İŞLETME ARAŞTIRMALARI DERGİSİ
JOURNAL OF BUSINESS RESEARCH-TURK
2025, 17(2), 1648-1665
https://doi.org/10.20491/isarder.2025.2057

Jobless Growth in the European Union: Panel Fourier Toda-Yamamoto Causality Test

İdris YAĞMUR [a]
[a] Manisa Celal Bayar Üniversitesi, Kırkağaç Meslek Yüksekokulu, Muhasebe ve Vergi Bölümü, Manisa, Türkiye, idris.yagmur@cbu.edu.tr

ARTICLE INFO

Keywords:
Jobless Growth Hypothesis
Economic Growth
Panel Fourier Toda-Yamamoto Causality Test

Received 9 December 2024
Revised 14 June 2025
Accepted 20 June 2025

Article Classification:
Research Article

ABSTRACT

Purpose – To analyze the validity of the jobless growth hypothesis for the economies of the 27 member states of the European Union (EU) with annual data covering the period 1991-2022 by using the Panel Fourier Toda-Yamamoto causality test using employment rate and growth rate data. Since 2023 employment data have not yet been entered in some countries, the data set ends in 2022.

Design/methodology/approach – The variables are first tested for cross-sectional dependence, homogeneity and the presence of unit roots using the Panel Fourier Lagrange Multiplier (LM) unit root test. Finally, the Panel Fourier Toda-Yamamoto causality test is used to examine the causality relationship between economic growth and employment variables.

Findings – While the jobless growth hypothesis is not valid in 7 member states of the EU, it is valid in the remaining 20 countries.

Discussion – In 7 EU member states (Bulgaria, Czechia, Finland, Germany, Luxembourg, Portugal and Romania), economic growth leads to employment, which means that the jobless growth hypothesis is not valid in these countries. In the remaining 20 countries, it is found that economic growth does not cause employment and therefore the jobless growth hypothesis is valid. This result means that although economic growth has been realized in 20 countries, employment has not increased.

1. Introduction

Economic growth and employment variables are considered as success indicators of national economies and are indispensable elements of economic policies of many countries, especially developed countries (Sodipe and Ogunrinola, 2011: 232). Economic growth means the increase in the total or per capita amount of goods and services produced (Yılmaz, 2005: 64). Employment, on the other hand, emerges as a result of the production process and means the use of labor force in order to realize production (Turhan and Erdal, 2022: 67). In this context, there is a general idea in the economic literature that if economic growth is realized, employment rates will also increase (Çondur et al., 2016: 1066). In other words, the increase in goods and services produced is expected to lead to an increase in the labor force used to produce them. When the results of recent analyses are analyzed, it is seen that contrary results have emerged. Although economic growth has increased in some countries, especially in European countries, it is noteworthy that employment rates have decreased. This situation, which is one of the most important issues that economists have emphasized in recent years, is referred to as "jobless growth" (Atabey, 2020: 724).

In addition to economic growth and employment, unemployment is another concept that is extremely important for national economies. The fact that the phenomenon of unemployment is not taken into account when evaluating the relationship between economic growth and employment causes the evaluations to remain quite limited (Merdan, 2023: 146). Because the labor force constitutes the part of the population that participates in production and consists of the sum of employed individuals and unemployed people (Apaydın, 2018: 164). Therefore, addressing the impact of economic growth on only a portion of the labor force leads to an incomplete evaluation. In addition, the literature is dominated by the idea that economic growth increases employment rates and reduces unemployment rates. Especially in recent years, it is observed that unemployment rates have increased along with economic growth in the process of growth that does not generate employment (Altuntepe and Güner, 2013: 73).

Developments in the opposite direction of these expectations in the relationship between economic growth and employment and unemployment may also occur in terms of the relationship between employment and

Suggested Citation
Yağmur, İ. (2025). Jobless Growth in the European Union: Panel Fourier Toda-Yamamoto Causality Test, Journal of Business Research-Turk, 17 (2), 1648-1665.

unemployment (Bayrak, 2019: 303). It is observed that the relationship between employment and unemployment does not always materialize as expected. The general expectation in this regard is that unemployment will decrease while employment rates increase. However, in some cases, this expected negative relationship does not emerge due to the effects of various factors (Kosfeld and Dreger, 2006: 527). Since this relationship between economic growth, employment and unemployment variables has a complex structure, these variables should be evaluated together (Takım, 2010: 317). For this reason, policy makers need to identify the situations that prevent economic growth and employment growth, and determine and enact the policies necessary to overcome such obstacles.

The main objective of the study is to test the validity of the jobless growth hypothesis for the economies of the EU member states with annual data covering the period 1991-2022 by using employment rate and growth rate data separately with the Panel Fourier Toda-Yamamoto causality test from growth to employment and from employment to growth. The data set ends in 2022. The reason for this is that employment data for 2023 has not yet been entered in some countries. For this purpose, in the analysis section of the study, cross-sectional dependence, homogeneity test, and Panel Fourier LM unit root test were first performed on the variables. Subsequently, inverse roots of the AR characteristic polynomial, autocorrelation, and heteroskedasticity tests were applied. Finally, the Panel Fourier Toda-Yamamoto causality test was used to examine the causality relationship between economic growth and employment variables. To the best of our knowledge, there is no comprehensive study that includes all EU member countries in the analysis using these variables and analysis method. This study is believed to contribute to the literature thanks to the new generation methodology used in this study, the country group and the recent data.

This study consists of five main sections. After the introduction, there is a literature review on the validity of the jobless growth hypothesis, followed by a section explaining the dataset and methodology, then the findings from the econometric analysis, and finally a section that presents the conclusion of the study and policy recommendations.

2. Literature Review

In the literature, an increase in employment rates is expected in case of economic growth. However, as a result of the analyzes, it has been observed that the opposite results have emerged recently. This situation leads to an intensification of research on economic growth and employment. In this framework, in this section of the study, recent, national and international empirical studies on the validity of the jobless growth hypothesis are presented chronologically.

İçellioğlu (2018) analyzed the effect of growth rates in national income per capita on the labor force participation rate of women and men using annual data for Latvia, Lithuania and Estonia for the period 2000-2016 using Hausman, Durbin-Watson and Baltagi-Wu tests. The results show that the growth in GDP per capita in the countries considered decreases the labor force participation rate of women, while there is no statistically significant effect on the labor force participation rate of men.

Abraham (2019) tested the validity of the jobless growth hypothesis for the Indian economy using data covering the period 1993-1994 and 2011-2012 with employment data obtained from the National Sample Survey. According to the results, the jobless growth hypothesis is valid.

Bölükbaş (2019a) analyzed the relationship between growth and unemployment and inflation using annual data covering the period 2005-2017 for 17 different regions in Türkiye with the ARDL (Autoregressive Distributed Lag Bound Test) model and Dumitrescu-Hurlin (2012) panel causality test. The results show that the hypothesis of jobless growth is valid.

Bölükbaş (2019b) analyzed the relationship between employment, unemployment and youth unemployment and growth for 7 Balkan countries by using the Kónya (2006) causality test for the period 1996-2017. According to the results, since there is a unidirectional causality from growth to employment in Croatia and Greece, the hypothesis of jobless growth employment is not valid in these countries.

Karlılar and Kıral (2019) analyzed the relationship between female labor force participation rate and growth for 4 country-income groups covering the period 1996-2017 with the Generalized Method of Moments. The results show that for upper-middle-income and high-income countries, the first effect of growth on female labor force participation rates is decreasing and the second effect is increasing, while for lower-middle-income and low-income countries, growth has a first increasing and second decreasing effect on female labor force participation rates.

Meyer and Sanusi (2019) analyzed the validity of the jobless growth hypothesis using Johansen cointegration and Vector Error Correction Models (VECM) using quarterly data covering the period 1995:Q1-2016:Q4 for South Africa. According to the results, the jobless growth hypothesis is not valid for the South African economy.

Petek and Çelik (2019) examined the relationship between female labor force employment and growth using the Kónya (2006) causality test for Türkiye and the last 14 EU member states for the period 2000-2017. Since the results show that there is a causality relationship from growth to female employment, the hypothesis of jobless growth is not valid in the countries considered.

Tekgül (2019) examined the effects of industrialization on growth, employment and mean productivity of the labor force with the ARDL approach using data covering the periods 1930-1979 and 1980-2017 for the Turkish economy. The results show that there is a positive relationship between an increase in output and employment in the manufacturing industry and a negative relationship between an increase in labor productivity and employment in both periods.

Tunçsiper and Sayın (2019) analyzed the impact of young female and male employment rates on growth using quarterly data covering the period 2014-2019 for the Turkish economy with the Vector Autoregressive Model. Since the results show that there is a unidirectional causality relationship between growth and employment of young women and a bidirectional causality relationship between employment of young men, the jobless growth hypothesis is not valid in Türkiye.

