and unemployment are rarely addressed in an integrated way; in terms of public policies, the effects on employment depend strongly on the institutional context and the efficiency of resource allocation. At the same time, while there is growing concern about the effects of external shocks, comparative, multi-state and longitudinal approaches remain limited.

In this context, there is a major gap in the literature: the absence of integrated and comparative econometric models, applied on a large panel dataset, that simultaneously analyse the influence of economic performance, demographic transition and external shocks on unemployment in the European Union. This study contributes to filling this gap by applying a rigorous econometric methodology to a sample of the 27 EU Member States over the period 2012-2023, providing a comprehensive empirical perspective relevant for informing public employment policies.

2.2. Research hypotheses

Building on the literature on the determinants of unemployment in the European context, as well as on the theoretical premises regarding the relationship between macroeconomic indicators and labor market dynamics, this study formulates a set of hypotheses aimed at exploring how economic, demographic and institutional factors influence the unemployment rate in the EU Member States. First, given the strong theoretical link between the level of economic development and the capacity of an economy to create jobs, it is assumed that higher economic performance - as measured by real gross domestic product per capita - is associated with lower unemployment. A more competitive and efficient economy can better absorb the available labor force and help reduce structural and cyclical unemployment. This relationship is well documented in the literature. Studies by Been et al. (Been et al., 2024) și Feng et al. (Feng et al., 2024) shows that the negative elasticity of unemployment to GDP is significant in most EU Member States and the authors' analysis Schraff & Pontusson (Schraff & Pontusson, 2024) and Nadiri et al. (Nadiri et al., 2024) have shown that economic performance is one of the strongest predictors of employment, especially in developed regions. Complementarily, other studies (Aleca & Mihai, 2025; Bănică et al., 2024; Ramiro Troitiño & Mazur, 2024; Roszko-Wójtowicz et al., 2024) have demonstrated that digitization and innovation enhance the positive impact of economic growth on employment, provided that an institutional infrastructure is in place to facilitate the transition of the workforce. Thus, Research Hypothesis 1 (H1) is formulated: Economic performance, as measured by real GDP per capita, exerts a significant negative effect on the unemployment rate in the EU Member States.

The demographic dimensions of the labour market are also considered to play a key role in unemployment trends. In this respect, the increase in the number of beneficiaries of the public pension system is interpreted as an indication of the withdrawal of a significant part of the population from the labour force, which may reduce the pressure on employment. A number of specialized analyses (Ahonen & Kuivalainen, 2024; Aitken & Singh, 2023; Simionescu et al., 2024) support this hypothesis, indicating that a higher share of the older retired population is associated with a reduction in unemployment among working-age groups, particularly in mature economies with a stable institutional structure. OECD report (OECD, 2023b) also warns that this trend may vary depending on the national context, but confirms that the demographic transition is influencing the distribution of the workforce and employment. Similarly, a number of papers (Cicerchia, 2019; Fabra et al., 2024; Massey, 2023; Su et al., 2022) have drawn attention to the fact that demographic pressures should not be seen solely as a threat, but also as an opportunity to reconfigure the labour market. Therefore, the following research hypothesis can be formulated - Hypothesis 2 (H2): A higher number of pension recipients is associated with a decrease in the unemployment rate, through the withdrawal effect of the inactive population from the labour market.

Finally, it is important to consider the potential impact of exogenous shocks on the labour market. Events such as global economic crises, the COVID-19 pandemic, political changes or geopolitical tensions may affect all EU Member States simultaneously, leading to temporary disruptions in the functioning of the labour market. These phenomena cannot be explained by structural variables alone, requiring the inclusion of controls for temporary effects. Some recent studies (Abrahm & Vošta, 2022; Ebbinghaus & Weishaupt, 2022; Tesche, 2022) showed that the pandemic had a rapid and differentiated impact on unemployment, while other studies (Campos et al., 2025; Haapanala et al., 2022; Uxó et al., 2024) have argued that institutional protection policies, where they existed, contributed to reducing the year-on-year variation in unemployment. In the same vein, the literature (Chen et al., 2022; Figueiredo & Lima, 2022; Jacquart et al., 2024; Ma et al., 2023) proposes to integrate time fixed effects to control for common and unexpected influences of exogenous events. Thus, it is assumed that these variations can be captured by introducing annual dummy variables reflecting common effects on all observational units and we can propose Research Hypothesis 3 (H3): The presence of significant structural shocks, reflected by annual variations captured by time fixed effects, significantly influences the unemployment rate in the EU member countries.

