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Validity of Okun's Law for African Union Countries: Panel Data Analysis for the Period 1991-2023

Afrika Birliği Ülkeleri İçin Okun Kanununun Geçerliliği: 1991-2023 Dönemi Panel Veri Analizi

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Abstract: The main objective of the study is to analyze the validity of Okun's law for 48 African Union countries using annual growth and unemployment rate data covering the period 1991-2023. For this purpose, cross-sectional dependence, homogeneity and Panel Fourier Lagrange Multiplier (LM) unit root tests are used in the analysis part of the study. Then, the relationship between the variables is analyzed using the Panel Fourier cointegration test. Finally, for the long-run cointegration coefficient estimates between the variables, the Common Correlated Effects Mean Group estimator, or (CCE-MG) estimator as it is called in the literature, was used. According to the results of the analysis, unemployment has a negative impact on economic growth. Therefore, Okun's law is found to be valid for the African Union countries. In addition, according to the CCE-MG estimator used in the study, it is concluded that there is an econometrically significant and negative relationship between economic growth and unemployment within the panel. The effect of unemployment variable on economic growth is calculated as -1.9. As a result of this calculation, it is concluded that for every 1% increase in unemployment, economic growth will be negatively affected by 1.9%.

Keywords: Economic Growth, Unemployment, Okun's Law, Panel Data Analysis.

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Öz: Çalışmanın temel amacı, 1991-2023 dönemini kapsayan yıllık büyüme ve işsizlik oranı verilerini kullanarak 48 Afrika Birliği ülkesi için Okun kanununun geçerliliğini analiz etmektir. Bu amaçla çalışmanın analiz kısmında, kesit bağımlılık, homojenlik ve Panel Fourier LM birim kök testleri kullanılmıştır. Daha sonra değişkenler arasındaki ilişki, Panel Fourier eşbütünleşme testi ile gerçekleştirilmiştir. Son olarak, değişkenler arasındaki uzun dönem eşbütünleşme katsayı tahminleri için Ortak Korelasyonlu Etkiler Ortalama Grup tahmincisi yani literatürdeki adıyla (CCE-MG) tahmincisi kullanılmıştır. Analiz sonuçlarına göre, işsizlik ekonomik büyümeyi negatif etkilemektedir. Dolayısıyla Afrika Birliği ülkeleri için Okun kanununun geçerli olduğu tespit edilmiştir. Ayrıca çalışmada kullanılan CCE-MG tahmincisine göre, panel içerisinde ekonomik büyüme ile işsizlik arasında ekonometrik olarak anlamlı ve negatif bir ilişkinin olduğu sonucuna ulaşılmıştır. İşsizlik değişkeninin ekonomik büyümeye etkisi -1.9 olarak hesaplanmıştır. Bu hesaplama neticesinde işsizlik her %1 artığında ekonomik büyümenin %1.9 oranında negatif etkileneceği sonucu ortaya çıkmıştır.

Anahtar Kelimeler: Ekonomik Büyüme, İşsizlik, Okun Kanunu, Panel Veri Analizi.

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1. Introduction

Reducing unemployment rates and achieving a high growth rate are among the main macroeconomic objectives of all countries. Therefore, one of the main objectives of policy makers is to increase the quantity of goods and services in order to increase the welfare level of the country and to try to reduce unemployment rates by creating new employment opportunities. Therefore, when the realized growth is transformed into an employment-friendly growth, in other words, unemployment rates are expected to decrease by establishing new production facilities and expanding employment areas thanks to the success in growth (Öztürk and Sezen, 2018: 2).

This expectation between growth and unemployment was addressed by Arthur M. Okun (1962) and became one of the most important studies in the economic literature. Okun argued that an increase in unemployment rates would reduce the Gross Domestic Product (GDP). This inverse relationship between unemployment and growth has been referred to as "Okun's law" (Yılmaz and Akcan, 2022: 216).

Okun's law expressed the effect on the unemployment rate in the event that the actual output deviates from the potential output with the following formulation (Özçelik and Erdem, 2020: 329):

$$U = U^* - \beta\left(\frac{Y - Y^*}{Y^*}\right) \quad or \quad U - U^* = -\beta\left(\frac{Y - Y^*}{Y^*}\right) \tag{1}$$

In Equation 1, U represents the unemployment rate, U^* the natural rate of unemployment, β the Okun coefficient, Y the actual GDP, and Y^* the potential GDP. β has a negative value. This value means that there is an inverse relationship between growth and unemployment (Tumanoska, 2019: 162-163). In addition, Okun calculated this coefficient as 0.3 in his study published in 1962. According to this result, a 1% increase in unemployment rates leads to a 0.3% increase in the GDP deficit, in other words, a 1% increase in realized output leads to a 0.3% decrease in the unemployment rate (Sarıca et al., 2022: 277).

The results of recent studies show that, contrary to expectations, the relationship between unemployment and economic growth has weakened in some developed and developing countries. In other words, increases in growth do not have a positive impact on unemployment rates. Therefore, the degree of the relationship between growth and unemployment is a very important issue for policy makers. Therefore, policymakers should take measures to increase economic growth and reduce unemployment rates with the employment areas they will create (Yalçınkaya et al., 2018: 9).

From this point of view, the main objective of the study is to analyze the validity of Okun's law for the African Union countries using annual data covering the period 1991-2023 by using growth rate and unemployment rate data. For this purpose, in the analysis part of the study, cross-sectional dependence and homogeneity tests were first applied for unemployment and growth variables. The unit root of the variables is tested with the Panel Fourier LM unit root test developed by Nazlıoğlu and Karul (2017). This method eliminates the problem of determining the date, number and type of break in panel unit root tests where structural breaks are handled with dummy variables. The cointegration relationship between growth and unemployment variables is analyzed with the Panel Fourier cointegration test developed by Olayeni et al. (2021). This method takes into account cross-section dependence and smooth transitions. Finally, the CCE-MG estimator is used for the long-run cointegration coefficient estimates between the variables.

To the best of our knowledge, there is no comprehensive study that includes 48 African Union countries in the analysis using these analysis methods. Therefore, it is believed that the unit root test used in this study eliminates the problem of determining the date, number and type of break, and the new generation cointegration test takes into account cross-sectional dependence and smooth transitions, and contributes to the literature thanks to the country group included in the analysis and up-to-date data.

This study consists of five (5) main sections. After the introduction, there is a literature review on the validity of Okun's law, followed by a section explaining the dataset and methodology, then the findings from the econometric analyses applied, and finally a section that presents the conclusion of the study and includes policy recommendations.

2. Literature Review

In the literature, a decrease in unemployment rates is expected in case of economic growth. It is also observed that results contrary to this expectation emerge. In this framework, in this section of the study, recent, national and international empirical studies on the validity of Okun's law are presented chronologically.