Atabey (2020) analyzed the relationship between gender-based employment and growth using quarterly data covering the period 2006-2019 for the Turkish economy with the Toda-Yamamoto (1995) causality test. The results show that the jobless growth hypothesis is valid for Türkiye.

Barın et al. (2020), using data covering the period 2004-2016 for 20 member countries of the Organization of Islamic Cooperation, analyzed the effect of the ratio of female labor force participation rates to male labor force participation rates on economic growth with Levin, Lin and Chu; Im, Peseran and Shin and ADF-Fisher tests. According to the results, female employment positively affects growth.

Canbay (2020) analyzed the relationship between economic growth and unemployment using data covering the 1991-2018 period for BRICS-T countries with the Kónya (2006) causality test. According to the results, there is a unidirectional and negative relationship between growth and unemployment in Brazil, India, South Africa and Russia.

Kopuk and Meçik (2020) analyzed the effect of the amount of foreign trade obtained in the manufacturing industry and agriculture sectors on growth with Johansen cointegration and Granger causality tests using data covering the 1998:Q1-2020:Q1 period for the Turkish economy. According to the results, there is a unidirectional relationship from the agricultural sector to growth.

Kucharski and Kwiatkowski (2020) analyzed the validity of the jobless growth hypothesis using the Ordinary Least Squares method using data covering the period 2000-2019 for Poland and EU countries. The results show that the lowest jobless growth is valid in Poland.

Öztürk (2020) examined the validity of the jobless growth hypothesis in Türkiye for the period 1988-2018 using the Hatemi-J and Roca (2014) asymmetric causality test. According to the results, the jobless growth hypothesis is valid for Türkiye.

Tumanoska (2020) analyzed the relationship between unemployment and growth for the total and youth population with the ARDL model using annual data covering the period 1991-2017 for 7 Southeast European countries and 14 EU countries. According to the results, there is a negative relationship between unemployment and growth in both country groups.

Tütüncü and Zengin (2020) examined the relationship between growth and women's employment using data covering the period 1991-2016 for E7 countries with the multi-break cointegration test developed by

Westerlund (2006) and the Common Correlated Effects panel cointegration estimator. According to the results, the jobless growth hypothesis is not valid in Brazil, China, India and Russia.

Uslu (2020) examined the validity of the jobless growth hypothesis for Türkiye by using Maki (2012) cointegration and VECM-based causality tests using data covering the periods 1923-1971, 1972-2019 and 1923-2019. The results show that the jobless growth hypothesis is valid for the period 1972-2019 in the Turkish economy.

Impin and Kok (2021) analyzed the effects of inflation, interest rate and unemployment rate variables on growth using ARDL method and Toda-Yamamoto causality test using data covering the period 2010-2018 for the Malaysian economy. The results show that there is no long-run relationship between unemployment rate and growth, and there is a unidirectional causality relationship from economic growth to unemployment rate.

Albayrak (2022) analyzed whether employment in the industrial and service sectors causes growth or not by using annual data covering the period 1999-2021 for the Turkish economy with the ARDL cointegration method. According to the results, employment in the industrial sector positively affects growth in the short and long run, while employment in the services sector positively affects growth in the short run.

Göksu (2022) analyzed the validity of the jobless growth hypothesis for the Turkish economy using monthly data covering the period 2014:M1-2022:M4 using ARDL method and Toda-Yamamoto causality test. According to the results, the jobless growth hypothesis is not valid for Türkiye.

Özer (2022) tested the relationship between growth and unemployment using the Fractional Frequency Fourier ARDL bounds test approach and the Fractional Frequency Fourier Toda-Yamamoto causality test using data covering the period 2005:Q1-2021:Q1 for the Turkish economy. The results show that there is a unidirectional and negative relationship between growth and unemployment and that the jobless growth hypothesis is not valid in Türkiye.

Şahin (2022) tested the relationship between female employment and growth using the Driscoll-Kraay panel data method using data covering the period 2009-2020 for 31 European countries. The results show that female employment positively affects economic growth.

Turhan and Erdal (2022) examined the relationship between growth and agricultural employment using the Granger causality test using data covering the period 1990-2019 for the Turkish economy. The results show that there is a unidirectional causality relationship between agricultural growth and agricultural employment and a unidirectional causality relationship between agricultural employment and total employment. Since a causal relationship is found between the variables, the the jobless growth hypothesis is not valid in Türkiye.

Uğur and Kütükçü (2022) examined the effect of growth on unemployment by using the LM Bootstrap cointegration test for D-8 countries for the period 1991-2018. According to the results, economic growth reduces unemployment.

Baskak (2023) analyzed the effect of sectoral employment rates on growth by using the Dumitrescu-Hurlin (2012) panel causality test for Turkic Republics using data for the period 1991-2019. According to the results, the hypothesis of jobless growth is not valid in the Turkic Republics.

Çiğdem et al. (2023) examined the validity of the jobless growth hypothesis for the Turkish economy by using the data on women’s employment and growth covering the period 1990-2021 with Granger causality test. According to the results, the jobless growth hypothesis is not valid in Türkiye.

Özgün (2023) examined the relationship between growth and services sector employment by using data covering the period 1998-2021 for the Turkish economy with Engle-Granger cointegration analysis and Granger causality test. According to the results, the hypothesis of jobless growth is not valid in Türkiye.

Yıldırım and Engeloğlu (2023) examined the relationship between sectoral employment rates and growth by using quarterly data covering the period 2000:Q1-2022:Q3 for the Turkish economy with Johansen cointegration and Granger causality tests. The results show that agricultural, construction and service sector employment affect growth, while industrial sector employment does not affect growth.

Aktop (2024) analyzed the relationship between youth employment and exports, imports and growth variables with Toda-Yamamoto causality test using data covering the period 2005:Q1-2022:Q4 for the Turkish economy. Since the results show that there is a causality relationship from growth to youth employment, the hypothesis of jobless growth is not valid in Türkiye.

An analysis of empirical studies reveals that the periods, countries, country groups and methods used in the analysis are different. This situation causes the results obtained regarding the validity of the jobless growth hypothesis to differ from each other. In this context, the literature review reveals that there are studies that reach different conclusions on the validity of the jobless growth hypothesis.

3. Data and Methodology

In this study, economic growth and employment data are used to test whether the jobless growth hypothesis is valid in EU countries. The data are obtained from the World Bank database. The economic growth and employment series to be analyzed are selected annually with a total number of 32 observations and cover the period 1991-2022. The data set ends in 2022. The reason for this is that employment data for 2023 have not yet been entered in some countries. In order to test the hypothesis of jobless growth in EU countries, firstly, cross-section dependence test, homogeneity test and Panel Fourier LM unit root test were applied to determine the stationarity test with econometric analysis programs. Then, the inverse roots of the AR characteristic polynomial, correlation and heteroskedasticity tests, and the Panel Fourier Toda-Yamamoto causality test, which is a current and new generation method, were used to examine the causality relationship between economic growth and employment variables.

In the model established to test whether the jobless growth hypothesis is valid in EU countries; GDP rates (GDP) representing economic growth as the dependent variable and employment rates (EMP) as the independent variable. The panel model in which all variables included in the analysis are defined is constructed as in equation 1:

$$GDP_{it} = a_{it} + \beta_1 EMP_{it} + \varepsilon_{it} \tag{1}$$

In the model, α_{it} represents country-specific fixed effects, β is the slope coefficient, ε_{it} is the error term, t=1991,...,2022 is the time period, i= 1,2,3,...,27 is the number of countries, GDP_{it} is economic growth and EMP_{it} is the employment variable.

3.1. *Cross-Section Dependence and Homogeneity Test*

In panel data analysis methods, it is very important to determine whether the series in the cross-section affect each other or not. For this purpose, the study utilizes the LM test, which was first developed by Breusch and Pagan (1980), for the existence of cross-section dependence:

$$CD_{LM1} = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij}^2 \tag{2}$$

$\hat{\rho}_{ij}^2$ in Equation 2 represents the sample estimate of the pairwise correlations between the variables in the panel data (Kılıç et al., 2024: 5). The LM test statistics developed by Breusch and Pagan (1980) follow an asymptotic distribution under the null hypothesis. Pesaran (2004) developed another test that can be used for large values of N and T:

$$CD_{LM2} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T\hat{\rho}_{ij}^2 - 1)\,, N(0,1) \tag{3}$$

N is the number of cross-sectional units and T is the time dimension of the panel data. The Pesaran (2004) test statistics, called CD_{LM2}, are characterized as a scaled-up version of the CD_{LM1} test statistics (Pesaran, 2004: 5):

The cross-section dependence is finally formulated by the LM_{adj} test proposed by Pesaran et al. (2008) and they correct the bias in the LM test by using the exact mean and variance of the LM test:

$$LM_{adj} = \sqrt{\left(\frac{2}{N(N-1)}\right)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{\upsilon_{Tij}}}\,, N(0,1) \tag{4}$$

In Equation 4, k represents the number of regressors, μ_{Tij} the mean and υ_{Tij} the variance (Kızılkaya, 2021: 383). The main hypothesis and alternative hypothesis for cross-section dependence are as follows:

H_0: There is no cross-section dependence.