By formulating these hypotheses, the research proposes an integrated approach aimed at capturing the interdependencies between the economic, demographic and contextual dimensions of employment in the European Union, thus contributing to the development of a comparative and empirically grounded perspective on unemployment in the post-crisis context.

3. Methods

In the context of widening labour market imbalances and increasing demographic and fiscal pressures in the Member States of the European Union, this analysis aims to investigate the influence of a set of economic and demographic factors on unemployment dynamics, using a linear regression approach based on panel data. By integrating a robust methodological framework and a set of relevant indicators at the macroeconomic level, the study aims not only to identify significant relationships between variables, but also to highlight the implications of these relationships for the formulation of public policies in the European area.

3.1. Data and variables

The study is based on a panel dataset covering the period 2012-2023 and includes the 27 EU Member States. The data used have been collected from official sources on the Eurostat platform and reflect both economic and demographic indicators of direct relevance to labor market dynamics as shown in Table 1.

Table 1. Indicators analysed

Symbol	Indicators	U.M	Source
Rempl	Employment rates	Percentage	Eurostat (Eurostat, 2025a)
RealGDP	Real GDP per capita	Euro per capita	Eurostat (Eurostat, 2025e)
PenBenf	Pension beneficiaries	Person	Eurostat (Eurostat, 2025d)
Runempl	Total unemployment rate	Percentage	Eurostat (Eurostat, 2025g)
GovGrFC	General government gross fixed capital formation - annual data	Percentage of gross domestic product (GDP)	Eurostat (Eurostat, 2024b)
ExpendPen	Expenditure on pensions	Percentage of gross domestic product (GDP)	Eurostat (Eurostat, 2025b)
Rfert	Total fertility rate	Percentage	Eurostat (Eurostat, 2025f)
LifeExp	Life expectancy at birth	Percentage	Eurostat (Eurostat, 2025c)

Source: Elaborated by authors

The dependent variable used in this study is the total unemployment rate, expressed as a percentage of the economically active population. The choice of this variable was based on its socio-economic importance and its central role in Member States' public policies, particularly in the context of the challenges of an ageing population, fiscal pressures and global economic instability.

As regards the explanatory variables, they were selected based on both the literature and their theoretical relevance for understanding the determinants of unemployment. The employment rate was included to capture the direct effect of labour force integration on unemployment reduction, assuming a negative relationship between the two dimensions. Real GDP per capita has been considered as a proxy for overall economic performance and the potential for labour absorption, with a more developed economy expected to have lower unemployment.

The number of pension beneficiaries has been included to reflect demographic pressure on the labour market, given that an ageing population implies a decrease in the number of people in work and an increase in the tax burden on those in work. Public pension expenditure as a percentage of GDP reflects not only the size of the social protection system, but also budgetary pressures that may influence employment policies. Also, general government gross fixed capital formation has been introduced as an indicator of public investment, on the assumption that it can contribute to job creation and thus to reducing unemployment.

Two key demographic variables have also been included: the total fertility rate, which provides an insight into the future of the labour force, and life expectancy at birth, used as an indicator of the ageing process of the population with direct implications for the sustainability of pension systems and the structure of the labour market.

To control for the potential influence of structural or contextual events affecting all countries in the sample simultaneously, such as economic crises or the COVID-19 pandemic, the model includes dummy variables for each year, with 2012 used as the baseline.

3.2. Econometric model

To assess the influence of economic and demographic factors on the unemployment rate in the Member States of the European Union, an econometric multiple linear regression model was estimated on panel data. This methodological choice reflects the main objective of the research, which is to capture the relationships between the dependent variable - the total unemployment rate - and a structured set of explanatory variables, through an approach that allows controlling for both cross-sectional (cross-country) and time (12-year) variation.