Table 1: Summary of the Empirical Literature on Okun's Law

Author(s)	Year of Publication	Target Country(s)	Data Set	Analysis Method	Conclusion
Abdioğlu and Albayrak	2018	Türkiye	1988-2015	ARDL (Autoregressive Distributed Lag Bound Test) bound test approach	Okun's law is valid.
Eğri	2018	Egypt	1970-2016	Granger causality test	Okun's law is not valid.
Güçlü	2018	G7	1980-2016	Least Squares (LS) method	Okun's law is valid.
Pata et al.	2018	Türkiye	2006:Q2-2014:Q4	Unrestricted VAR and Hsiao (1981) Granger causality test	Okun's law is valid.
Soylu et al.	2018	9 Eastern European country	1992-2014	Pooled Panel OLS method and Pedroni cointegration test	Okun's law is valid.
Üzar and Akyazı	2018	34 OECD countries	2000-2011	Dumitrescu-Hurlin (2012) causality test	Okun's law is valid.
Abubakar and Nurudeen	2019	India	1991-2017	LS method	Okun's law is valid.
Altunöz	2019	Euro area	2000-2012	Panel cointegration test and Vector Error Correction model	Okun's law is valid.
Astari et al.	2019	Indonesia	1991-2016	ARDL	Okun's law is valid.
Bhat et al.	2019	India	1983-2013	Granger causality test	Okun's law is valid.
Oruç	2019	Fragile Five	1990-2017	LS method	Okun's law is valid.
Tumanoska	2019	North Macedonia	1991-2017	ARDL	Okun's law is valid.
Al-Sawaie	2020	Jordan	1976-2018	ARDL	Okun's law is valid.
Boğa	2020	Türkiye	2000-2019	Johansen cointegration test	Okun's law is valid.
Öztürk	2020	Türkiye	1988-2018	Hatemi-J-Roca (2014) causality test	Okun's law is valid.
Yayar and Öztaş	2020	D-8	1998-2017	Kónya (2006) causality test	Okun's law is valid.
Ak	2021	Türkiye	2005:1-2020:9	ARDL	Okun's law is valid.
Çevik and Sungur	2021	Türkiye	2000-2018	Markov Regime Change Model	Okun's law is valid.

Hashmi et al.	2021	BRICS	1991-2008 and 2009-2018	Fixed coefficient, fixed effects and pooled mean group methods	Okun's law is valid.
Mete	2021	35 OECD countries	2005-2018	Generalized Method of Moments	Okun's law is valid.
Feto and Jayamohan	2021	Ethiopia	1991-2016	ARDL	Okun's law is valid.
Sarıca et al.	2022	Türkiye	2005-2020	NARDL (The Nonlinear Autoregressif Distributed Lag) method	Okun's law is valid.
Şenol and Onaran	2022	Türkiye	1990-2020	Johansen cointegration and Granger causality tests	Okun's law is valid.
Yılmaz and Akcan	2022	Türkiye	2014:Q1-2021:Q3	ARDL	Okun's law is valid.
Amor	2023	Tunisia	1980-2020	ARDL	Okun's law is valid.
Bakkal	2023	Türkiye	2006:Q1-2022:Q1	ARDL	Okun's law is not valid.
Konya et al.	2023	Turkic Republics	1991-2019	Westerlund cointegration test, Extended mean group estimator and Dumitrescu-Hurlin (2012) causality test	Okun's law is valid.
Turna	2023	Türkiye	2005:Q1-2022:Q2	ARDL	Okun's law is valid.
Yıldırım and Vıcıl	2023	Türkiye	2001-2023	Granger causality test and self-excited threshold autoregressive (SETAR) model	Okun's law is valid.
Şit	2024	Brazil, India, Russia, South Africa and Türkiye	1990-2017	LS method	Okun's law is valid.

When the empirical studies are analyzed, it is seen that the countries, country groups, periods, and methods used in the analysis are different. Despite this, Okun's law is found to be valid in most of the literature studies included in the analysis.

3. Data and Methodology

The study utilizes economic growth and unemployment data to test whether Okun's law is valid in African countries. The data were obtained from the World Bank database. The economic growth and unemployment variables to be analyzed were selected annually with a total number of 33 observations and were determined to cover the period 1991-2023. Since the economic growth and unemployment data of the African Union member countries can be compiled between 1991 and 2023 in the widest scope, 48 African Union countries whose data are available are included in the analysis. In order to test the validity of Okun's law, 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 Panel Fourier cointegration test developed by Olayeni et al. (2021), a new generation method, was used to examine the cointegration relationship between economic growth and unemployment variables. Finally, the CCE-MG

estimator developed by Pesaran (2006) is used to estimate the long-run cointegration coefficients between the variables.

In the model established to test the validity of Okun's law; GDP rates representing economic growth were used as the dependent variable and unemployment rates were used as the independent variable. The panel model in which all variables included in the analysis are defined is constructed as in Equation 1:

$$GDP = a_i + \beta_1 UNEMP + \varepsilon_{it} \quad (2)$$

In the model, α_i represents country-specific fixed effects, β is the slope coefficient, ε_{it} is the error term, t= 1991,...,2023 is the time period, i= 1,2,3,...,48 is the number of countries, *GDP* is economic growth and *UNEMP* is the unemployment variable.

3.1. Cross-Section Dependence and Homogeneity Test

The LM test developed by Breusch and Pagan (1980) for the existence of cross-section dependence in the panel data analysis method is given in the following formulation:

$$CD_{LM1} = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{p}_{ij}^2 \quad (3)$$

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

$$CD_{LM2} = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\hat{\rho}_{ij}^2 - 1), N(0,1) \quad (4)$$

In Equation 4, *N* denotes the number of cross-sectional units and *T* denotes the time dimension of the panel data. Pesaran (2004) test statistics, called CD_{LM2}, are expressed as a scaled version of CD_{LM1} test statistics (Pesaran, 2004: 5):

Pesaran et al. (2008) formulated cross-sectional dependence with the LM_{adj} test and corrected the bias in the LM test by using the exact mean and variance of the LM test.

$$LM_{adj} = \sqrt{\left(\frac{2}{N(N-1)}\right)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{\upsilon_{Tij}}}, N(0,1) \quad (5)$$

Here k denotes the number of regressors, μ_{Tij} mean and υ_{Tij} variance (Atılgan and İspir, 2022: 17). The null 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 (Yayar and Öztaş, 2020: 194).

After analyzing the cross-section dependence, the formulation proposed by Pesaran and Yamagata (2008) in equations 6 and 7 below is used to investigate whether the structure between the series is homogeneous:

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2k}}\right) \quad (6)$$

$$\tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - \mathrm{E}(\tilde{z}_{iT})}{\sqrt{Var(\tilde{z}_{iT})}}\right) \quad (7)$$

Where N is the number of cross-sections, k is the number of explanatory variables, $\tilde{S}$ and $\tilde{z}_{iT}$ are the adjusted Swamy test statistics and independent random variables with bounded mean and variance, respectively (Yıldırım and Şahin, 2018: 78).