H_1: There is cross-section dependence.

When the probability values of the test statistics are higher than the significance levels, the null hypothesis of no cross-section dependence cannot be rejected. When the probability values are lower than the significance levels, it is understood that the series contain cross-section dependence and the null hypothesis is rejected (Canbay, 2020: 6).

After analyzing the cross-section dependence, the formulation proposed by Pesaran and Yamagata (2008) in equations 5 and 6 is used to investigate whether the structure between the series is homogeneous:

$$\tilde{\Delta}= \sqrt{N}\left(\frac{N^{-1}\tilde{S}-k}{\sqrt{2k}}\right) \tag{5}$$

$$\tilde{\Delta}_{adj}= \sqrt{N}\left(\frac{N^{-1}\tilde{S}-\mathrm{E}(\tilde{z}_{iT})}{\sqrt{Var(\tilde{z}_{iT})}}\right) \tag{6}$$

In these equations, N and k represent the number of cross-sections and explanatory variables, $\tilde{S}$ represents the adjusted Swamy test statistic and independent random variables with bounded mean and variance, respectively (Demir and Görür, 2020: 20).

H_0: $\beta_i = \beta$, ∀i Slope coefficients are homogeneous.

H_1: $\beta_i \neq \beta_j$ Slope coefficients are not homogeneous.

When the probability values of the test statistics obtained from Equations 5 and 6 are greater than the critical values, it is concluded that the slope coefficients are homogeneous and the null hypothesis cannot be rejected. When the probability values obtained are smaller than the critical values, it is understood that they do not have a homogeneous structure and the alternative hypothesis is valid by rejecting the null hypothesis (Doğanay and Değer, 2017: 133).

3.2. *Panel Fourier LM Unit Root Test*

Panel Fourier LM unit root test was developed by Nazlıoğlu and Karul (2017) and they estimated a regression model for this test. In this test method, the stationarity of a time series is investigated. In this context, the Panel Fourier LM unit root test tests the null hypothesis that the coefficients on the lagged dependent variable are equal to zero after estimating a regression model (Özbek, 2021: 158-159). The stationarity analysis of the variables is given in equation 7:

$$\Delta y_{it} = \delta_{0i} + \delta_{1i}\Delta \sin\left(\frac{2\pi kt}{T}\right) + \delta_{2i}\Delta \cos\left(\frac{2\pi kt}{T}\right) + \varepsilon_{it} \tag{7}$$

P_{LM} and Z_{LM} values are calculated with the formulas in equations 8 and 9. The panel statistic P_{LM} is obtained by averaging the individual statistics in equation 8.

$$P_{LM}(k) = N^{-1}\sum_{i=1}^{N}\tilde{\tau}_i(k) \tag{8}$$

$$Z_{LM}(k) = \frac{\sqrt{N}\big(P_\tau(k) - \xi(k)\big)}{\zeta(k)} \sim N(0,1) \tag{9}$$

The asymptotic distribution of $\tilde{\tau}_i(k)$ depends on $\xi(k)$ and $P_{LM}(k)$ tends to a standard normal distribution with mean and variance $\xi(k)$ and $\zeta^2(k)$, respectively. Moreover, to compute the test statistic, it is necessary to know the numerical values of the mean $\xi(k)$ and variance $\zeta^2(k)$. These values are obtained from Monte Carlo simulation of the limiting distribution of the test statistic in the absence of a closed-form expression (Nazlıoğlu and Karul, 2017: 5-6).

3.3. *Panel Fourier Toda-Yamamoto Causality Test*

Panel causality test is a statistical method used to determine the direction of causality between variables in panel data. As panel data represent data with cross-sectional and time series dimensions, the Fourier approach allows analyzing such data. As structural breaks affect the results of unit root and cointegration tests, they also affect the results of causality tests (Yılancı and Görüş, 2020). In this context, Enders and Jones (2016) consider structural breaks in the VAR (Vector Autoregressive) test model and propose a new causality test by augmenting it with a Fourier function. Since a small number of low-frequency components can capture structural changes, there is no need to predetermine the number, dates and patterns of breaks. However, Nazlıoğlu et al. (2016) proposed a causality test by augmenting the Toda-Yamamoto method with the Fourier function.

Yılancı and Görüş (2020) proposed a panel version of the Fourier Toda-Yamamoto test to test the null hypothesis of no causality in the panel framework. In this framework, the causality relationship between variables is formulated as in equations 10 and 11:

$$y_{\mathrm{i,t}} = \mu_{\mathrm{i}} + \sum_{j=1}^{k_{\mathrm{i}}+d_{\max_i}} A_{11} y_{\mathrm{i,t-j}} + \sum_{j=1}^{k_{\mathrm{i}}+d_{\max_i}} A_{12} x_{\mathrm{i,t-j}} + A_{13} \sin\left(\frac{2\pi t f_{\mathrm{i}}}{T}\right) + A_{14} \cos\left(\frac{2\pi t f_{\mathrm{i}}}{T}\right) + u_{\mathrm{i,t}} \quad (10)$$

$$x_{\mathrm{i,t}} = \mu_{\mathrm{i}} + \sum_{j=1}^{k_{\mathrm{i}}+d_{\max_i}} A_{21} y_{\mathrm{i,t-j}} + \sum_{j=1}^{k_{\mathrm{i}}+d_{\max_i}} A_{22} x_{\mathrm{i,t-j}} + A_{23} \sin\left(\frac{2\pi t f_{\mathrm{i}}}{T}\right) + A_{24} \cos\left(\frac{2\pi t f_{\mathrm{i}}}{T}\right) + u_{\mathrm{i,t}} \quad (11)$$

In the above equations, π = 3.1416, t is the trend term and T is the sample size. The value f_{i} denotes a specific frequency. To test the null hypothesis of no causality, equations 10 and 11 are first estimated separately for each country. Before calculating the bootstrap p-value, a Wald test is applied to the restriction of the first k lags for the relevant variables (Yurtkuran, 2022: 295-296). Yılancı and Görüş (2020) formulated the Panel Fourier Toda-Yamamoto causality test as in equation 12:

$$\mathrm{FTYP} = -2 \sum_{i=1}^{N} ln(p_{\mathrm{i}}^{*}) \quad (12)$$

In equation 12, p_{i}^{*} denotes the bootstrap p values corresponding to the Wald statistic for the i-th individual cross-section. Yılancı and Görüş (2020) used the bootstrap technique in the causality test for cross-section-dependent panels proposed by Emirmahmutoğlu and Köse (2011) since the limit distribution of the Fisher test statistic is not correct in the presence of a cross-section. This test allows for endogenous determination of the number, location and shape of breaks. In addition, the results of individual Fourier Toda-Yamamoto tests can be found with this test and cross-sectional dependencies between units are also taken into account.

4. Empirical Findings

In this study, the economic growth and employment variables are analyzed with the help of Panel Fourier LM unit root and Panel Fourier Toda-Yamamoto causality tests with annual data covering the period 1991-2022. In this section of the study, firstly, descriptive statistics of the variables are presented. Then, the results of the cross-section dependence test, homogeneity test of slope coefficients and Panel Fourier LM unit root test are discussed. After that, correlation and heteroskedasticity issues in the model were checked. Finally, in order to examine the causality relationship between the variables, the results of the Panel Fourier Toda-Yamamoto causality test from growth to employment and from employment to growth are presented.

