



ISSN: 2146-1740
<https://dergipark.org.tr/tr/pub/ayd>,
Doi: 10.54688/ayd.1526649
Araştırma Makalesi/Research Article



TESTING THE UNEMPLOYMENT HYSTERESIS HYPOTHESIS FOR TÜRKİYE BY AGE, GENDER AND FREQUENCY DIFFERENCES: EVIDENCE FROM WAVELET-BASED UNIT ROOT TESTS*

Tuba ÇAT¹ Mustafa KIRCA²

Abstract

Article Info

Received:
01/08/2024

Accepted:
27/11/2024

The main objective of this study is to test the unemployment hysteresis hypothesis by age, gender and frequency differences (period) for Türkiye. For this purpose, monthly data cover a long period between 2005 and 2023. Wavelet transforms of unemployment rates, along with their original values, are used to investigate the hysteresis effect for short, medium, and long-run components. First, the linearity of the series and the significance of structural breaks are tested. The Fourier Augmented Dickey-Fuller (FADF) test is used for linear series with significant structural breaks. The Fourier Kapetanios-Shin-Snell (FKSS) test is used to test the hysteresis hypothesis for non-linear series with significant structural breaks. For series without significant structural breaks, ADF and KSS tests are used. The findings reveal that the hypothesis of unemployment hysteresis in Türkiye differs by age, gender, and frequency differences.

Keywords: Unemployment, Hysteresis Hypothesis, Wavelet Transform, Unit Root Test

Jel Codes: C32, E24, J23.



*This article is derived from the master's thesis titled "Do Age and Gender Matter for Unemployment Hysteria in Türkiye? Evidence from Wavelet-Based Unit Root Tests," conducted by Tuba ÇAT under the supervision of Assoc. Prof. Dr. Mustafa KIRCA at the Social Sciences Institute of Ordu University.

¹Master of Science, Independent Researcher, ORCID: 0009-0008-5418-661X, tubacatt7@gmail.com

² **Corresponding Author:** Assoc. Prof. Dr., Ordu University, Ünye Faculty of Economics and Administrative Sciences, Department of Economics, ORCID: 0000-0002-5630-7525, mustafakirca52@gmail.com

Cite: Çat, T. & Kırca, M. (2024). Testing the unemployment hysteresis hypothesis for Türkiye by age, gender and frequency differences: evidence from wavelet-based unit root tests. *Akademik Yaklaşımlar Dergisi*, 15 (3), 1599-1623.



1. Introduction

As in many developing countries, unemployment in Türkiye is both an economic and social issue. An analysis of data from 2005 to 2023 reveals that the average unemployment rate in Türkiye is 10.55%. Youth and female unemployment are frequently discussed topics within the Turkish economy. For example, the highest unemployment rate was observed among young women during the specified period at 22.3%. Compared to developed countries such as those in the G7, EU-27, and OECD, Türkiye's overall, age-specific, and gender-specific unemployment rates are higher than the averages in these countries (OECD, 2023a). Reducing the country's unemployment rates to the levels of developed countries is crucial, which highlights the importance of studies on unemployment and efforts to combat it. Especially during periods of crisis, there is an increase in unemployment rates across all segments of society, similar to many other countries. Therefore, the Turkish economy needs to determine whether these increases in unemployment rates are permanent or temporary.

The persistence or temporary of unemployment is debated in economics through two main theories. The first is the natural rate of unemployment theory proposed by Friedman (1968) and Phelps (1968). As stated by the theory, unemployment rate will not fall below a certain level for an extended period. It posits that temporary economic shocks do not have permanent effects, and unemployment rate is going to return to its natural level in the long run. Therefore, the unemployment series is considered a level stationary series. The second theory, the unemployment hysteresis hypothesis, was presented by Blanchard and Summers (1986). According to this hypothesis, unemployment rates are not a stationary process. The average unemployment rate changes over time and across different periods. The situation where the impact of an economic shock on the unemployment rate is permanent, causing unemployment to deviate from its average, is defined as unemployment hysteresis. In the examined time series, new approaches incorporating asymmetries and nonlinearities have emerged and been evaluated. The validity of structural breaks resulting from crisis shocks in economic policies on unemployment hysteresis is tested using unit root tests. Various econometric exercises, especially time series econometrics, are used to test both the natural rate theory and hysteresis hypothesis of unemployment for Türkiye and many other countries.