H_0: $\beta i = \beta$, $\forall$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 the equations above 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 (Öncel et al., 2017: 409-410).

3.2. Panel Fourier LM Unit Root Test

This test method was developed by Nazlıoğlu and Karul (2017). The Panel Fourier LM method tests whether a time series is stationary or not. In this framework, 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 (Nazlıoğlu and Karul, 2017: 5). Since the Fourier approach eliminates the problem of determining the date, number and type of break in panel unit root tests where structural breaks are handled with dummy variables, the Panel Fourier LM method is preferred in this study. The formulation in equation 8 is used for the stationarity analysis of the variables:

$$\Delta y_{it} = \delta_{0i} + \delta_{1i}\Delta \sin\left(\frac{2\pi kt}{T}\right) + \delta_{2i}\Delta \cos\left(\frac{2\pi kt}{T}\right) + \varepsilon_{it} \quad (8)$$

P_{LM} and Z_{LM} values are calculated by the formulas in equations 9 and 10. The panel statistic P_{LM} is obtained by averaging the individual statistics in equation 9.

$$P_{LM}(k) = N^{-1}\sum_{i=1}^{N}\tilde{\tau}_i(k) \quad (9)$$

$$Z_{LM}(k) = \frac{\sqrt{N}\left(P_{\tau}(k) - \xi(k)\right)}{\zeta(k)} \sim N(0,1) \quad (10)$$

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. It is also necessary to know the numerical values of the mean $\xi(k)$ and variance $\zeta^2(k)$ to calculate the test statistic. These values are obtained from the 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 Cointegration Test

The panel Fourier cointegration test was developed and introduced to the literature by Olayeni et al. (2021). This test is robust to nonlinearity, cross-sectional dependence and unknown number and forms of structural breaks. In other words, the Panel Fourier cointegration method takes into account both cross-sectional dependence and smooth transitions. Therefore, it is preferred in this study since it has superiority over other test methods. The relationship between $X_{i,t}$ and $Z_{i,t}$ is given as follows:

$$X_{i,t} = \beta_{0,i} + \beta_{1,i}Z_{i,t} + v_{i,t} \quad \text{and} \quad (11)$$

$$v_{i,t} = \rho_i v_{i,t-1} + \varepsilon_{i,t} \quad (12)$$

To implement the resampling routine, Olayeni et al. (2021) follow the following steps: Equation 11 is estimated by OLS to obtain the residuals $\hat{v}_{i,t}$. Using the residuals in equation 11, equation 12 is estimated

by OLS. With $\hat{\rho}_i$, we obtain the estimated residuals $\hat{\phi}_{i,t}$ given by $\hat{\phi}_{i,t} = \hat{v}_{i,t} - \hat{\rho}_i \hat{v}_{i,t-1}$. Residual-based stationarity is bootstrapped from $\{\hat{\phi}_{i,t}\}$ with replacement and pseudo residuals $\{\ddot{\phi}_{i,t}\}$ are calculated. Under the assumption of no cointegration relationship, we calculate the pseudo residual $\ddot{v}_{i,t}$ by summing $\ddot{\phi}_{i,t}$. $\ddot{X}_{i,t} = \hat{\beta}_{0,i} + \hat{\beta}_{1,i}\ddot{Z}_{i,t} + \ddot{v}_{i,t}$ to obtain the pseudo series on $\ddot{X}_{i,t}$. Here $\hat{\beta}_{0,i}$ and $\hat{\beta}_{1,i}$ denote the parameter estimates in equation 11. Equation 11 is estimated using $\{\ddot{X}_{i,t}, Z_{i,t}\}$ data. Using equation 12 and $\{v^{\cdots}_{i,t}\}$, $\ddot{\rho}_i$ is estimated. This is repeated 3-7 B times. It is recommended to set B to 399 or 999. In the presence of nonlinearity and structural breaks, equation 12 is modified to the formulation in equation 13. To deal with structural breaks, residuals are first calculated. Thus, soft shifts in the data are partially separated.

$$\tilde{v}_{i,t} = \hat{v}_{i,t} - \hat{\alpha}_i - \hat{X}_i sin\left(\frac{2\pi kt}{T}\right) - \hat{\varphi}_i cos\left(\frac{2\pi kt}{T}\right) \quad (13)$$

In Equation 13, k is the approximation frequency and $\hat{X}$ and $\hat{\varphi}_i$ are the amplitude and displacement parameters. The null hypothesis states that there is no cointegration relationship between the variables (Olayeni et al., 2021: 482-483).

After determining the cointegration relationship between variables in panel countries, the CCE-MG estimator developed by Pesaran (2006) was used for long-run cointegration coefficient estimates.

4. Empirical Findings

In this section of the study, after presenting the descriptive statistics of the variables, the results of cross-sectional dependence and homogeneity tests for growth and unemployment variables are presented. Then, the results of the Panel Fourier LM unit root test for the determination of the unit root status of the variables and the results of the Panel Fourier cointegration test for the cointegration relationship between the variables are presented. Finally, CCE-MG estimation results are presented for the long-run cointegration coefficient estimates between the variables.

Table 2: Descriptive Statistics for Variables

GDP						
Country	**Angola**	**Benin**	**Botswana**	**Burkina Faso**	**Burundi**	**Cabo Verde**
Mean	3.7738	4.6792	3.9200	5.4139	1.2130	6.3577
Median	3.0546	4.8112	4.5566	5.8892	1.8490	6.9125
Maximum	15.0300	7.1914	11.9206	11.0147	5.4138	19.1826
Minimum	-23.9834	1.7132	-14.1442	0.2327	-8.0000	-20.8053
Std. Dev.	7.6222	1.6444	5.3170	2.4514	3.7928	7.1932
Skewness	-1.1870	-0.2964	-1.5035	-0.1251	-1.0155	-1.3352
Kurtosis	6.5389	1.9752	6.0180	2.6758	3.2128	7.3807
Jarque-Bera	24.9687	1.9273	24.9563	0.2306	5.7338	36.1922
Probability	0.0000	0.3815	0.0000	0.8911	0.0569	0.0000
Sum	124.5364	154.4138	129.3613	178.6596	40.0294	209.8052
Sum Sq. Dev.	1859.1280	86.5246	904.6453	192.2985	460.3243	1655.7310
Observations	33	33	33	33	33	33
Country	**Algeria**	**Chad**	**Equatorial Guinea**	**Ethiopia**	**Morocco**	**Gabon**
Mean	2.6515	4.8757	15.6899	6.8552	3.5766	2.1410
Median	3.1000	3.2715	8.3129	8.3641	3.4996	2.6762
Maximum	6.5000	33.6294	149.9730	13.5726	12.3729	7.0918
Minimum	-5.0000	-15.7098	-9.1100	-8.6725	-7.1782	-8.9326
Std. Dev.	2.3560	8.1538	30.4841	5.5796	4.0383	3.5232
Skewness	-1.2790	0.9503	2.8706	-1.2885	-0.4924	-1.0171
Kurtosis	4.9842	6.7904	12.6869	4.1137	3.8710	4.1953
Jarque-Bera	14.4100	24.7226	174.3477	10.8360	2.3764	7.6539
Probability	0.0007	0.0000	0.0000	0.0044	0.3048	0.0218