Table 1. Descriptive Statistics of Variables

	EMP	**GDP**	**EMP**	**GDP**	**EMP**	**GDP**
Country	**Austria**		**Belgium**		**Bulgaria**	
Mean	4.7786	1.7963	4.2250	1.8024	3.2023	1.6130
Median	4.7394	2.1688	4.2978	1.8130	3.5809	2.9443
Maximum	5.4891	4.8064	4.6732	6.9280	4.0510	7.6617
Minimum	4.3734	-6.6330	3.4902	-5.3045	1.9967	-14.1154
Std. Dev.	0.2586	2.1904	0.3016	2.0396	0.7488	5.2212
Skewness	0.9599	-2.2011	-0.7429	-1.0410	-0.7277	-1.3425
Kurtosis	3.5310	8.9655	2.8460	6.9089	1.7172	4.2496
Jarque-Bera	5.2897	73.2897	2.9754	26.1523	5.0185	11.6936
Probability	0.0710	0.0000	0.2259	0.0000	0.0813	0.0029

Sum	152.9155	57.4822	135.2010	57.6783	102.4732	51.6146
Sum Sq. Dev.	2.0735	148.7267	2.8200	128.9579	17.3831	845.1019
Observations	32	32	32	32	32	32
Country	**Croatia**		**Cyprus**		**Czechia**	
Mean	4.9924	1.2393	4.3665	3.3442	3.4859	1.9212
Median	5.0206	3.0521	4.5468	4.3332	3.5920	2.6118
Maximum	5.7894	13.0411	7.3923	9.9113	4.1733	6.7669
Minimum	4.3871	-21.0887	1.7314	-6.5875	2.3964	-11.6149
Std. Dev.	0.3295	6.5650	1.6430	3.7815	0.5451	3.7943
Skewness	0.1191	-1.5028	-0.2571	-0.7167	-0.4925	-1.6500
Kurtosis	2.6768	5.7902	2.1137	3.2413	2.0865	6.5400
Jarque-Bera	0.2149	22.4255	1.4001	2.8172	2.4062	31.2285
Probability	0.8981	0.0000	0.4966	0.2445	0.3003	0.0000
Sum	159.7581	39.6575	139.7270	107.0132	111.5500	61.4769
Sum Sq. Dev.	3.3662	1336.0920	83.6813	443.2899	9.2107	446.2865
Observations	32	32	32	32	32	32
Country	**Denmark**		**Estonia**		**Finland**	
Mean	3.8075	1.8098	2.8680	2.3783	3.9218	1.6524
Median	3.8516	1.9733	2.6965	3.9089	3.9831	2.5788
Maximum	4.3372	6.8445	4.1709	13.0500	4.5468	6.3338
Minimum	2.7985	-4.9065	1.0167	-21.1687	3.4133	-8.0744
Std. Dev.	0.3658	2.1140	0.7294	7.1486	0.2685	3.2703
Skewness	-0.6311	-0.7207	-0.2010	-1.5199	-0.0061	-1.1511
Kurtosis	2.9881	5.4323	3.0675	5.5668	2.5349	4.2482
Jarque-Bera	2.1246	10.6581	0.2215	21.1051	0.2886	9.1446
Probability	0.3457	0.0048	0.8952	0.0000	0.8656	0.0103
Sum	121.8413	57.9150	91.7758	76.1069	125.4973	52.8774
Sum Sq. Dev.	4.1479	138.5442	16.4924	1584.1890	2.2343	331.5481
Observations	32	32	32	32	32	32
Country	**France**		**Greece**		**Germany**	
Mean	4.4876	1.4813	4.7531	1.4039	7.4135	1.0049
Median	4.4483	1.8540	4.8342	1.7368	7.4438	1.9397
Maximum	5.0245	6.4352	5.2649	5.1083	8.3419	8.3799
Minimum	4.0725	-7.5405	3.8736	-5.6938	6.3237	-10.1493
Std. Dev.	0.2523	2.2501	0.3493	2.1276	0.5581	4.3840
Skewness	0.4715	-1.9287	-0.8222	-1.3964	-0.2947	-0.9917
Kurtosis	2.1812	9.9880	2.8187	6.0038	2.2770	3.5221
Jarque-Bera	2.0797	84.9490	3.6494	22.4299	1.1602	5.6091
Probability	0.3535	0.0000	0.1613	0.0000	0.5598	0.0605
Sum	143.6020	47.4031	152.0997	44.9242	237.2308	32.1562
Sum Sq. Dev.	1.9730	156.9544	3.7828	140.3298	9.6545	595.7960
Observations	32	32	32	32	32	32
Country	**Hungary**		**Ireland**		**Italy**	
Mean	4.6547	1.8653	5.1793	5.9767	6.5392	0.7676
Median	4.2880	3.1071	5.4245	5.7478	6.5927	1.2801
Maximum	7.0008	7.0612	6.1733	24.4753	7.2733	8.3102
Minimum	3.5046	-11.8920	3.7050	-5.0958	5.8795	-8.9742
Std. Dev.	0.9495	3.9031	0.6952	5.5106	0.3770	2.8471
Skewness	0.8977	-1.7897	-0.4755	0.8430	0.0298	-1.0165
Kurtosis	3.0331	6.4196	2.0491	5.6519	2.1799	7.1279
Jarque-Bera	4.2995	32.6749	2.4118	13.1671	0.9014	28.2301
Probability	0.1165	0.0000	0.2994	0.0014	0.6372	0.0000

Sum	148.9491	59.6902	165.7370	191.2549	209.2553	24.5629
Sum Sq. Dev.	27.9490	472.2711	14.9838	941.3539	4.4054	251.2777
Observations	32	32	32	32	32	32
Country	**Latvia**		**Lithuania**		**Luxembourg**	
Mean	3.6456	1.6366	2.5042	1.9722	2.3698	3.3538
Median	3.7140	2.8555	2.3023	3.7697	2.6694	2.9951
Maximum	4.7473	11.9718	3.7095	11.1075	3.9170	8.6442
Minimum	2.2652	-32.1186	1.4216	-21.2590	0.0086	-3.2390
Std. Dev.	0.6534	8.6110	0.6396	7.6092	1.0576	2.7654
Skewness	-0.1837	-2.1549	0.6927	-1.6891	-0.8634	0.0954
Kurtosis	2.1033	8.7284	2.3542	5.1902	2.7897	2.8069
Jarque-Bera	1.2521	68.5196	3.1149	21.6115	4.0344	0.0983
Probability	0.5347	0.0000	0.2107	0.0000	0.1330	0.9520
Sum	116.6603	52.3722	80.1328	63.1109	75.8344	107.3221
Sum Sq. Dev.	13.2359	2298.6520	12.6801	1794.8890	34.6736	237.0714
Observations	32	32	32	32	32	32
Country	**Malta**		**Netherlands**		**Poland**	
Mean	4.1694	4.9693	3.8043	2.0889	3.9042	3.7876
Median	4.4319	4.7473	3.8895	2.1810	3.9534	4.4166
Maximum	4.9428	19.6813	4.1147	6.1919	4.2297	7.1029
Minimum	3.4716	-8.1568	3.2539	-3.8861	3.4587	-7.0156
Std. Dev.	0.4178	4.6635	0.2473	2.1922	0.2179	2.8140
Skewness	-0.4410	0.3334	-0.9355	-0.9472	-0.4471	-1.9762
Kurtosis	1.7621	6.0202	2.6340	4.3378	2.1533	8.1805
Jarque-Bera	3.0806	12.7551	4.8461	7.1715	2.0223	56.6126
Probability	0.2143	0.0017	0.0887	0.0277	0.3638	0.0000
Sum	133.4193	159.0161	121.7383	66.8440	124.9329	121.2017
Sum Sq. Dev.	5.4121	674.1827	1.8961	148.9784	1.4717	245.4711
Observations	32	32	32	32	32	32
Country	**Portugal**		**Romania**		**Slovak Republic**	
Mean	5.6269	1.4922	1.2563	2.3031	2.7355	2.7777
Median	5.5527	1.7904	1.2438	3.8804	2.8798	3.6421
Maximum	6.5582	6.8275	1.6930	10.4281	3.5658	10.8320
Minimum	4.5980	-8.3005	0.9106	-12.9182	1.6878	-14.5738
Std. Dev.	0.6401	3.0693	0.1733	5.2832	0.5168	4.8452
Skewness	-0.0821	-1.0570	0.5803	-1.0296	-0.5068	-1.6820
Kurtosis	1.4577	4.6853	3.2532	3.7929	2.2689	6.7291
Jarque-Bera	3.2077	9.7462	1.8814	6.4914	2.0824	33.6299
Probability	0.2011	0.0077	0.3904	0.0389	0.3530	0.0000
Sum	180.0621	47.7494	40.2011	73.7001	87.5347	88.8859
Sum Sq. Dev.	12.7023	292.0450	0.9310	865.2910	8.2800	727.7546
Observations	32	32	32	32	32	32
Country	**Slovenia**		**Spain**		**Sweden**	
Mean	2.8922	2.2164	5.1013	1.9012	3.7614	2.1888
Median	2.8921	3.2480	5.1257	2.7442	3.7560	2.6129
Maximum	3.7611	8.2285	6.0062	6.4032	4.1609	6.1470
Minimum	1.6407	-8.9001	3.9925	-11.1673	3.3658	-4.3398
Std. Dev.	0.6112	3.9757	0.4061	3.3497	0.1977	2.4789
Skewness	-0.1819	-1.3886	-0.3681	-2.0470	0.0592	-0.7560
Kurtosis	2.0848	4.3463	3.6384	8.4504	2.6865	3.0884
Jarque-Bera	1.2930	12.7010	1.2661	61.9564	0.1498	3.0588
Probability	0.5239	0.0017	0.5310	0.0000	0.9278	0.2167

Sum	92.5488	70.9263	163.2423	60.8382	120.3645	70.0426
Sum Sq. Dev.	11.5799	489.9964	5.1133	347.8253	1.2112	190.4927
Observations	32	32	32	32	32	32

Descriptive statistics for employment and economic growth data for the 27 EU member states covering 32 years between 1991 and 2022 are given in Table 1 above. The data set ends in 2022. This is because employment data for 2023 have not yet been entered in some countries. According to the data in the table, the highest employment rate is calculated in Germany with 8.3% and the lowest employment rate is calculated in Luxembourg with 0.0086%. When the growth rates are analyzed, the highest growth rate was realized in Ireland with 24.4% and the lowest growth rate was realized in Latvia with -32.1%.