The estimated regression model has the following general form:

$$\begin{aligned}
 Runempl_{it} = & \alpha_0 + \alpha_1 PenBenf_{it} + \alpha_2 Rempl_{it} + \alpha_3 ExpendPen_{it} \\
 & + \alpha_4 RealGDP_{it} + \alpha_5 GovGrFC_{it} + \alpha_6 Rfert_{it} \\
 & + \alpha_7 LifeExp_{it} + \sum_{t=2013}^{2023} \delta_t Year_t + \varepsilon_{it}
 \end{aligned} \tag{1}$$

where the index i is the country, t is the year, and ε_{it} is the random error component.

The coefficients δt capture time fixed effects, introduced by dummy variables for each year, in order to control for influences common to all countries in the sample in certain years - such as external shocks, economic crises, pandemics or European reforms - that may simultaneously affect the unemployment rate, independently of the individual characteristics of each Member State.

The model was estimated using the Ordinary Least Squares (OLS) method. The choice of the OLS model over other more advanced panel approaches such as fixed effects or dynamic models (GMMs) was motivated by the balanced nature of the sample, the stability of the dependent variable over time and the objective of the research, which is mainly aimed at identifying the direct effects of the main determinants on unemployment in an aggregate framework, comparable across countries.

4. Results and discussions

To assess the impact of economic and demographic factors on the unemployment rate in the Member States of the European Union, a multiple linear regression model was estimated based on panel data collected for the period 2012-2023. This section presents and interprets the results obtained, both statistically and in terms of their economic significance and policy implications.

To assess the robustness of the estimates and to verify the absence of multicollinearity among the explanatory variables included in the model, variance inflation factor (VIF) analysis was applied as shown in Table 2, which provides a measure of the degree to which the variance of the regression coefficients is influenced by the correlation between the independent predictors.

Table 2. Variance Inflation Factor - VIF

	VIF	1/VIF
PenBenf	1.327	0.753
Rempl	1.809	0.553
ExpendPen	2.035	0.491
RealGDP	1.995	0.501
GovGrFC	1.418	0.705
Rfert	1.347	0.742
LifeExp	2.946	0.339
2013.Year	1.837	0.544
2014.Year	1.845	0.542
2015.Year	1.855	0.539
2016.Year	1.901	0.526
2017.Year	1.923	0.520
2018.Year	1.948	0.513
2019.Year	1.996	0.501
2020.Year	1.957	0.511
2021.Year	1.968	0.508
2022.Year	2.103	0.476
2023.Year	2.221	0.450
Mean VIF	1.913	.

Source: Elaborated by authors using Stata program

The obtained results reveal that all the VIF values are below the threshold of 3, which indicates the lack of excessive correlation between the explanatory variables and suggests that the model is well specified in terms of the relative independence of the predictors.

Analysis of the correlation matrix (Table 3) provides insight into the intensity and direction of the linear relationships between the variables included in the regression model, providing a basis for interpreting the subsequent econometric results.

Table 3. Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Runempl	1.000							
(2) PenBenf	0.012	1.000						
(3) Rempl	-0.768	-0.078	1.000					
(4) ExpendPen	0.399	0.454	-0.294	1.000				
(5) RealGDP	-0.250	0.004	0.316	0.068	1.000			
(6) GovGrFC	-0.193	-0.216	0.196	-0.245	-0.185	1.000		
(7) Rfert	-0.252	0.033	0.220	-0.121	0.111	0.152	1.000	
(8) LifeExp	0.121	0.237	0.068	0.512	0.587	-0.408	-0.180	1.000

Source: Elaborated by authors using Stata program

From the observations presented, there is a very strong negative correlation between the unemployment rate (Runempl) and the employment rate (Rempl), with a correlation coefficient of -0.768 indicating a theoretically expected robust inverse relationship between the two dimensions of the labor market. This result suggests that an increase in the share of the employed population is associated with a significant reduction in the level of unemployment, confirming the hypothesis of fundamental interdependence between these two variables.

The linear regression model estimated in Table 4, with the total unemployment rate in the EU Member States as the dependent variable, provides a convincing picture of the relationship between unemployment and a number of economic and demographic factors. The explanatory rate of the model is high, with a coefficient of determination R^2 of 0.693, indicating that about 69.3% of the variation in the unemployment rate is explained by the variables included in the model. The overall significance of the regression is supported by the F-test ($F = 38.225$, $p < 0.001$), which attests to the statistical significance of the model.