Sum	87.5000	160.8978	517.7673	226.2228	118.0268	70.6531
Sum Sq. Dev.	177.6224	2127.5210	29737.0500	996.2375	521.8417	397.2180
Observations	33	33	33	33	33	33
Country	**Gambia**	**Ghana**	**Guinea**	**Guinea-Bissau**	**South Africa**	**Cameroon**
Mean	3.2549	5.2441	4.4552	3.4725	2.0877	3.1153
Median	4.0581	4.7004	4.1330	4.2000	2.4855	3.8324
Maximum	7.2349	14.0471	10.8206	16.8150	5.6038	7.0489
Minimum	-8.1304	0.5139	-1.1226	-22.4457	-5.9634	-7.9321
Std. Dev.	3.4776	2.4807	2.2923	5.7609	2.3974	2.9436
Skewness	-1.3404	1.3981	0.6086	-2.4117	-1.1934	-2.2474
Kurtosis	4.7708	6.2565	4.8432	14.3123	5.1969	8.2248
Jarque-Bera	14.1927	25.3314	6.7087	207.9469	14.4700	65.3145
Probability	0.0008	0.0000	0.0349	0.0000	0.0007	0.0000
Sum	107.4122	173.0560	147.0222	114.5917	68.8933	102.8065
Sum Sq. Dev.	386.9980	196.9261	168.1522	1062.0320	183.9168	277.2641
Observations	33	33	33	33	33	33
Country	**Kenya**	**Comoros**	**Congo Dem. Rep.**	**Congo Rep.**	**Lesotho**	**Libya**
Mean	3.6945	2.4786	2.2005	1.9929	2.5934	5.4342
Median	4.1468	2.6470	4.3845	2.2059	3.4661	0.7497
Maximum	8.0585	10.8479	9.4703	11.6373	6.9666	153.4926
Minimum	-0.7995	-5.3956	-13.4691	-8.6852	-7.4587	-58.3182
Std. Dev.	2.3326	2.9449	6.0879	5.0718	3.0955	34.8525
Skewness	-0.2695	-0.2491	-0.9680	-0.1963	-1.1328	2.4969
Kurtosis	2.2560	6.0082	2.9443	2.5076	4.7047	12.0608
Jarque-Bera	1.1606	12.7843	5.1574	0.5454	11.0532	147.1732
Probability	0.5597	0.0017	0.0759	0.7613	0.0040	0.0000
Sum	121.9184	81.7942	72.6157	65.7657	85.5818	179.3300
Sum Sq. Dev.	174.1155	277.5127	1186.0030	823.1479	306.6303	38870.1800
Observations	33	33	33	33	33	33
Country	**Liberia**	**Madagascar**	**Malawi**	**Mali**	**Mauritius**	**Egypt**
Mean	4.4817	2.4437	3.8935	4.5260	3.9734	4.3712
Median	4.7110	3.6935	4.0000	4.7562	4.1361	4.3720
Maximum	106.2798	9.7849	16.7288	15.3762	8.8799	7.1563
Minimum	-35.0857	-12.4080	-10.2402	-3.2187	-14.5465	1.1254
Std. Dev.	23.4096	4.3255	4.9119	3.5591	3.6956	1.5679
Skewness	2.2498	-1.7327	-0.5900	0.5811	-3.8400	-0.0309
Kurtosis	12.3112	6.3126	5.1470	4.7156	20.5218	2.3314
Jarque-Bera	147.0496	31.6010	8.2529	5.9044	503.2461	0.6199
Probability	0.0000	0.0000	0.0161	0.0522	0.0000	0.7335
Sum	147.8947	80.6411	128.4849	149.3589	131.1218	144.2491
Sum Sq. Dev.	17536.3700	598.7273	772.0476	405.3439	437.0491	78.6695
Observations	33	33	33	33	33	33
Country	**Mozambique**	**Mauritania**	**Namibia**	**Nigeria**	**Niger**	**Central African Rep.**
Mean	6.1839	3.2789	3.4476	4.0175	4.1895	1.3183
Median	6.6797	3.3836	3.8990	4.1959	3.5506	3.6165
Maximum	12.8517	18.3332	12.2696	15.3292	11.9000	8.5873
Minimum	-7.5766	-4.0447	-8.1014	-2.0351	-1.2085	-36.3920
Std. Dev.	4.1778	4.3322	3.5210	3.7288	3.4092	7.5911
Skewness	-1.0366	1.0150	-0.7079	0.5185	0.4259	-3.8744
Kurtosis	4.8937	5.7808	5.5676	3.9007	2.3355	19.7511
Jarque-Bera	10.8409	16.2988	11.8212	2.5944	1.6048	468.3838
Probability	0.0044	0.0003	0.0027	0.2733	0.4482	0.0000
Sum	204.0683	108.2042	113.7701	132.5787	138.2547	43.5038