Table 2. Results of Cross-Sectional Dependence Tests

Test	**Cross-Sectional Dependence LM 1**		**Cross-Sectional Dependence LM 2**		**Cross-Sectional Dependence LM 3**		**Cross-Sectional Dependence LM Adjusted**	
Variables	**Test Statistics**	**Prob. Value**	**Test Statistics**	**Prob. Value**	**Test Statistics**	**Prob. Value**	**Test Statistics**	**Prob. Value**
GDP	535.9230***	0.0000	6.9790***	0.0000	-3.4810***	0.0000	3.5510***	0.0000
EMP	2836.7620***	0.0000	93.8190***	0.0000	-2.3670***	0.0090	37.0050***	0.0000

Note: *** Critical value indicates 1% significance level.

Cross-section dependence is taken into account to determine the tests to be used for stationarity testing. According to Table 2, in all 4 tests analyzing growth and employment data for 27 countries, the variables contain cross-section dependence. Therefore, the main hypothesis is rejected.

Table 3. Slope Homogeneity Test Results

Slope Homogeneity Test	**Test Statistics**	**Probability Value**
Delta Tilde	-1.723	0.958
Delta Tilde Adjusted	-1.810	0.965

According to the homogeneity of slope coefficients test results in Table 3, since the probability values of delta and adjusted delta test statistics are greater than the significance levels, it is concluded that the slope coefficients are homogeneous. Therefore, the null hypothesis that slope coefficients are homogeneous cannot be rejected.

Table 4. Panel Fourier LM Unit Root Test Results

k	**Fouriertau LM k=1**		**Fouriertau LM k=2**		**Fouriertau LM k=3**	
Variables	**GDP**	**EMP**	**GDP**	**EMP**	**GDP**	**EMP**
Austria	-3.8131	-2.1647	-3.2206	-2.6632	-3.9481	-3.1110
Belgium	-2.4377	-2.2600	-1.9794	-2.7356	-2.5572	-3.1614
Bulgaria	-6.0553	-1.5437	-5.7725	-3.1261	-5.0901	-1.9755
Croatia	-5.5339	-1.2655	-5.6836	-3.1088	-5.6219	-2.0343
Cyprus	-5.4511	-1.3786	-4.4283	-3.1652	-4.7511	-2.3417
Czechia	-8.0869	-1.5980	-3.4812	-3.0101	-4.9744	-2.3710
Denmark	-4.6847	-1.1590	-5.1597	-2.1920	-4.6322	-1.6601
Estonia	-4.5784	-1.2869	-4.6659	-2.2014	-4.2749	-1.8742
Finland	-3.5012	-1.3956	-0.8727	-1.9061	-4.8547	-1.6770
France	-6.2206	-0.8188	-6.0519	-1.3569	-5.3092	-0.9939
Greece	-5.4302	-0.1861	-5.2876	-0.4610	-4.6225	-0.4719
Germany	-6.4918	-0.1214	-5.2297	-0.4292	-6.6465	-0.4175
Hungary	-6.7068	-0.5102	-5.2332	-0.7846	-6.6941	-0.7144
Ireland	-6.6016	-0.5938	-5.8252	-0.9175	-4.8304	-0.8757
Italy	-5.6146	-0.4772	-4.4256	-0.6561	-6.1051	-0.7497

Latvia	-5.6816	-0.4682	-4.8466	-0.4832	-4.6034	-0.7002
Lithuania	-3.7657	-0.4234	-2.6956	-0.2620	-3.2351	-0.6944
Luxembourg	-2.8294	-0.8963	-2.4096	-0.7656	-2.9200	-0.9988
Malta	-3.4348	-1.8191	-2.7653	-1.5794	-3.2788	-1.9459
Netherlands	-4.6825	-1.0998	-4.4001	-0.8927	-4.2253	-1.2187
Poland	-4.6389	-0.8307	-4.2774	-0.4529	-4.7019	-0.8906
Portugal	-6.0525	-1.4500	-5.4453	-1.6157	-5.6306	-2.1140
Romania	-3.4054	-1.2527	-4.0081	-1.3671	-3.2159	-1.9654
Slovak Rep.	-5.2704	-1.1035	-6.6048	-1.3575	-4.8795	-1.9260
Slovenia	-4.0556	-0.9670	-4.3670	-1.1493	-3.8967	-1.6734
Spain	-5.3630	-0.8110	-5.7477	-0.9973	-5.3989	-1.4951
Sweden	-4.6621	-0.6292	-4.8024	-0.7605	-4.7255	-1.2759
P_{LM}	**-5.0019*** **	**-1.0559**	**-4.4328*** **	**-1.4962**	**-4.6527*** **	**-1.5307**
Z_{LM}	**-17.3245**	**16.0247**	**-15.8827**	**5.1571**	**-20.4499**	**4.2897**
Prob. Value	**0.0000**	**1.0000**	**0.0000**	**1.0000**	**0.0000**	**1.0000**

Note: *** Critical value indicates 1% significance level.

When the k values of the economic growth variable in Table 4 are analyzed, it is found that it does not contain a unit root in all 3 Fouriertau LM waves, in other words, it is stationary, and when the k values of the employment variable are analyzed, it is found that it contains a unit root in all 3 Fouriertau LM waves. The results of this test show that the variables are not stationary at the same level. For this reason, the Panel Fourier Toda-Yamamoto causality test, which takes into account the stationarity of the variables at different levels, was applied.

Figure 1 shows the graph of the inverse roots of the AR characteristic polynomial created according to the appropriate lag lengths for EU member countries, while Tables 5 and 6 show the correlation LM test results and heteroskedasticity test results, respectively.

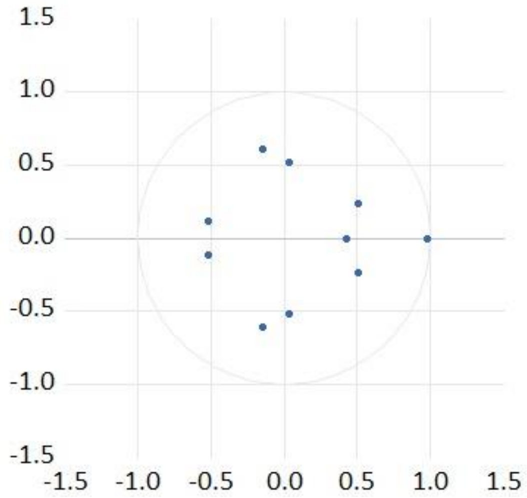

Figure 1. Inverse Roots of AR Characteristic Polynomial

The lag length has been determined as 5. Figure 1 shows that all inverse roots belonging to variables and lags are located within the unit circle.

Table 5. Correlation Test Results

Lag	LRE* stat	df	Probability
1	1.381468	4	0.8474
2	1.950215	4	0.7449
3	3.308568	4	0.5076
4	3.358055	4	0.4998
5	1.950614	4	0.7448

The correlation tests in Table 5 show that there is no significant autocorrelation problem in the model, with high probability values for all lags.

Table 6. Heteroskedasticity Test Results

Chi-sq	df	**Probability**
117.1826	60	0.1738

The probability value of 0.1738 in the heteroskedasticity test in Table 6 indicates that there is no problem of varying variance in the error variances. The study continued with the Panel Fourier Toda-Yamamoto causality test.