This study aims to test the unemployment hysteresis hypothesis for Türkiye for the period from January 2005 to October 2023 based on age, gender, and period differentiations. In this study, in addition to the general (total) unemployment rate, the unemployment hysteresis hypothesis is tested within various categories, including female unemployment, male

unemployment, youth unemployment, youth female unemployment, youth male unemployment, adult unemployment, adult female unemployment, and adult male unemployment rates. Thus, it is investigated whether unemployment hysteresis varies by age and gender. When testing the hysteresis hypothesis, not only the original variables but also wavelet transformations are considered. With the help of wavelet transformations, the short, medium, and long-run unemployment hysteresis hypotheses are examined. The use of these transformations constitutes the most important distinguishing feature of the study. Another distinguishing feature is the utilization of unit root tests that account for nonlinearity and the presence of structural breaks, which could lead to the emergence of the hysteresis hypothesis. In this study, the unemployment hysteresis hypothesis is analyzed in the original, short-, medium- and long-run series of unemployment rates using the Fourier Augmented Dickey-Fuller (FADF), Fourier Kapetanios-Shin-Snell (FKSS), ADF, and KSS unit root tests as recommended by Yılanıcı et al. (2024).

The subsequent sections of the study begin with a literature review. Secondly, the introduced datasets used in the analysis are presented. Thirdly, the methods employed in the analysis are explained. Fourthly, the study concludes with the conclusion section after presenting the findings.

2. Literature Review

The hypothesis, developed following the study conducted by Blanchard and Summers (1986), has been subject to various analyses utilizing advanced econometric methods. These analyses have focused on the natural rate and unemployment hysteresis hypotheses. Studies examining the hysteresis hypothesis test the stationarity of the unemployment rate (Røed, 1996; Lee et al., 2010; Arı et al., 2013; Fruoka, 2017; Kar, 2019; Yaya et al., 2019; Yılanıcı et al., 2020; Caporale et al., 2022). The findings of these studies using unit root tests vary across countries. In particular, the unemployment hysteresis hypothesis is generally invalid for developed countries, while it is more valid for other countries.

Unit root tests are also used in studies testing the unemployment hysteresis in Türkiye. In these studies, structural breaks have been incorporated into the model alongside frequently used unit root tests, and non-linear unit root tests have been utilized. For example, Tekin (2018), Bayat et al. (2020), Coşkun (2021), Ulucak (2021) tested the hysteresis effect on the general unemployment rate in Türkiye, and mostly the unemployment hysteresis hypothesis was validated. When the findings of these studies are analyzed, it is seen that the validity of the unemployment hysteresis hypothesis varies according to the methodology and the different

periods analyzed. The studies of Azazi and Ateş (2022) and Aydın (2023) are examples of this case.

Besides, panel data methods have been used to test the hypothesis in the general unemployment rate in Turkey together with other countries. Panel data techniques frequently utilize both traditional and unit root tests that consider structural breaks (Koç & Güner, 2020; Songur, 2020; Dedeoğlu, 2021; Komşu & Komşu, 2021; Özbek & Türkmen, 2021; Bostancı & Koç, 2022; Kılıç et al., 2022; Akyüz, 2023; Atabey & Karakuş, 2023). These studies support both the natural rate and the unemployment hysteresis hypotheses for other countries. In these studies that examine the hysteresis hypothesis with the help of panel data analysis, it is found that the unemployment hysteresis hypothesis is mostly valid in Türkiye, just like the studies using time series methods. Only the study by Koç and Güner (2020) on a group of emerging economies found results supporting the natural rate hypothesis in Türkiye.

Since the main target of our study is to test the unemployment hysteresis hypothesis on the basis of gender and age, Table 1 presents in the studies that test this hypothesis in terms of gender and age differences in Türkiye and other countries. Studies for Türkiye generally find that there is a hysteresis effect in both female and male unemployment rates. However, Şak (2021) concludes that there is no unemployment hysteresis in male. Table 1 also includes studies that test the unemployment hysteresis hypothesis by gender and age in other countries samples. In these countries, it is found that there is a hysteresis effect mostly in female and youth unemployment.