Sum Sq. Dev.	558.5272	600.5648	396.7216	444.9219	371.9248	1843.9770
Observations	33	33	33	33	33	33
Country	**Rwanda**	**Sao Tome and Principe**	**Senegal**	**Sierra Leone**	**Somalia**	**Sudan**
Mean	6.0240	3.0245	3.8231	3.0106	4.2934	2.4109
Median	8.1577	2.5000	3.8219	3.7538	6.6944	3.8582
Maximum	35.2241	8.8661	7.4075	26.5241	9.9468	18.3127
Minimum	-50.2481	-0.4744	-0.0475	-20.4911	-17.8470	-17.0047
Std. Dev.	12.1254	2.2250	2.0012	8.9753	5.4922	6.1479
Skewness	-2.7767	0.9176	-0.1073	-0.2438	-2.4778	-0.8857
Kurtosis	16.1274	3.4549	2.0926	5.0071	9.7269	5.8027
Jarque-Bera	279.3568	4.9155	1.1956	5.8660	95.9882	15.1148
Probability	0.0000	0.0856	0.5500	0.0532	0.0000	0.0005
Sum	198.7915	99.8069	126.1621	99.3493	141.6808	79.5584
Sum Sq. Dev.	4704.7990	158.4160	128.1490	2577.8080	965.2613	1209.4980
Observations	33	33	33	33	33	33
Country	**Togo**	**Tanzania**	**Tunisia**	**Uganda**	**Zambia**	**Zimbabwe**
Mean	3.4955	5.1025	3.1692	6.1650	4.4002	1.3512
Median	4.7951	5.4681	3.1784	5.6376	5.0575	1.4845
Maximum	14.9824	7.6722	7.8057	11.5232	10.2982	21.4521
Minimum	-15.0958	0.5843	-8.5918	2.9513	-8.6254	-17.6690
Std. Dev.	5.4777	1.9435	2.9657	2.2585	3.8060	8.6787
Skewness	-0.9141	-0.7685	-1.8541	0.5546	-1.4158	-0.0460
Kurtosis	5.8273	2.6586	8.7848	2.5713	5.5998	3.1162
Jarque-Bera	15.5870	3.4087	64.9189	1.9446	20.3180	0.0302
Probability	0.0004	0.1819	0.0000	0.3782	0.0000	0.9850
Sum	115.3508	168.3841	104.5821	203.4464	145.2078	44.5880
Sum Sq. Dev.	960.1556	120.8740	281.4603	163.2317	463.5385	2410.2130
Observations	33	33	33	33	33	33
UNEMP						
Country	**Angola**	**Benin**	**Botswana**	**Burkina Faso**	**Burundi**	**Cabo Verde**
Mean	16.3302	1.3541	19.4250	3.5954	2.2493	12.7839
Median	16.4680	1.4020	19.3430	3.6700	2.4000	13.1160
Maximum	17.1050	2.6470	23.8000	5.3480	3.1910	14.6600
Minimum	14.6200	0.6900	13.8200	2.4140	0.9190	10.6700
Std. Dev.	0.5167	0.4938	2.4275	0.9758	0.9226	0.9296
Skewness	-1.9482	0.7065	-0.0569	0.2630	-0.1391	-0.5843
Kurtosis	7.5213	2.9886	2.5185	1.7293	1.2134	2.6903
Jarque-Bera	48.9842	2.7457	0.3366	2.6008	4.4952	2.0093
Probability	0.0000	0.2534	0.8451	0.2724	0.1057	0.3662
Sum	538.8960	44.6840	641.0260	118.6490	74.2280	421.8700
Sum Sq. Dev.	8.5438	7.8028	188.5742	30.4706	27.2360	27.6520
Observations	33	33	33	33	33	33
Country	**Algeria**	**Chad**	**Equatorial Guinea**	**Ethiopia**	**Morocco**	**Gabon**
Mean	17.8107	0.8924	8.1332	2.9333	11.0995	18.8167
Median	13.7900	0.8290	8.1160	3.0020	10.5390	18.2580
Maximum	31.8400	1.6930	9.1940	4.0240	14.0890	21.2730
Minimum	9.8200	0.6600	7.2850	2.2510	8.9100	16.9100
Std. Dev.	7.6163	0.2357	0.3881	0.5268	2.0086	1.4515
Skewness	0.4696	1.7188	0.6926	0.2680	0.4110	0.1687
Kurtosis	1.5287	6.1201	4.3835	1.9942	1.4724	1.4053
Jarque-Bera	4.1894	29.6341	5.2701	1.7859	4.1376	3.6532

Probability	0.1231	0.0000	0.0717	0.4094	0.1263	0.1610
Sum	587.7530	29.4480	268.3950	96.8000	366.2840	620.9500
Sum Sq. Dev.	1856.2700	1.7784	4.8193	8.8822	129.1038	67.4221
Observations	33	33	33	33	33	33
Country	**Gambia**	**Ghana**	**Guinea**	**Guinea-Bissau**	**South Africa**	**Cameroon**
Mean	8.7093	5.5242	4.8637	3.2458	21.7663	5.4225
Median	9.6810	5.2370	4.8340	3.2040	20.2950	3.9890
Maximum	10.3830	10.4560	5.9930	3.6280	28.8380	9.1180
Minimum	4.1270	2.1730	4.4230	3.0300	19.3900	3.0630
Std. Dev.	1.9217	2.2214	0.3776	0.1491	2.8071	2.1731
Skewness	-1.1505	0.6183	1.1098	1.4336	1.2938	0.5703
Kurtosis	2.7761	2.5072	4.1760	4.3636	3.6600	1.5954
Jarque-Bera	7.3486	2.4363	8.6758	13.8601	9.8049	4.5014
Probability	0.0254	0.2958	0.0131	0.0010	0.0074	0.1053
Sum	287.4080	182.2980	160.5020	107.1120	718.2890	178.9430
Sum Sq. Dev.	118.1730	157.9032	4.5637	0.7110	252.1493	151.1149
Observations	33	33	33	33	33	33
Country	**Kenya**	**Comoros**	**Congo Dem. Rep.**	**Congo Rep.**	**Lesotho**	**Libya**
Mean	3.2912	4.8457	3.8281	20.1241	16.1564	19.1539
Median	2.8410	4.7090	3.4010	19.8990	16.0450	19.1860
Maximum	5.8050	5.8840	5.3690	22.3730	18.3510	19.6490
Minimum	2.6500	4.3690	2.9480	19.3790	15.4050	18.6130
Std. Dev.	1.0235	0.4202	0.7323	0.6446	0.6317	0.2837
Skewness	1.7452	1.5312	0.4694	2.2100	2.1779	-0.2051
Kurtosis	4.3115	4.3918	1.8321	7.7897	8.0366	2.0693
Jarque-Bera	19.1174	15.5580	3.0872	58.4063	60.9681	1.4224
Probability	0.0001	0.0004	0.2136	0.0000	0.0000	0.4911
Sum	108.6100	159.9070	126.3270	664.0940	533.1620	632.0800
Sum Sq. Dev.	33.5195	5.6512	17.1600	13.2960	12.7704	2.5754
Observations	33	33	33	33	33	33
Country	**Liberia**	**Madagascar**	**Malawi**	**Mali**	**Mauritius**	**Egypt**
Mean	2.5432	3.9274	5.0094	1.6067	8.1666	9.8929
Median	2.4030	3.4280	4.9660	1.3940	8.3140	9.3800
Maximum	4.0920	6.3000	5.6810	3.5280	9.5900	13.1540
Minimum	2.0210	0.5990	4.6900	1.2060	6.0570	7.3060
Std. Dev.	0.4995	1.7774	0.2084	0.5756	1.1593	1.7974
Skewness	1.3723	-0.0749	1.6161	2.2469	-0.2388	0.3624
Kurtosis	4.6621	1.6978	5.9848	6.7812	1.6807	1.9907
Jarque-Bera	14.1556	2.3625	26.6153	47.4256	2.7069	2.1232
Probability	0.0008	0.3069	0.0000	0.0000	0.2583	0.3459
Sum	83.9260	129.6040	165.3110	53.0210	269.4990	326.4650
Sum Sq. Dev.	7.9845	101.0958	1.3898	10.6020	43.0091	103.3781
Observations	33	33	33	33	33	33
Country	**Mozambique**	**Mauritania**	**Namibia**	**Nigeria**	**Niger**	**Central African Rep.**
Mean	3.1551	10.0155	20.9045	4.0212	1.3303	5.7426
Median	3.0650	9.9310	20.9860	3.8270	1.4260	5.6310
Maximum	3.9840	11.0680	24.4500	5.7120	3.1000	6.6760
Minimum	2.6460	9.2870	16.7710	3.0740	0.3170	5.3720
Std. Dev.	0.3627	0.3987	1.6463	0.5775	0.7094	0.3146
Skewness	0.5068	0.8887	-0.2274	1.5592	0.5527	1.5844
Kurtosis	2.2766	3.7753	2.7968	4.7321	2.7593	4.8408
Jarque-Bera	2.1324	5.1700	0.3413	17.4969	1.7600	18.4668
Probability	0.3443	0.0754	0.8431	0.0002	0.4148	0.0001