Table 7. Panel Fourier Toda-Yamamoto Causality Test Results from Growth to Employment

Countries	**Optimal Lag**	**Freq.**	**Wald Stat.**	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**	**Prob. Value**	**Hypothesis (GDP→EMP)**
Austria	2	3	0.231	6.273	4.640	4.463	0.850	**Valid.**
Belgium	5	3	8.703	17.254	13.523	9.100	0.150	**Valid.**
Bulgaria	5	1	73.516***	8.975	7.602	6.830	0.000	**Not valid.**
Croatia	5	3	3.921	13.619	12.137	11.130	0.700	**Valid.**
Cyprus	3	1	0.551	10.283	7.377	5.946	1.000	**Valid.**
Czechia	5	2	12.564**	16.101	11.054	10.319	0.050	**Not valid.**
Denmark	1	1	0.394	5.745	5.082	4.920	0.800	**Valid.**
Estonia	3	1	1.240	7.452	6.449	5.098	0.600	**Valid.**
Finland	1	1	2.612*	3.926	2.625	1.721	0.100	**Not valid.**
France	1	2	0.160	5.466	4.378	2.054	0.800	**Valid.**
Greece	2	1	0.265	6.154	5.141	4.582	0.850	**Valid.**
Germany	5	2	13.208*	19.676	13.351	10.845	0.100	**Not valid.**
Hungary	5	2	6.934	31.444	17.881	12.473	0.350	**Valid.**
Ireland	5	3	1.059	16.518	10.048	9.911	0.950	**Valid.**
Italy	5	1	2.696	12.027	8.387	8.366	0.800	**Valid.**
Latvia	2	2	0.185	12.066	6.945	6.223	0.900	**Valid.**
Lithuania	4	3	1.317	20.219	19.498	11.524	0.950	**Valid.**
Luxembourg	5	3	8.858*	36.846	10.154	6.994	0.100	**Not valid.**
Malta	1	2	0.471	15.217	6.494	2.718	0.450	**Valid.**
Netherlands	1	3	0.192	1.889	1.618	1.551	0.550	**Valid.**
Poland	3	1	7.830	10.205	8.485	7.833	0.150	**Valid.**
Portugal	1	1	2.708*	4.245	2.776	1.768	0.100	**Not valid.**
Romania	5	2	13.450**	15.688	11.776	10.819	0.050	**Not valid.**
Slovak Rep.	5	1	1.894	22.589	14.718	11.360	0.950	**Valid.**
Slovenia	4	1	5.222	19.034	14.105	11.335	0.250	**Valid.**
Spain	1	1	0.001	6.920	5.685	5.254	1.000	**Valid.**
Sweden	1	3	0.200	8.633	5.404	2.780	0.600	**Valid.**

Note: *, ** and *** Critical values indicate 10%, 5% and 1% significance level, respectively.

The test results of the jobless growth hypothesis, in other words, the Panel Fourier Toda-Yamamoto causality results from growth to employment are presented in Table 7. When the Wald test statistic values in the table are analyzed, it is found that Bulgaria is significant at 1%, Czechia and Romania at 5%, Finland, Germany, Luxembourg and Portugal at 10% level. These results imply that economic growth causes employment in Bulgaria, Czechia, Finland, Germany, Luxembourg, Portugal and Romania. Therefore, it is concluded that the jobless growth hypothesis is not valid in these 7 countries, while the jobless growth hypothesis is valid in the other 20 countries.

Table 8. Panel Fourier Toda-Yamamoto Causality Test Results from Employment to Growth (EMP→GDP)

Countries	Optimal Lag	Frequency	Wald Stat.	1% Critical Value	5% Critical Value	10% Critical Value	Probability Value
Austria	2	3	1.012	5.817	5.193	4.923	0.500
Belgium	5	3	7.142	25.943	20.183	17.387	0.450
Bulgaria	5	1	69.475***	18.858	13.083	10.379	0.000
Croatia	5	3	6.035	16.013	10.579	9.978	0.500
Cyprus	3	1	1.590	10.548	5.718	5.414	0.600
Czechia	5	2	1.119	24.801	22.092	17.890	0.950
Denmark	1	1	0.008	3.041	2.790	1.786	0.900
Estonia	3	1	4.329	8.932	8.670	6.647	0.150
Finland	1	1	2.695**	2.840	2.646	1.767	0.050
France	1	2	13.177***	3.268	2.555	2.511	0.000
Greece	2	1	11.933***	11.738	6.384	3.824	0.000
Germany	5	2	7.470	14.031	9.699	8.941	0.250
Hungary	5	2	0.693	19.239	11.853	11.053	0.950
Ireland	5	3	49.546***	12.203	9.857	7.817	0.000
Italy	5	1	9.712	27.641	23.342	13.986	0.250
Latvia	2	2	1.099	13.568	8.725	7.573	0.750
Lithuania	4	3	11.543*	21.663	12.515	10.515	0.100
Luxembourg	5	3	21.488**	22.832	16.697	11.923	0.050
Malta	1	2	6.536***	2.614	2.259	1.860	0.000
Netherlands	1	3	4.894**	6.481	2.884	2.784	0.050
Poland	3	1	5.151	13.987	8.524	6.956	0.250
Portugal	1	1	1.387	5.407	2.425	2.280	0.300
Romania	5	2	6.414	29.746	15.260	15.240	0.450
Slovak Rep.	5	1	13.104**	15.192	8.564	7.421	0.050
Slovenia	4	1	2.987	10.410	9.424	8.520	0.550
Spain	1	1	0.030	6.585	5.772	4.547	0.750
Sweden	1	3	2.062*	3.865	3.309	1.660	0.100

Note: *, ** and *** Critical values indicate 10%, 5% and 1% significance level, respectively.

Table 8 presents the results of the Panel Fourier Toda-Yamamoto causality test from employment to economic growth. When the Wald test statistic values in the table are analyzed, significance is found at the 1% level in Bulgaria, France, Greece, Ireland and Malta, 5% in Finland, Luxembourg, Netherlands and Slovak Republic, and 10% in Lithuania and Sweden. These significance levels imply that employment causes growth in 11 countries. In other words, in Bulgaria, Finland, France, Greece, Ireland, Lithuania, Luxembourg, Malta, Netherlands, Slovak Republic and Sweden, the employment of individuals leads to economic growth.

5. Conclusion and Policy Recommendations

The jobless growth hypothesis is defined as a failure to increase employment despite the realization of economic growth in the economy. However, in the literature, an increase in employment rates is generally expected in case of economic growth. For this purpose, the validity of the jobless growth hypothesis is tested by using the Panel Fourier LM unit root test and Panel Fourier Toda-Yamamoto causality test using annual data covering the period 1991-2022 for EU countries.

In the reviewed literature, it is seen that there are studies that reach different results in terms of the validity of the jobless growth hypothesis. Therefore, it is important for the studies on the jobless growth hypothesis that the analysis method is new and the data are up-to-date. In the study, it was concluded that the jobless growth hypothesis is valid in 20 countries. The results of the analysis support the results of Abraham (2019), Bölükbaş (2019a), Atabey (2020), Kucharski and Kwiatkowski (2020), Öztürk (2020) and Uslu (2020).

According to the results of the Panel Fourier Toda-Yamamoto causality test applied to the 27 EU member countries, it has been concluded that in countries where there is no causal relationship from economic growth to employment, the hypothesis of jobless growth is valid, while in countries where there is a causal relationship, the hypothesis of jobless growth is not valid. From this perspective, in 7 of the 27 analyzed countries (Bulgaria, Czechia, Finland, Germany, Luxembourg, Portugal, and Romania), economic growth leads to employment. This finding clearly indicates that the economic policies implemented in these countries have been successful in aligning growth processes with the capacity to create employment, and therefore, the hypothesis of jobless growth is not valid for these countries. These countries have the potential to serve as models for other EU countries by more thoroughly examining their best practices, such as labor market flexibility, effective vocational training and lifelong learning programs, policies supporting innovation and research and development, incentives for small and medium-sized enterprises, or strategic investments in sectors with high employment intensity. It is of great importance for policymakers in these countries to maintain their current productivity and efficiency in the labor market, thereby continuing the stable growth-employment relationship.

On the other hand, in the remaining 20 countries, it has been determined through the Panel Fourier Toda-Yamamoto causality test that economic growth does not lead to employment, thus validating the hypothesis of jobless growth. This critical finding necessitates a comprehensive economic discussion and investigation into the reasons why growth in these countries does not create sufficient employment. Among the fundamental economic and structural reasons underlying this situation are the rapid spread of automation and digitalization leading to job losses in some traditional sectors, the prevalence of capital-intensive production techniques, changes in global value chains and trends in outsourcing, structural rigidities in labor markets, the education system’s inability to adapt to the rapidly changing skill needs of the labor market, or inadequate/misguided active labor market programs. In some countries, demographic factors or the prevalence of the informal economy can also contribute to employment not receiving a sufficient share of growth. These results strongly emphasize the necessity of developing targeted and concrete policy interventions that take into account country-specific conditions and dynamics, rather than a uniform employment policy across the EU.

As a result of this analysis, policymakers in the 20 countries where no causal relationship was identified should undertake comprehensive revisions to maximize the employment impacts of their economic growth policies, rather than focusing solely on GDP growth. In this context, the determination of economic growth policies that can create employment should start with sectoral transformation and support; strategic investment incentives, infrastructure development, and regulatory reforms should be implemented for sectors with high employment creation potential, such as healthcare services and high-value-added tourism. Simultaneously, comprehensive education reforms focusing on the future needs of the labor market should be implemented, vocational training and lifelong learning programs should be expanded, and university-industry collaboration and apprenticeship programs should be strengthened. Regulations that increase labor market flexibility should be adopted, and the effectiveness and scope of active labor market programs such as job placement services, internships, and entrepreneurship supports should be enhanced. Additionally, tools such as tax reductions or social security premium supports that encourage employment should also be actively utilized. Finally, innovation should be directed towards areas with high employment creation potential, research and development expenditures should be increased, and bureaucratic and financial barriers that facilitate the establishment of new businesses should be removed. The increase in employment will lead to a decrease in the unemployment rate and the reintegration of idle individuals into the economy, making it possible to overcome the political, cultural, and psychological problems caused by unemployment alongside economic growth. The study provides an important framework for the EU’s future growth and employment strategies and once again highlights the need to consider micro-level differences in policies.