Table 5. Linear regression model

Runempl	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
PenBenf	0	0	-4.41	0	0	0	***
Rempl	-0.432	0.031	-14.03	0	-0.493	-0.372	***
ExpendPen	0.249	0.068	3.64	0	0.115	0.384	***
RealGDP	0	0	-4.24	0	0	0	***
GovGrFC	0.002	0.161	0.02	0.988	-0.314	0.319	
Rfert	-1.181	0.901	-1.31	0.191	-2.953	0.592	
LifeExp	0.375	0.086	4.37	0	0.206	0.543	***
2012b	0	.	.	.	.	.	
2013	-0.187	0.714	-0.26	0.794	-1.592	1.219	
2014	-0.504	0.716	-0.70	0.482	-1.912	0.905	
2015	-0.771	0.718	-1.07	0.283	-2.184	0.641	
2016	-1.367	0.726	-1.88	0.061	-2.797	0.062	*
2017	-1.765	0.731	-2.42	0.016	-3.203	-0.327	**
2018	-2.259	0.736	-3.07	0.002	-3.707	-0.812	***
2019	-2.568	0.745	-3.45	0.001	-4.033	-1.103	***
2020	-2.084	0.737	-2.83	0.005	-3.535	-0.633	***
2021	-1.625	0.739	-2.20	0.029	-3.079	-0.170	**
2022	-1.998	0.764	-2.61	0.009	-3.501	-0.494	***
2023	-2.238	0.785	-2.85	0.005	-3.783	-0.693	***
Constant	9.935	6.842	1.45	0.147	-3.528	23.397	
Mean dependent var		8.246	SD dependent var				4.597
R-squared		0.693	Number of obs				324
F-test		38.225	Prob > F				0.000
Akaike crit. (AIC)		1562.423	Bayesian crit. (BIC)				1634.257

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: Elaborated by authors using Stata program

Hypothesis 1 (H1), that real GDP per capita exerts a significant negative effect on the unemployment rate, is convincingly supported by the results. The coefficient associated with the RealGDP variable is negative and significant at a high level of confidence ($p < 0.001$), indicating that an improvement in economic performance is systematically associated with a reduction in the incidence of unemployment. This relationship confirms theoretical hypotheses regarding the fundamental role of economic growth in job creation and labour market strengthening. Hypothesis 1 is therefore validated.

As for Hypothesis 2 (H2), which postulates the existence of a negative relationship between the number of pension recipients and the unemployment rate, the results indicate a negative and statistically significant coefficient for the PenBenf variable ($p < 0.001$), although rounded to zero in the table. This finding supports the hypothesis that the withdrawal from the labour force of an increasing share of the population contributes to easing labour market pressures and facilitates employment among younger cohorts. Hypothesis 2 is therefore also validated.

Regarding Hypothesis 3 (H3), which assumes that annual structural shocks have a significant effect on unemployment, the model results clearly support this claim. The coefficients associated with the annual variables (2016-2023) are mostly negative and statistically significant ($p < 0.05$ or $p < 0.01$), indicating relevant changes in the unemployment rate relative to the base year (2012). These variations are congruent with important events, such as the post-crisis recovery, pandemic effects or national reforms implemented in the post-2020 period. Thus, Hypothesis 3 is validated, confirming the importance of including time fixed effects to capture exogenous influences on the European labour market.

Figure 1 illustrates the relationship between real GDP per capita (RealGDP) and the total unemployment rate (Runempl) for the 27 EU Member States, analysed over the 2012-2023 period.