Sum	104.1190	330.5110	689.8480	132.7000	43.9010	189.5070
Sum Sq. Dev.	4.2094	5.0865	86.7329	10.6727	16.1061	3.1671
Observations	33	33	33	33	33	33
Country	**Rwanda**	**Sao Tome and Principe**	**Senegal**	**Sierra Leone**	**Somalia**	**Sudan**
Mean	12.0732	14.7656	3.2643	4.0221	18.9895	14.2429
Median	11.8020	14.4000	2.8530	4.1590	18.9470	14.7830
Maximum	15.7930	17.6300	6.7570	4.6780	19.6860	17.4400
Minimum	10.7590	13.5900	2.6480	3.1740	18.3720	7.5300
Std. Dev.	1.0735	1.0342	0.9616	0.4398	0.2852	1.8193
Skewness	2.5086	1.0138	2.3139	-0.6330	0.3459	-1.5755
Kurtosis	8.3686	3.1981	7.7513	2.4161	3.5212	7.0461
Jarque-Bera	74.2428	5.7067	60.4866	2.6725	1.0318	36.1612
Probability	0.0000	0.0577	0.0000	0.2628	0.5970	0.0000
Sum	398.4160	487.2640	107.7210	132.7280	626.6540	470.0160
Sum Sq. Dev.	36.8754	34.2249	29.5924	6.1903	2.6028	105.9118
Observations	33	33	33	33	33	33
Country	**Togo**	**Tanzania**	**Tunisia**	**Uganda**	**Zambia**	**Zimbabwe**
Mean	3.2593	3.0082	15.1869	3.1786	11.5796	5.9237
Median	3.6360	3.0290	15.3300	3.4180	12.0000	5.3830
Maximum	4.4700	3.8810	18.3340	3.9140	19.7000	10.0870
Minimum	1.9820	2.1250	12.3650	1.9000	5.0310	4.3900
Std. Dev.	0.8880	0.4819	1.5052	0.4980	4.4604	1.4524
Skewness	-0.3161	-0.1052	-0.1841	-1.1867	0.2190	1.5327
Kurtosis	1.4038	2.2224	2.6687	3.6719	1.9673	4.4658
Jarque-Bera	4.0527	0.8923	0.3375	8.3659	1.7302	15.8757
Probability	0.1318	0.6401	0.8447	0.0153	0.4210	0.0004
Sum	107.5560	99.2690	501.1680	104.8930	382.1280	195.4830
Sum Sq. Dev.	25.2322	7.4326	72.4968	7.9365	636.6472	67.5033
Observations	33	33	33	33	33	33

Descriptive statistics on economic growth and unemployment data for the 48 countries of the African Union are given in Table 2. According to the data in the table, on average, the highest growth rate was calculated in Equatorial Guinea with 15.6% and the lowest growth rate was calculated in Burundi with 1.2%. When unemployment rates are analyzed, it is found that the highest unemployment rate was realized in South Africa with 21.7% and the lowest unemployment rate was realized in Chad with 0.89%.

Table 3: Cross-Sectional Dependence Test Results

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	3296.3030***	0.0000	45.6510***	0.0000	-0.7990	0.2120	6.3420***	0.0000
UNEMP	11474.3920***	0.0000	217.8310***	0.0000	-2.7610***	0.0030	78.5680***	0.0000

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

When the results of the cross-section dependence analysis applied to the economic growth and unemployment series are analyzed, it is concluded that the probability value is significant at the 1% level in 3 of the 4 tests applied for the economic growth variable. In all 4 tests applied for the unemployment variable, the probability value was found to be significant at the 1% level. Therefore, the fact that it was significant at the 1% level led to the conclusion that the constructed series contain cross-section dependence.

Table 4: Slope Homogeneity Test Results

Slope Homogeneity Test	Test Statistics	Probability Value
Delta Tilde	-1.577	0.943
Delta Tilde Adjusted	-1.629	0.948

When the homogeneity test results are analyzed, it is observed that the probability values of both test statistics are insignificant. Therefore, this non-significance leads to the conclusion that the slope coefficients of the series are homogeneous.

Table 5: Panel Fourier LM Unit Root Test Results

k	Fouriertau LM k=1		Fouriertau LM k=2		Fouriertau LM k=3	
Variables	**GDP**	**UNEMP**	**GDP**	**UNEMP**	**GDP**	**UNEMP**
Angola	-1.2508	-6.6887	-1.7356	-4.4496	-2.5667	-2.6758
Benin	-0.7374	-6.3155	-1.3160	-4.0932	-1.3364	-2.5117
Botswana	-3.2693	-6.6817	-3.6584	-4.3247	-2.7109	-2.5777
Burkina Faso	-1.0062	-5.7075	-1.2758	-4.5699	-1.3646	-3.2500
Burundi	-1.5177	-5.6130	-1.7525	-4.3618	-1.8275	-2.9540
Cabo Verde	-1.6567	-5.2967	-1.4509	-3.8857	-0.9504	-2.4891
Algeria	-1.7483	-4.1822	-1.8486	-2.9801	-2.6447	-1.9226
Chad	-3.7734	-4.4567	-4.0922	-3.2466	-5.7927	-2.1358
Equatorial Guinea	-4.9554	-4.6427	-4.8214	-3.4425	-4.7310	-2.3244
Ethiopia	-1.7325	-4.6908	-2.0268	-3.6154	-2.9102	-2.2180
Morocco	-0.6530	-4.6350	-0.8049	-3.6634	-1.2305	-2.3073
Gabon	-2.7980	-4.5362	-3.1456	-3.6039	-3.7632	-2.2959
Gambia	-4.5164	-3.2227	-4.5678	-3.1945	-4.9118	-2.7866
Ghana	-4.2880	-3.2504	-3.9035	-3.1911	-3.7515	-2.6253
Guinea	-1.2637	-3.3443	-1.7260	-3.2771	-2.9623	-2.6440
Guinea-Bissau	-4.5932	-3.4106	-4.8779	-3.4219	-6.4648	-2.8799
South Africa	-5.6993	-3.2375	-2.8942	-3.2555	-1.8075	-2.8230
Cameroon	-4.9009	-3.3122	-4.7518	-3.3485	-5.3168	-3.0262
Kenya	-1.9213	-1.8180	-2.0993	-2.0022	-2.8274	-1.3039
Comoros	-2.6092	-1.3104	-2.7237	-1.4918	-3.2707	-0.8048
Congo Dem. Rep.	-4.0628	-1.2828	-3.6846	-1.4487	-4.0854	-0.6434
Congo Rep.	-4.6299	-1.8376	-4.8774	-2.1472	-5.1100	-1.7790
Lesotho	-4.0929	-1.7376	-3.5750	-2.0262	-4.5754	-1.6571
Libya	-1.4696	-1.9159	-1.7554	-2.1676	-2.8119	-1.8284
Liberia	-2.9684	-0.9513	-2.7543	-0.6388	-3.8222	-0.2784
Madagascar	-6.3723	-0.8831	-6.3118	-0.6266	-5.6944	-0.3291
Malawi	-3.7429	-0.9914	-4.1375	-0.6741	-5.0511	-0.3339
Mali	-4.8690	-1.2227	-5.0852	-0.7966	-4.9667	-0.3444
Mauritius	-3.7372	-1.3058	-4.1930	-0.9407	-5.5853	-0.5495
Egypt Arab Rep.	-3.0026	-1.4094	-3.1461	-1.0370	-3.1270	-0.6967
Mozambique	-2.0118	-2.6401	-1.9559	-2.3949	-2.0661	-2.0016
Mauritania	-3.6718	-2.7264	-3.6160	-2.5163	-4.3317	-2.0483
Namibia	-2.6964	-1.9657	-2.5220	-1.7197	-2.5147	-1.3115
Nigeria	-4.3753	-4.1021	-4.5903	-3.9276	-4.2309	-2.9961
Niger	-2.8786	-3.9810	-2.3214	-3.8839	-2.1224	-2.9212
Central African Rep.	-1.0826	-3.9220	-2.1081	-3.8709	-6.1069	-2.9525