References

Abraham, V. (2019). Jobless Growth Through the Lens of Structural Transformation. *Indian Growth and Development Review*, 12 (2), 182-201. https://doi.org/10.1108/IGDR-07-2018-0077

Aktop, V. S. (2024). Genç İstihdamı, Dış Ticaret ve Ekonomik Büyüme: Todo-Yamamoto Nedensellik Analizi. *Erzurum Teknik Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 18, 78-93. https://doi.org/10.29157/etusbed.1307096

Albayrak, M. (2022). Sanayi ve Hizmet Sektörleri İstihdamı ile Ekonomik Büyüme İlişkisi. Küpeli, S. O., ve Fidan, A. (Ed.), *Sosyal Bilimlerde Disiplinler Arası Çalışmalar - I*, İstanbul, Efe Akademi Yayınları, 85-105.

Altuntepe, N. ve Güner, T. (2013). Türkiye'de İstihdam-Büyüme İlişkisinin Analizi (1988-2011). *Uluslararası Alanya İşletme Fakültesi Dergisi*, 5 (1), 73-84.

Apaydın, F. (2018). Türkiye'de İşsizliğin Karakteristiklerinin Karşılaştırmalı Analizi. *Süleyman Demirel Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 30, 159-200.

Atabey, A. Ö. (2020). Türkiye'deki Kadın İstihdamı, Erkek İstihdamı ve Ekonomik Büyüme Arasındaki İlişki: Toda-Yamamoto Nedensellik Testi. *Journal of Academic Social Resources*, 5 (19), 823-834. https://doi.org/10.31569/ASRJOURNAL.135

Barın, N. E., Kundak, S. and Cenikli, V. S. (2020). The Effects of Female Employment on Economic Growth: An Application of Panel Data on the Member Countries of the Organisation of Islamic Cooperation. Grima, S., Özen, E. and Boz, H. (Ed.), *Contemporary Issues in Business Economics and Finance (Contemporary Studies in Economic and Financial Analysis*, 104, Leeds, Emerald Publishing Limited, 29-44.

Baskak, T. E. (2023). Türk Cumhuriyetlerinde Sektörel İstihdam Oranları ile Büyüme İlişkisi. *İzmir İktisat Dergisi*, 38 (4), 908-929. https://doi.org/10.24988/ije.1193779

Bayrak, S. (2019). Ekonomik Büyüme, İstihdam ve İşsizlik İlişkisi: Geniş Tanımlı İşsizlik Oranları ile Türkiye Üzerine Bir Araştırma. *Anemon Muş Alparslan Üniversitesi Sosyal Bilimler Dergisi*, 7 (6), 301-310. https://doi.org/10.18506/anemon.523421

Bölükbaş, M. (2019a). Türkiye'de Ekonomik Büyümenin Enflasyon ve İşsizlik ile İlişkisi: Bölgeler Düzeyinde Bir Araştırma. *TESAM Akademi Dergisi*, 6 (Türkiye Ekonomisi Özel Sayısı), 185-211. https://doi.org/10.30626/tesamakademi.584294

Bölükbaş, M. (2019b). The Relationship of Economic Growth with Employment, Unemployment and Youth Unemployment in the Balkan Countries: An Empirical Analysis. *İzmir İktisat Dergisi*, 34 (3), 385-398. https://doi.org/10.24988/ije.2019343863

Breusch, T. S. and Pagan, A. R. (1980). The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics. *The Review of Economic Studies*, 47 (1), 239-253. https://doi.org/10.2307/2297111

Canbay, Ş. (2020). İktisadi Büyüme ile İşsizlik Arasındaki İlişkilerin Kónya (2006) Panel Nedensellik Testi ile Sınanması: BRICS Ülkeleri ve Türkiye Örneği. *International Journal of Innovative Approaches in Social Sciences*, 4 (1), 1-18. https://doi.org/10.29329/ijiasos.2020.250.1

Çiğdem, G., Çelik, B. S. ve İmre, S. (2023). Kadınların İşgücüne Katılım Oranı-İktisadi Büyüme İlişkisi: Türkiye'den Ampirik Kanıtlar. *Uluslararası Eşitlik Politikası Dergisi*, 3 (1), 99-119.

Çondur, F., Erol, H. ve Göcekli, S. G. B. (2016). Türkiye'de Ekonomik Büyüme ve İstihdam İlişkisi. *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi*, 30 (5), 1065-1079.

Demir, Y. ve Görür, Ç. (2020). OECD Ülkelerine Ait Çeşitli Enerji Tüketimleri ve Ekonomik Büyüme Arasındaki İlişkinin Panel Eşbütünleşme Analizi ile İncelenmesi. *EKOIST: Journal of Econometrics and Statistics*, 32, 15-33. https://doi.org/10.26650/ekoist.2020.32.0005

Doğanay, M. A. ve Değer, M. K. (2017). Yükselen Piyasa Ekonomilerinde Doğrudan Yabancı Yatırımlar ve İhracat İlişkisi: Panel Veri Eşbütünleşme Analizleri (1996-2014). *Çankırı Karatekin Üniversitesi İİBF Dergisi*, 7 (2), 127-145. https://doi.org/10.18074/ckuiibfd.345332

Dumitrescu, E. I. and Hurlin, C. (2012). Testing for Granger Non-causality in Heterogeneous Panels. *Economic Modelling*, 29 (4), 1450-1460. https://doi.org/10.1016/j.econmod.2012.02.014

Emirmahmutoğlu, F. and Köse, N. (2011). Testing for Granger Causality in Heterogeneous Mixed Panels. *Economic Modelling*, 28 (3), 870-876. https://doi.org/10.1016/j.econmod.2010.10.018

Enders, W. and Jones, P. (2016). Grain Prices, Oil Prices, and Multiple Smooth Breaks in a VAR. *Studies in Nonlinear Dynamics & Econometrics*, 20 (4), 399-419. https://doi.org/10.1515/snde-2014-0101

Göksu, S. (2022). İstihdam Yaratmayan Büyüme Hipotezi Türkiye İçin Geçerli Mi? Öndoğan, Z. (Ed.), *6. Uluslararası İzmir İktisat Kongresi*, 29-30 Ağustos, İzmir, İKSAD Publishing House, 76-82.

Hatemi-J, A. and Roca, E. (2014). BRICs and PIGs in the Presence of Uncle Sam and Big Brothers: Who Drive Who? Evidence Based on Asymmetric Causality Tests. Dr. Alexandr Akimov (Ed.), *Griffith Business School Discussion Papers Finance*, 1-19.

Impin, P. D. A. and Kok, S. C. (2021). The Effect of Inflation Rate, Interest Rate and Unemployment Rate on the Economic Growth of Malaysia. *Malaysian Journal of Business and Economics*, 8 (1), 125-140. https://doi.org/10.51200/mjbe.vi.3322

İçellïoğlu, C. Ş. (2018). Kişi Başı Milli Gelirdeki Büyümenin Kadınların İşgücüne Katılımı Üzerindeki Etkisi: Baltık Ülkeleri Üzerine Panel Veri Uygulaması. *Hitit Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 11 (3), 1877-1888. https://doi.org/10.17218/hititsosbil.412063

Karlılar, S. ve Kıral, G. (2019). Kadın İşgücüne Katılımı ve Ekonomik Büyüme Arasındaki İlişki: Ülke Grupları İçin Panel Veri Analizi. *Üçüncü Sektör Sosyal Ekonomi Dergisi*, 54 (2), 935-948. https://doi.org/10.15659/3.sektor-sosyal-ekonomi.19.04.1099

Kılıç, C., Soyyiğit, S., Bayar, Y. and Bekun, F. V. (2024). Exploration on Terrorism, Ecological Footprint and Environmental Sustainability in Countries with the Most Terrorism Antecedent: Accessing Evidence from Panel Fourier Analysis. *Heliyon*, 10 (1), 1-15. https://doi.org/10.1016/j.heliyon.2023.e22849

Kızılkaya, F. (2021). Ekonomik Büyüme ve Sağlık Harcamaları: OECD Ülkeleri İçin Panel Fourier Nedensellik Testi. *Dicle Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 11 (22), 376-392. https://doi.org/10.53092/duiibfd.969813

Kónya, L. (2006). Exports and Growth: Granger Causality Analysis on OECD Countries with a Panel Data Approach. *Economic Modelling*, 23 (6), 978-992. https://doi.org/10.1016/j.econmod.2006.04.008