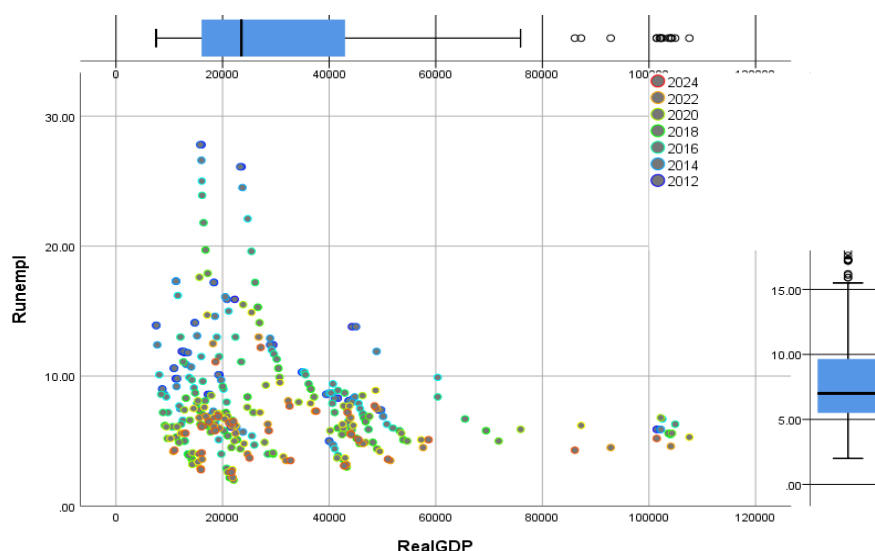


Figure 1. Relationship between real GDP per capita and the unemployment rate in the European Union (2012-2023)

Source: Elaborated by authors using SPSS program

Overall, there is an inverse relationship between the two variables in the sense that higher levels of real GDP per capita are generally associated with lower unemployment rates. This negative trend is visible in the density of points in the top left and bottom right half of the graph, indicating that countries with lower levels of economic development tend to have higher unemployment, while more prosperous economies with real GDP per capita above 40. The figure therefore supports the hypothesis that economic performance is a structural determinant of unemployment in the European Union and that economic heterogeneity remains a central explanatory factor for national divergences in employment rates.

Figure 2 illustrates the relationship between the total number of pension recipients (PenBenf) and the total unemployment rate (Runempl) for the 27 EU Member States, analyzed over the period 2012-2023.

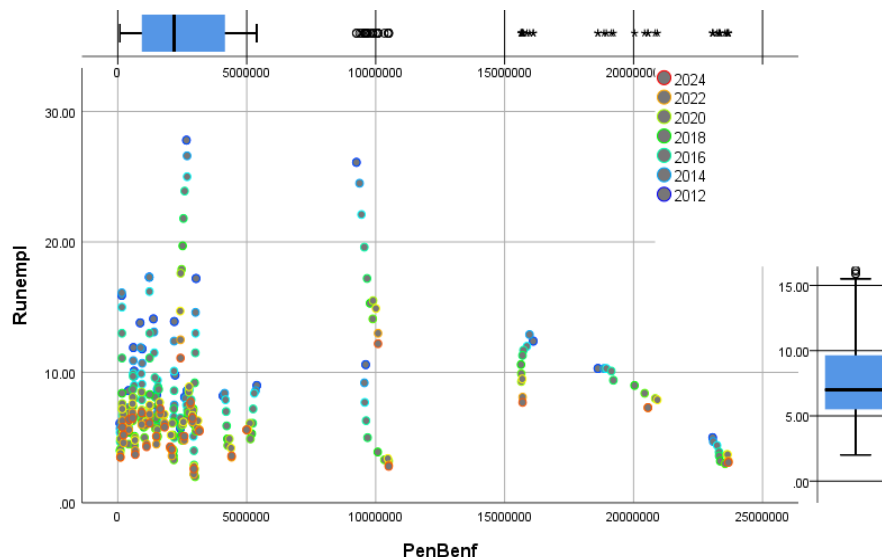


Figure 2. Relationship between the number of pension beneficiaries and the unemployment rate in the European Union (2012-2023)

Source: Elaborated by authors using SPSS program

Analyzing the distribution of points, a general trend of a negative correlation between the number of pension recipients and the unemployment rate can be observed, especially in the segments where PenBenf exceeds 10 million. Thus, Member States with a higher number of pensioners seem to have, on average, lower levels of unemployment. This observation is consistent with the hypothesis that population ageing and the withdrawal of the population from economic activity may free up jobs, reducing the pressure on the economically active segments of the population, especially in the developed economies of Western Europe. At the same time, the increased density of points in the lower part of the vertical axis for high PenBenf values indicates relatively stable unemployment in countries with well-institutionalized pension systems and ageing populations. In contrast, countries with a relatively low number of pensioners - especially in Central and

Eastern Europe - show higher variability in the unemployment rate, signaling a higher degree of vulnerability in the labor market. Figure 3 highlights the relationship between government gross fixed capital formation as a percentage of GDP (GovGrFC) and the total unemployment rate (Runempl) across the 27 EU Member States, analyzed over the period 2012-2023.