Rwanda	-5.8977	-3.3474	-5.5944	-3.0998	-5.0911	-2.1121
Sao Tome and Principe	-2.9833	-3.2174	-3.2433	-2.9648	-2.8865	-1.9666
Senegal	-3.3169	-3.1425	-3.5104	-2.8557	-3.4276	-1.8215
Sierra Leone	-5.9639	-3.5952	-5.8490	-3.3084	-6.3224	-2.0387
Somalia	-4.0826	-3.5007	-4.6746	-3.2894	-4.8285	-2.0083
Sudan	-0.5974	-3.6006	-1.4193	-3.4580	-3.2995	-2.1710
Togo	-7.7473	-3.1468	-7.3093	-2.9223	-6.7327	-1.5839
Tanzania	-5.4213	-3.2186	-5.2284	-3.0498	-4.2880	-1.7120
Tunisia	-4.3062	-3.3744	-5.3591	-3.2358	-4.1036	-1.8515
Uganda	-4.6214	-4.3376	-5.4752	-4.2327	-5.7325	-2.6112
Zambia	-3.1192	-4.2245	-4.1016	-4.1937	-3.8105	-2.6710
Zimbabwe	-1.6545	-4.4344	-1.8624	-4.3637	-3.3301	-2.7932
P_{LM}	-3.3389***	-3.3827***	-3.4528***	-2.9419***	-3.8166***	-2.0118
Z_{LM}	-4.3598	-4.8530	-11.8147	-6.9342	-18.4324	0.6357
Prob. Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.7375

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

For the economic growth and unemployment series of 48 countries, panel unit root test was applied in 3 Fouriertau LM waves. When the k values of the economic growth variable in Table 5 are analyzed, it is concluded that it does not contain a unit root in all 3 Fouriertau LM waves, while the unemployment variable does not contain a unit root in 1 and 2 Fouriertau LM waves, but contains a unit root in 3 Fouriertau LM waves. Since it is concluded that the unemployment variable does not contain a unit root in 2 Fouriertau LM waves, the unemployment series is interpreted as not containing a unit root and the analysis is continued with the Panel Fourier cointegration test.

Table 6: Panel Fourier Cointegration Test Results (GDP and UNEMP)

	GLS					**PP**				
	Test Statistics	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**	**k**	**Test Statistics**	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**	**k**
Angola	-1.493*	-2.634	-1.742	-0.759	1	-8.282***	-3.072	-2.212	-0.894	1
Benin	-5.295***	-2.713	-1.665	0.097	1.5	-5.527***	-3.282	-2.073	0.334	1.5
Botswana	-5.860***	-2.542	-1.617	0.211	0.8	-11.265***	-3.115	-1.960	0.589	0.8
Burkina Faso	-5.598***	-2.977	-2.037	-0.793	0.1	-6.578***	-3.156	-2.393	-1.031	0.1
Burundi	-4.303***	-3.116	-1.898	-0.471	1.3	-5.046***	-2.943	-2.095	-0.358	1.3
Cabo Verde	-4.903***	-2.549	-1.728	0.405	0.5	-10.305***	-3.015	-1.996	0.003	0.5
Algeria	-4.621***	-2.799	-1.869	0.049	1.1	-6.137***	-3.105	-2.152	0.096	1.1
Chad	-3.342***	-2.916	-2.021	1.072	1.5	-6.937***	-3.201	-2.411	-0.748	1.5
Equatorial Guinea	-1.957**	-3.002	-1.917	-0.872	1.7	-5.265***	-3.008	-2.122	-0.987	1.7
Ethiopia	-6.568***	-2.994	-1.585	0.642	0.1	-8.874***	-3.030	-1.860	2.804	0.1
Morocco	-1.463*	-3.663	-2.125	-0.340	1	-14.385***	-4.102	-2.485	-0.042	1
Gabon	-5.540***	-3.036	-1.993	-0.624	1.9	-6.819***	-3.134	-2.275	-0.672	1.9
Gambia	-5.450***	-3.464	-1.940	-0.350	1.4	-12.603***	-3.622	-2.342	-0.846	1.4
Ghana	-5.299***	-2.836	-1.894	-0.021	1.3	-6.366***	-3.429	-2.365	-0.944	1.3
Guinea	-5.615***	-3.124	-2.354	-1.116	1.5	-10.913***	-3.294	-2.498	-1.230	1.5
Guinea-Bissau	-5.854***	-2.550	-1.373	1.023	0.8	-11.689***	-2.774	-1.554	1.545	0.8
South Africa	-5.690***	-3.094	-2.181	-1.056	0.8	-12.657***	-3.542	-2.472	-1.324	0.8
Cameroon	-1.025*	-3.122	-2.019	-0.213	0.1	-7.023***	-3.201	-2.127	-0.161	0.1
Kenya	-5.113***	-3.121	-1.810	-1.088	1	-10.003***	-3.875	-2.180	-1.269	1
Comoros	-5.259***	-3.060	-1.979	-0.683	0.1	-6.469***	-3.636	-2.417	-1.396	0.1
Congo Dem. Rep.	-3.564***	-3.293	-2.054	-0.491	1.5	-6.299***	-3.344	-2.458	-0.644	1.5