The literature predominantly consists of studies examining hysteresis effects on the general unemployment rate. However, in the evolving literature, it is observed that this hypothesis is also tested in different unemployment rates such as female, male, youth, young female, young male, adult female, and adult male unemployment rates. With the advancement of econometrics, particularly time series econometrics, many new and robust unit root tests are being utilized to test the unemployment hysteresis hypothesis. As mentioned in the literature, the study by Yılcı et al. (2024) employs wavelet transformation to decompose variables into short, medium, and long-run components. Additionally, they consider the linearity and the presence of structural breaks in unemployment rates. They argue that by doing so, they obtain stronger evidence when testing the unemployment hysteresis hypothesis. In this study, a similar analysis process is adopted following the approach suggested by Yılcı et al. (2024) for Nordic countries. Thus, both the unemployment rates used and the methodology employed in the study

represent, to the best of our knowledge, a unique feature compared to previous studies conducted for Türkiye.

Table 1.
Studies by Age and Gender Groups

Author(s)	Year	Method	Finding
Çemrek & Şeker (2020)	2005:1-2019:6	ZA, LS, Unit Root Tests with Structural Breaks	Female unemployment rates exhibit hysteresis effects.
Çiçen (2020)	2005-2014	Fourier KPSS	Female unemployment rates demonstrate a greater hysteresis effect compared to males across different educational levels.
Öztürk (2020)	2005:1-2019:8	ADF, PP, and LS Unit Root Test with Breaks	Hysteresis effects are present in general, as well as youth unemployment and non-agricultural employment series.
Göçen (2021)	2005:01-2020:05	ADF, KPSS, FADF, FKPS	While the natural rate hypothesis applies to female unemployment, hysteresis effects are present in male unemployment rates.
Önal (2021)	1988-2019	ADF, PP, KPSS, Ng-Perron Unit Root Tests	The hysteresis theory is applicable to both men and women.
Şak (2021)	1988-2018	Fourier Kruse	Hysteresis effects are present in women but not valid in men.
Atamer et al. (2023)	1988-2020	ADF, PP, ZA, LS Unit Root Tests	Hysteresis effects are present in both female and male unemployment rates.
Üçler et al. (2023)	2014:1-2022:1	Phillips Perron	There is a greater hysteresis effect in the data of young female unemployment compared to young male unemployment.
Özen Atabey (2024)	1988-2021	FADF and FKSS	In FADF results, general and male unemployment rates exhibit hysteresis effects, while in FKSS test results, hysteresis effects are observed in general, female, and youth unemployment.
Other Countries			
Özpolat & Özsoy (2018)	1998:01-2017:09 14 OECD Countries	Fourier ADF Unit Root Test (FADF)	According to gender analysis, there is no hysteresis in France. In Belgium, hysteresis exists in women but not in men. In Korea, hysteresis is not valid for women, but it is valid for men.
Belke (2020)	2003Q2-2019Q1 28 EU Countries	Fourier KSS Unit Root Test	Except for Hungary and Portugal, the natural rate hypothesis is valid in all countries, including female unemployment. In addition to the two countries, the natural hypothesis is valid in the United Kingdom, Spain, Germany, and Slovenia, among others.

Yılancı et al. (2024)	The periods vary from country to country. Nordic Countries	Wavelet Transform Fourier ADF and Fourier KSS	The results obtained from the original and transformed series indicate differences. It is mostly found that there is a hysteresis effect in youth and female unemployment rates.
--------------------------	---	---	--

3. Data

Our research examines the presence of hysteresis effects in unemployment rates using data covering the period from January 2005 to October 2023 for Türkiye. Since the data used in the study have a starting date of January 2005, this time interval is included in the analysis. The data used in the analysis are obtained from the OECD (Organization for Economic Cooperation and Development) (2023) database. The variables included in the analysis are total (general) unemployment rate (TUR), female unemployment rate (FUR), male unemployment rate (MUR), youth unemployment rate (YUR), youth female unemployment rate (YFUR), youth male unemployment rate (YMUR), adult unemployment rate (AUR), adult female unemployment rate (AFUR), and adult male unemployment rate (AMUR). The youth unemployment rates cover the age range of 15-24, while the adult unemployment rates cover the age range of 25-74.