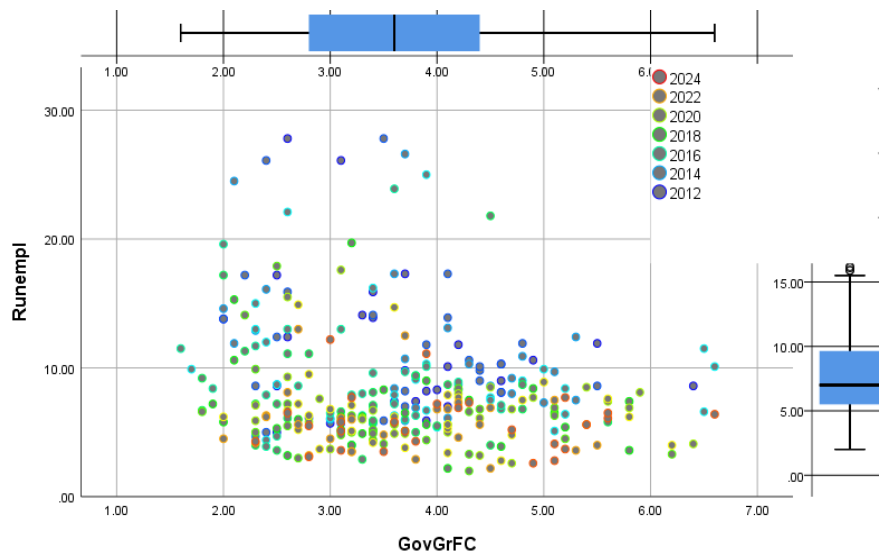


Figure 3. Relationship between government gross fixed capital formation and the unemployment rate in the European Union (2012-2023)

Source: Elaborated by authors using SPSS program

In a context in which public investment policies are frequently promoted as key instruments for boosting aggregate demand and reducing unemployment, this graph aims to explore the extent to which this link is empirically reflected at the European level. This finding is consistent with the structural specificity of the European Union, characterized by considerable diversity in terms of administrative efficiency, employment policies, labour market structure and maturity of public institutions. Thus, while in some Member States public investment may have a positive effect on employment (through high fiscal multipliers and efficient budget execution), in others such spending may have marginal effects or be delayed over time due to bureaucratic bottlenecks or inefficient targeting of funds.

Figure 4 plots the relationship between government spending on pensions as a percentage of GDP (ExpendPen) and the total unemployment rate (Runempl), analysed for the 27 EU Member States over the 2012-2023 period.

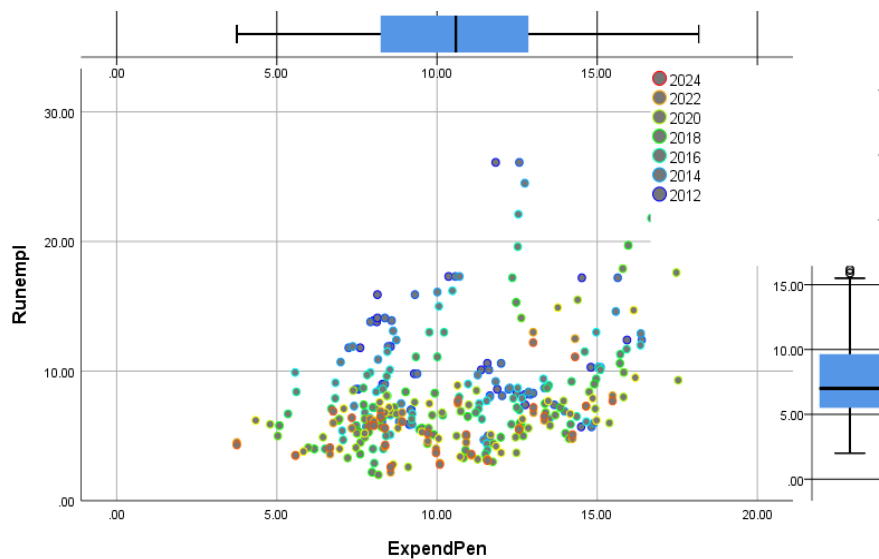


Figure 4. Relationship between government pension expenditure and the unemployment rate in the European Union (2012-2023)