Congo Rep.	-5.073***	-2.513	-1.668	-0.521	1.6	-6.688***	-2.890	-1.972	-0.815	1.6
Lesotho	-5.457***	-2.908	-1.971	-0.710	1.9	-12.127***	-3.245	-2.106	-0.762	1.9
Libya	-5.124***	-2.751	-1.697	0.757	1.9	-11.313***	-3.721	-2.108	2.599	1.9
Liberia	-3.251***	-2.561	-1.520	0.098	1.7	-5.298***	-2.904	-2.021	-0.630	1.7
Madagascar	-5.665***	-3.216	-2.026	-0.319	1.2	-8.542***	-3.313	-2.197	-0.460	1.2
Malawi	-6.386***	-2.603	-1.411	0.710	1.9	-5.887***	-2.919	-1.750	0.649	1.9
Mali	-5.538***	-3.205	-1.968	-0.983	1.9	-6.313***	-3.540	-2.342	-1.321	1.9
Mauritius	-5.387***	-3.182	-2.331	-0.401	1.9	-9.975***	-3.560	-2.474	-1.063	1.9
Egypt Arab Rep.	-4.457***	-2.426	-1.296	0.332	0.1	-4.969***	-2.952	-1.754	0.049	0.1
Mozambique	-5.787***	-3.432	-2.143	-0.775	0.8	-9.551***	-3.415	-2.275	-0.689	0.8
Mauritania	-5.842***	-3.058	-1.927	-0.907	1.8	-5.930***	-3.253	-2.174	-1.440	1.8
Namibia	-4.621***	-2.411	-1.492	0.107	1.1	-6.448***	-2.864	-1.961	0.006	1.1
Nigeria	-4.313***	-2.473	-1.454	1.200	0.1	-4.736***	-2.559	-1.596	5.088	0.1
Niger	-5.986***	-3.038	-2.047	-0.623	0.4	-12.188***	-3.570	-2.364	-0.415	0.4
Central African Rep.	-5.385***	-2.611	-1.649	-0.696	1.2	-6.086***	-3.281	-2.219	-0.579	1.2
Rwanda	-6.348***	-2.614	-1.762	-0.745	0.1	-6.496***	-3.328	-2.032	-1.228	0.1
Sao Tome and Principe	-4.633***	-2.307	-1.311	0.286	1.2	-4.732***	-2.937	-1.706	0.367	1.2
Senegal	-5.175***	-2.392	-1.523	0.468	1.8	-10.014***	-2.720	-1.723	0.779	1.8
Sierra Leone	-4.936***	-2.564	-1.584	-0.131	1.1	-6.439***	-2.820	-1.966	-0.715	1.1
Somalia	-5.744***	-2.493	-1.398	0.439	1.3	-6.317***	-2.790	-1.723	1.409	1.3
Sudan	-4.591***	-2.821	-1.796	-0.800	1.1	-4.474***	-3.220	-2.265	-1.038	1.1
Togo	-1.408*	-3.232	-2.234	-0.400	1.9	-9.098***	-3.472	-2.315	-1.009	1.9
Tanzania	-5.059***	-3.264	-2.187	-0.654	1	-8.547***	-2.759	-2.081	-0.663	1
Tunisia	-4.711***	-2.675	-1.601	1.038	0.4	-9.472***	-3.192	-2.018	1.584	0.4
Uganda	-4.902***	-2.235	-1.227	0.553	0.1	-4.950***	-2.556	-1.495	1.174	0.1
Zambia	-4.367***	-3.244	-2.115	-0.905	1.4	-8.511***	-3.380	-2.357	-0.594	1.4
Zimbabwe	-5.252***	-2.779	-1.699	-0.862	1.9	-5.362***	-3.095	-2.084	-1.145	1.9
Group Statistics						**Group Statistics**				
Mean	**-4.775*** **	**Prob.**	**0.002**			**Mean**	**-7.915*** **	**Prob.**	**0.001**	
Max	**-6.568*** **	**Prob.**	**0.000**			**Max**	**-14.385*** **	**Prob.**	**0.000**	
Median	**-5.175*** **	**Prob.**	**0.001**			**Median**	**-6.819*** **	**Prob.**	**0.001**	

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

When the results of the Panel Fourier cointegration test in Table 6 are analyzed, it is found that Angola, Morocco, Cameroon and Togo are significant at 10%, Equatorial Guinea is significant at 5% and all other countries are significant at 1% level according to GLS test statistic values, while all countries are significant at 1% level according to PP test statistic values. Therefore, according to GLS or PP values, significant cointegration probability values have been reached across countries. In this case, it is determined that there is a cointegration relationship between the economic growth and unemployment variables of the 48 African Union countries selected in the panel data analysis.

Table 7: The Panel Coefficient Estimates Results

Variable	Coefficient	Standard Error	Probability Value
UNEMP	-1.905466***	0.5627541	0.001
Constant	12.20592	7.470478	0.102

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

After determining the cointegration relationship between the variables, CCE-MG estimator was used for long-run cointegration coefficient estimates. According to the CCE-MG estimator, there is an econometrically significant and negative relationship between economic growth and unemployment within the panel. The effect of unemployment variable on economic growth is calculated as -1.9. Therefore, it is found that for every 1% increase in unemployment in the African Union countries, economic growth will decline by 1.9%.

5. Conclusion and Policy Recommendations

The relationship between unemployment and growth was first introduced to the literature by Arthur M. Okun (1962) with the so-called Okun's law. In this study, it was found that unemployment negatively affects GDP, in other words, economic growth. In this study, the relationship between economic growth and unemployment was investigated using data from 48 African Union countries. As a result of this research, it was concluded that unemployment negatively affects economic growth. Therefore, it is concluded that Okun's law is valid for the African Union countries. The results of the analysis support all other studies except the studies of Eğri (2018) and Bakkal (2023).

The validity of Okun's law leads to the conclusion that unemployment directly affects economic growth. This is an expected result throughout the literature, but the other important factor when Okun's law is valid is how large the Okun coefficient is. In the study, Okun coefficient was calculated as -1.9. As a result of this calculation, it is concluded that for every 1% increase in unemployment, economic growth will be negatively affected by 1.9%. In other words, an increase in the unemployment rate leads to a decrease in economic growth more than unemployment. In such cases, policies to be implemented towards unemployment will directly affect economic growth. In the 48 African Union countries used in the panel data analysis, on average, an increase in unemployment will affect economic growth more than unemployment. It is among the results of the study that the policies implemented to reduce the unemployment rate or to increase employment will have a direct and higher impact on economic growth. Therefore, the African Union countries should give importance to policies aimed at reducing unemployment rather than economic growth policies, and the implementation of policies that will reduce unemployment in accordance with the dynamics of the country will contribute to the formation of a positive atmosphere throughout the economy.

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