4. Method

In the study, the analysis process followed by Yılancı et al. (2024) is adopted when testing the unemployment hysteresis hypothesis. The process outlined in Figure 1 is followed. The figure shows that both the original unemployment rate series and the short, medium, and long-run components obtained from wavelet transformations undergo linearity and structural break tests. Here, four different scenarios can arise. The first two scenarios occur under the assumption that the series is linear. If the series is linear and has structural breaks, the FADF unit root test is conducted to test stationarity. The ADF unit root test is used if the series is only linear. The second scenario occurs under the assumption that the series is not linear. If the series is non-linear and has structural breaks, the FKSS unit test is used to test stationarity. If the series is only non-linear, the KSS unit test is used. If the tested unemployment rate series are stationary at the level values, it implies that the hysteresis hypothesis is not valid or the natural rate hypothesis is valid. Conversely, if it is not stationary, it implies that the hysteresis hypothesis is valid.

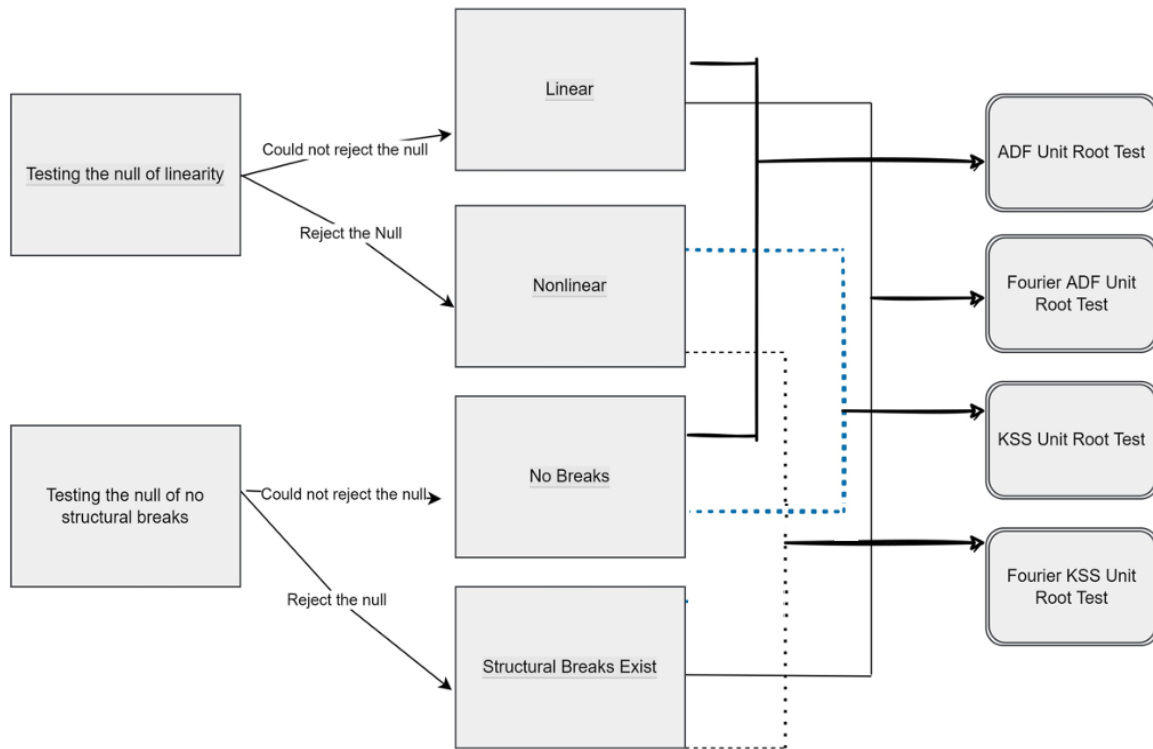


Figure 1.

Testing Strategy¹

4.1. Wavelet Transformation

In this study, we utilized the wavelet transform (decomposition) method to obtain short, medium, and long-run components of the unemployment rate series. Fan and Gencay (2010) first proposed a wavelet-based unit root test. As observed in numerous studies encompassing time series and panel analysis, such as Yılcı et al. (2024), Erdoğan and Solarin (2021), Aydın (2020), Aydın and Pata (2020), Rhif et al. (2019), and Ha et al. (2018), wavelet transforms (decompositions) are employed. Various wavelet transform methods exist. In this study, similar to the studies of Yılcı et al. (2024) and Ha et al. (2018), the Maximum Overlap Discrete Wavelet Transform (MODWT) method is employed. The representation of the time series to be transformed is as follows:

$$y(t) = \sum_k s_{j,k} \Phi_{j,k}(t) + \sum_k d_{j,k} \psi_{j,k}(t) + \sum_k d_{j-1,k} \psi_{j-1,k}(t) + \dots + \sum_k d_{1,k} \psi_{j,k}(t) \quad (1)$$