Kopuk, E. ve Meçik, O. (2020). Türkiye'de İmalat Sanayi ve Tarım Sektörlerinin Ekonomik Büyüme Üzerine Etkisi: 1998-2020 Dönemi Analizi. *Yönetim ve Ekonomi Dergisi*, 27 (2), 263-274. https://doi.org/10.18657/yonveek.693387

Kosfeld, R. and Dreger, C. (2006). Thresholds for Employment and Unemployment: A Spatial Analysis of German Regional Labour Markets, 1992-2000. *Papers in Regional Science*, 85 (4), 523-542. https://doi.org/10.1111/j.1435-5957.2006.00096.x

Kucharski, L. and Kwiatkowski, E. (2020). The Role of Labour Inputs in Contemporary Trends of Economic Growth. *CEJSH*, 16 (1), 2-7. https://doi.org/10.5604/01.3001.0014.5532

Maki, D. (2012), Tests for Cointegration Allowing for an Unknown Number of Breaks. *Economic Modelling*, 29 (5), 2011-2015. https://doi.org/10.1016/j.econmod.2012.04.022

Merdan, K. (2023). Ekonomik Büyüme, İşsizlik ve İstihdam İlişkisi: Türkiye Örneği. *Yönetim ve Ekonomi Dergisi*, 30 (100. Yıl Özel Sayısı), 145-166. https://doi.org/10.18657/yonveek.1361775

Meyer, D. F. and Sanusi, K. A. (2019). A Causality Analysis of the Relationships Between Gross Fixed Capital Formation, Economic Growth and Employment in South Africa. *Studia Universitatis Babes-Bolyai Oeconomica*, 64 (1), 33-44. https://doi.org/10.2478/subboec-2019-0003

Nazlıoğlu, Ş. and Karul, Ç. (2017). Panel LM Unit Root Test with Gradual Structural Shifts. *40th International Panel Data Conference*, 7 (8), 1-26.

Nazlıoğlu, Ş., Görmüş, A. and Soytaş, U. (2016). Oil Prices and Real Estate Investment Trusts (REITs): Gradual-shift Causality and Volatility Transmission Analysis. *Energy Economics*, 60, 168-175. https://doi.org/10.1016/j.eneco.2016.09.009

Özbek, S. (2021). Gelişmekte Olan Ülkelerde Dış Borçların Sürdürülebilirliğinin Analizi: Yeni Nesil Panel Birim Kök Testlerinden Kanıtlar. *Bilgi Ekonomisi ve Yönetimi Dergisi*, 16 (2), 155-163. https://doi.org/10.54860/beyder.976463

Özer, M. O. (2022). Ekonomik Büyüme ve İşsizlik Oranı Arasındaki İlişki: Kesirli Frekanslı Fourier ARDL Sınır Testi Yaklaşımı. *İstanbul İktisat Dergisi*, 72 (1), 269-292. https://doi.org/10.26650/ISTJECON2022-1020006

Özgün, F. (2023). Türkiye'de Hizmetler Sektörü İstihdamı ile Ekonomik Büyüme Arasındaki İlişki. *Uluslararası Ekonomi ve Yenilik Dergisi*, 9 (1), 69-93. https://doi.org/10.20979/ueyd.1198463

Öztürk, M. (2020). Küreselleşme Sürecinde Ekonomik Büyümenin İşsizlik Türleri Üzerindeki Etkisi. *Bilgi Sosyal Bilimler Dergisi*, 22 (1), 45-68.

Pesaran, M. H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. *CESifo*, Working Paper Series No. 1229; IZA Discussion Paper No. 1240, 1-41. https://www.ssrn.com/abstract=572504

Pesaran, M. H. and Yamagata, T. (2008). Testing Slope Homogeneity in Large Panels. *Journal of Econometrics*, 142 (1), 50-93. https://doi.org/10.1016/j.jeconom.2007.05.010

Pesaran, M. H., Ullah, A. and Yamagata, T. (2008). A Bias-adjusted LM Test of Error Cross-section Independence. *The Econometrics Journal*, 11 (1), 105-127. https://doi.org/10.1111/j.1368-423X.2007.00227.x

Petek, A. ve Çelik, N. (2019). Kadın İşgücü İstihdamı ile Ekonomik Büyüme Arasındaki İlişkinin Türkiye-Seçilmiş AB Ülkeleri Açısından Karşılaştırmalı Nedensellik Analizi. Harun, B. (Ed.), Ankara, Akademisyen Kitabevi, 153-169.

Sodipe, O. A. and Olurinola, O. (2011). Employment and Economic Growth Nexus in Nigeria. *International Journal of Business and Social Science*, 2 (11), 232-239.

Şahin, D. K. (2022). Kadın İstihdamının Ekonomik Büyümeye Etkisi: Ampirik Bir Analiz. *Uluslararası Ekonomi ve Yenilik Dergisi*, 8 (2), 277-288, https://doi.org/10.20979/ueyd.1135131

Takım, A. (2010). Türkiye'de Ekonomik Büyüme ile İşsizlik Arasındaki İlişki: Granger Nedensellik Testi. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, *27,* 315-324.

Tekgül, Y. (2019). Sanayileşme ve İstihdam Üzerine Kaldor ve Prebisch Karşıtlığı: Türkiye Ekonomisi Üzerine Bir Uygulama. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 28 (2), 134-148. https://doi.org/10.35379/cusosbil.588887

Toda, H. Y. and Yamamoto, T. (1995). Statistical Inference in Vector Autoregressions with Possibly Integrated Processes. *Journal of Econometrics*, 66 (1-2), 225-250. https://doi.org/10.1016/0304-4076(94)01616-8

Tumanoska, D. (2020). The Relationship between Economic Growth and Unemployment Rates: Validation of Okun's Law in Panel Context. *Research in Applied Economics*, 12 (1), 33-55. https://doi.org/10.5296/rae.v12i1.16665

Tunçsiper, B. ve Sayın, F. (2019). Türkiye'de Genç Kadın ve Erkek İstihdamının Ekonomik Büyümeye Etkisi. Erarslan, M. (Ed.), *ICHES Uluslararası İnsani Bilimler ve Eğitim Bilimleri Kongresi*, 8-10 Kasım, İzmir, Asos Yayınevi, 241-250.

Turhan, Ş. ve Erdal, B. (2022). Ekonomik Büyüme ve Tarımsal İstihdam. *Osmaniye Korkut Ata Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, 5 (1), 66-74. https://doi.org/10.47495/okufbed.972239

Tütüncü, A. ve Zengin, H. (2020). E7 Ülkelerinde Kadın İstihdamı ve Ekonomik Büyüme Arasındaki İlişki. *Uluslararası Yönetim İktisat ve İşletme Dergisi*, 16 (1), 1-16. https://doi.org/10.17130/ijmeb.700752

Uğur, B. ve Kütükçü, E. (2022). D-8 Ülkelerinde Ekonomik Büyümenin İşsizlik Üzerindeki Etkisi: Panel Eşbütünleşme Analizi. *Ahi Evran Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 6 (1), 65-78.

Uslu, H. (2020). İstihdam Yaratmayan Ekonomik Büyüme: Türkiye İçin Okun Yasası Çerçevesinde Ekonometrik Bir Analiz. *Optimum Ekonomi ve Yönetim Bilimleri Dergisi*, 7 (1), 101-126. https://doi.org/10.17541/optimum.578251

Westerlund, J. (2006). Testing for Panel Cointegration with Multiple Structural Breaks. *Oxford Bulletin of Economics and Statistics*, 68 (1), 101-132. https://doi.org/10.1111/j.1468-0084.2006.00154.x

Yılancı, V. and Görüş, M. Ş. (2020). Does Economic Globalization Have Predictive Power for Ecological Footprint in MENA Counties? A Panel Causality Test with a Fourier Function. *Environmental Science and Pollution Research*, 27 (32), 40552-40562. https://doi.org/10.1007/s11356-020-10092-9

Yıldırım, U. ve Engeloğlu, Ö. (2023). Türkiye'de Sektörel İstihdam ve Ekonomik Büyüme İlişkisi: Saklı Eşbütünleşme ve Asimetrik Nedensellik Testi. *Fiscaoeconomia*, 7 (2), 1445-1473. https://doi.org/10.25295/fsecon.1255703

Yılmaz, Ö. G. (2005). Türkiye Ekonomisinde Büyüme ile İşsizlik Oranları Arasındaki Nedensellik İlişkisi. *İstanbul Üniversitesi İktisat Fakültesi Ekonometri ve İstatistik Dergisi*, 2, 63-76.

Yurtkuran, S. (2022). Gelen Turist Sayısının En Fazla Olduğu 10 Ülkede Turizm ile CO_2 Salımı Arasındaki İlişki: Panel Fourier Toda-Yamamoto Nedensellik Analizi. *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 61, 281-303. https://doi.org/10.18070/erciyesiibd.988886