Source: Elaborated by authors using SPSS program

The distribution of the scatter plot points suggests a moderate positive trend between the level of pension expenditure and the unemployment rate, in the sense that Member States that allocate a higher share of GDP to pensions tend to have higher unemployment rates. This relationship is particularly visible in the 10-

15% range for ExpendPen, where there is a higher concentration of observations at high levels of unemployment (above 10%). This trend can be interpreted as an expression of the budgetary and institutional rigidities found in economies where the social protection system is costly and resources available for active employment policies are lower. On the other hand, the lower part of the graph (below 10% of GDP for pensions) shows a higher density of dots associated with lower levels of unemployment, suggesting that countries that maintain a balance between social spending and direct economic incentives may achieve better employment outcomes.

On the basis of the empirical results obtained, a number of relevant implications are drawn for the formulation of public policies aimed at reducing unemployment and adapting the labor market to the new economic and demographic realities facing the European Union. The finding that economic performance has a significant negative impact on unemployment underlines the importance of maintaining a sustained pace of growth in real GDP per capita, through investment in innovation, digitalization, infrastructure and skills development, which helps to stimulate labour demand in high value-added sectors.

The finding on the negative relationship between the number of pension recipients and the unemployment rate suggests the need to strengthen sustainable demographic transition policies that facilitate the gradual replacement of the outactive workforce, through measures to attract and retain young people in the labor market, but also by tailoring retirement policies to the specificities of each economy. The importance of temporary shocks, as evidenced by the significance of annual fixed effects, also calls for the development of flexible institutional intervention mechanisms capable of mitigating the impact of external shocks and supporting social cohesion and employment in periods of instability.

5. Conclusions

The study investigated, in a robust econometric framework, the influence of the main economic and demographic factors on the unemployment rate in the 27 Member States of the European Union over the period 2012-2023. By using a multiple linear regression model applied on balanced panel data, the analysis allowed the identification of the structural relationships that govern the dynamics of the European labour market in a context marked by demographic challenges, budgetary pressures and macroeconomic instability.

The results indicate that economic performance, as measured by real GDP per capita, has a significant negative effect on the unemployment rate, confirming the hypothesis that economic development favours labour force integration. At the same time, the number of pension recipients has been found to be negatively correlated with unemployment, suggesting that the ageing of the population, through the withdrawal of a sizable part of the labour force from the labour force, may indirectly contribute to easing the pressure on employment. Also, the inclusion of time fixed effects revealed the significant influence of structural shocks such as the COVID-19 pandemic on the evolution of unemployment, especially over the period 2016-2023.

Research limitations mainly derive from the model specification and data availability constraints. The choice of the OLS method, although justified for the descriptive and comparative objective of the study, does not allow capturing the dynamic or endogenous effects of explanatory variables, which could simultaneously and reciprocally influence the unemployment rate. Also, the model does not consider possible Member State-specific effects, which could hide institutional and structural differences between economies.

Future research directions aim to deepen the analysis by applying more advanced econometric models, such as fixed and random effects models, and dynamic models (GMMs) that allow for the treatment of endogeneity. An extension of the analysis could include additional variables such as migration rates, digitalization or indicators of active employment policies. Also, a disaggregated approach by country groupings (e.g. Western vs. Central and Eastern Europe) could reveal different typologies of the relationship between unemployment and the structural factors that determine it.

The study provides a relevant empirical contribution to the understanding of the mechanisms through which economic performance, demographic transitions and external shocks shape the evolution of unemployment in the European Union and underlines the need for differentiated and economy-specific policy design to strengthen the labour market.

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