The coefficient $s_{j,k}$ captures the trend of the original time series while $d_{j,k}, \dots, d_{1,k}$ represent detail coefficients providing information about deviations from the trend over short periods (Ha et al., 2018). Here, $\Phi_{j,k}$ represents the long-run movements of the series

¹ The test strategy used in the analysis process can be accessed from the study of Yılcı et al., 2024.

and is a low-frequency wavelet function while $\psi_{j,k}(t)$ is a scale function capturing short-run movements and indicating the high frequencies of the series. As indicated by Yılanıcı et al. (2024), the wavelet ($w_{j,t}$) and scaling ($v_{j,t}$) coefficients associated with MODWT are calculated as follows:

$$w_{j,t} = \sum_{L=0}^{L-1} \frac{\psi_{j,L}}{2^{j/2}} y_{t-L} \text{ mod } N \quad (2)$$

$$v_{j,t} = \sum_{L=0}^{L-1} \frac{\Phi_{j,L}}{2^{j/2}} y_{t-L} \text{ mod } N \quad (3)$$

Yılanıcı et al. (2024) demonstrate that in the study of Paramasivam et al. (2022), the wavelet transform (decomposition) layer $j=1,2,\dots,J_0$ and the mod N filtering operation in the decomposition process provides the same coefficient at each scale. As depicted above, $\Phi_{j,L}$ and $\psi_{j,L}$ within the equation represent the scale and wavelet functions of the discrete wavelet transform, respectively. “ y_t ” represents the time series undergoing the wavelet transform. Yılanıcı et al. (2024) noted that the scaling coefficient captures long-run behaviors while the wavelet coefficient captures short-run behaviors.

Yılanıcı et al. (2024), considering the study of Gencay et al. (2010), recommend using the Daubechies Least Asymmetric wavelet filter with a length of 8 wavelets. The formula $J = \log_2(T)$ is used to determine the maximum scale, where T represents the number of observations. This process results in the extraction of five components. The sum of the first (D1) and second (D2) components represents the short-run (less than 8 months), the third component (D3) represents the medium-run (8-32 months), and the sum of the fourth (D4) and fifth (D5) components represents the long run (more than 32 months). Thus, the linearity test and unit root tests outlined below can be applied to these wavelet-transformed series. This allows for the consideration of short, medium, and long-run components in both the linearity test and unit root tests.

4.2. Linearity Test

Many time series, such as the unemployment rate, can exhibit both linear and non-linear characteristics. Taking these features into account, numerous non-linear methods have been developed. Many studies employ non-linear methods to examine economic variables and the relationships between these variables (e.g., Guliyey, 2023; Tawiah, 2023; Galadima & Aminu, 2020; Güriş, 2018). Whether the series is linear or non-linear enables more reliable findings about the variables and their relationships. In determining whether time series are linear, the method developed by Harvey et al. (2008) is frequently used. Harvey et al. (2008) developed a

new linearity test using the average weights of statistics from two different linearity tests. They introduced a new test statistic using the formula $W_{\lambda} = \{1-\lambda\} W_S + \lambda W_U$. Here, W_S investigates the linearity of the series under the assumption that it is stationary, while W_U investigates the linearity under the assumption that the series is non-stationary. Besides, λ represents the weight and is calculated as $\lambda(U, S) = \exp\left(-g\left(\frac{U}{S}\right)^2\right)$. In this equation, g is a positive constant, and U and S are the unit root and stationarity test statistics. As noted by Yıllancı et al. (2024), Harvey (2008) recommends using the standard Dickey-Fuller unit root test statistic for U and the non-parametric stationarity statistic by Harris et al. (2003) for S . If the series being investigated for linearity is stationary, $\left(\frac{U}{S}\right)^2$ will diverge, causing λ to approach zero. Conversely, if the series has a unit root, $\left(\frac{U}{S}\right)^2$ will converge to zero, causing λ to approach one (Yıllancı et al., 2024; Malcıoğlu & Aydın, 2020).

First, to obtain the W_S test statistic for our unemployment rate (UR_t) series, the model presented in Equation 4 is estimated. Here, the unemployment series used in the study is assumed to be a stationary time series.

$$UR_t = \alpha_0 + \alpha_1 UR_{t-1} + \alpha_2 UR_{t-1}^2 + \alpha_3 UR_{t-1}^3 + e_t \quad (4)$$

By applying a restriction test on the coefficients α_2 and α_3 in Equation 4, the Wald test statistic, denoted here as W_S , is calculated using the formula $W_S = T\left(\frac{SSR_S^r}{SSR_S^u} - 1\right)$. This test statistic follows a $\chi^2(2)$ distribution. In this context, SSR_S^r represents the sum of squared residuals from Equation 4 without the restriction applied while SSR_S^u represents the sum of squared residuals for the model, excluding α_2 and α_3 . T denotes the number of observations. Here, the null hypothesis ($H_{0,S}: \alpha_2 = \alpha_3 = 0$) suggests that a time series such as the unemployment rate is linear. The alternative hypothesis ($H_{0,S}: \alpha_2 \neq 0$ and/or $\alpha_3 \neq 0$), on the other hand, indicates that the series is not linear.

When calculating the W_U test statistic, it is assumed that a time series such as the unemployment rate is non-stationary. In this case, Equation 4 is expressed as Equation 5 using difference series.

$$\Delta UR_t = \delta_0 + \delta_1 \Delta UR_{t-1} + \delta_2 \Delta UR_{t-1}^2 + \delta_3 \Delta UR_{t-1}^3 + u_t \quad (5)$$

After estimating the equation, the WU test statistic is calculated as $W_U = T\left(\frac{SSR_S^r}{SSR_S^u} - 1\right)$. This tests the alternative hypothesis $H_{0,U}: \delta_2 \neq 0$ and/or $\delta_3 \neq 0$ against the null hypothesis ($H_{0,U}:$

$\delta_2 = \delta_3 = 0$) that the unemployment rate series is linear. Finally, following the computation of these two test statistics, Harvey et al. (2008) calculate the W_λ test statistic as shown above. The W_λ test statistic follows a $\chi^2(2)$ distribution. W_λ indicates the test statistic distribution. If this test statistic exceeds the critical values of 9.21 (1%), 5.99 (5%), and 4.60 (10%), it implies that the unemployment rate series used in our study is non-linear. Conversely, if it falls below these critical values, it suggests linearity. Upon accessing findings regarding the linearity of variables, the FADF, FKSS, ADF, and KSS unit root tests, as proposed by Christopoulos and Leon-Ledesma (2010), are employed. Based on the results of these unit root tests, conclusions regarding hysteresis effects in the unemployment rate series will be drawn.

4.3. Fourier ADF and Fourier KSS Unit Root Tests

Following the linearity tests applied to the short, medium, and long-run components obtained through original and wavelet transformations, if the relevant series are found to be linear, the Fourier ADF and Fourier KSS unit root tests developed by Christopoulos and Leon-Ledesma (2010) are employed. Alongside these unit root tests, significant structural breaks in our unemployment rate series are also identified. In the absence of significant structural breaks, it is recommended to utilize the ADF unit root test, commonly employed in time series econometrics. Perron (1989) demonstrated that structural breaks in variables impact the results of unit root tests. Taking this into consideration, many researchers have developed unit root tests that account for structural breaks (e.g., Zivot & Andrews, 1992; Lumsdaine & Papell, 1997; Kapetanios, 2005; Carrion-i-Silvestre et al., 2009). As evidenced in our literature review, these tests that incorporate structural breaks are frequently utilized when testing the hypothesis of unemployment hysteresis. Knowing the number, location, and form of structural breaks is crucial in these unit root tests.

In the unit root tests developed by Christopoulos and Leon-Ledesma (2010) using Fourier functions, structural breaks are accounted for without specifying the number or location of breaks. Becker et al. (2006) recommended using Fourier functions in unit root tests. Christopoulos and Leon-Ledesma (2010) incorporated Fourier functions into the ADF unit root test, which is a linear unit root test developed by Said and Dickey (1984), to develop the Fourier ADF unit root test. In the same study, Christopoulos and Leon-Ledesma (2010) also proposed the Fourier KSS unit root test by incorporating Fourier functions into the KSS unit root test, which is a non-linear unit root test developed by Kapetanios, Snell, and Shin (2003). In the first stage of the test, significant structural breaks in the series under investigation (in this study, the

unemployment rates) are examined with the aid of Fourier functions. Equation 6 presents the estimation equation for the Fourier function for the unemployment rate (*UR*) variable.

$$UR_t = \beta_0 + \beta_1 \sin\left(\frac{2\pi kt}{T}\right) + \beta_1 \cos\left(\frac{2\pi kt}{T}\right) + \varepsilon_t \quad (6)$$

The term “ $\beta_1 \sin\left(\frac{2\pi kt}{T}\right) + \beta_1 \cos\left(\frac{2\pi kt}{T}\right)$ ” in Equation 6 is the Fourier function. Here, sin and cos are trigonometric terms. In the Fourier function, π represents the pi constant, k denotes the number of frequencies, t is the trend, and T is the number of observations. To find the optimal frequency value (k), Equation 5 needs to be estimated. The suitable frequency value ranges from 0 to 5, with k taking values of 1, 2, 3, 4, and 5. Equation 6 is estimated for each k value, and the frequency value that provides the smallest sum of squared residuals indicates the optimal frequency number. After obtaining the optimal frequency value, the significance of structural breaks is determined by applying a restriction test to the coefficients of the trigonometric terms. The F-statistic value calculated from the restriction test is compared with the critical value provided by Becker et al. (2006). The null hypothesis $H_0: \beta_1 = \beta_2 = 0$, which suggests that the trigonometric terms (i.e., structural breaks) are insignificant, is tested against the alternative hypothesis $H_1: \beta_1 \neq \beta_2 \neq 0$, indicating that the trigonometric terms (i.e., structural breaks) are significant. If the calculated F-statistic value exceeds the critical values provided by Becker et al. (2006), the null hypothesis is rejected, indicating that structural breaks are significant. If these structural breaks are not significant, the ADF unit root test is used if the series is linear, and the KSS unit root test is used if the series is non-linear². When the trigonometric terms, i.e., structural breaks, are significant, the second stage of the test involves estimating the model in Equation 6 using the Ordinary Least Squares (OLS) method to obtain the residuals (ε_t). Subsequently, these residuals are subjected to the ADF or KSS unit root test, completing the FADF and FKSS unit root testing process. Equations 7 and 8 present the FADF and FKSS unit root test equations, respectively.

$$\Delta\varepsilon_t = \alpha_1 \varepsilon_{t-1} + \sum_{j=1}^p \alpha_j \Delta\varepsilon_{t-j} + v_{1,t} \quad (7)$$

$$\Delta\varepsilon_t = \gamma_1 \varepsilon_{t-1}^3 + \sum_{j=1}^p \gamma_j \Delta\varepsilon_{t-j} + v_{2,t} \quad (8)$$

The term v_t in Equations 7-8 represents the white noise error term. As Yılançı et al. (2024) noted, these two models allow for testing the presence of unit roots in the original series (*UR* and its components) after removing the structural breaks in the deterministic components.

²Detailed information about the ADF and KSS tests can be found in the studies of Said and Dickey (1984) and Kapetanios, Snell, and Shin (2003), respectively.

If the series is linear, the FADF test equation is used, and the presence of a unit root in the variable is determined with the aid of the t-test. The null hypothesis of the FADF test ($H_0: \hat{\alpha}_1 = 0$) suggests that the series is non-stationary, meaning there is a unit root. The alternative hypothesis ($H_1: \hat{\alpha}_1 < 0$) indicates that the series is stationary, meaning there is no unit root. Similarly, the null hypothesis of the FKSS test ($H_0: \gamma_1 = 0$) suggests that the series is non-stationary, meaning there is a unit root, while the alternative hypothesis ($H_1: \gamma_1 < 0$) indicates that the series is stationary, meaning there is no unit root. The calculated t -statistic value is compared with the critical values provided by Christopoulos and Leon-Ledesma (2010), considering the optimal frequency value (k). If the calculated t -statistic value is absolutely smaller than the critical values, the null hypotheses cannot be rejected. The failure to reject the null hypotheses in the FADF, FKSS, ADF, and KSS unit root tests indicates that the hysteresis hypothesis is valid in the unemployment rate series. Conversely, if the series is stationary, it suggests that the hysteresis hypothesis is invalid and that a natural unemployment rate exists.

5. Findings

The findings of the analyses using the methods introduced above are presented in this section of the study. Based on the linearity and structural break test results for the unemployment rate variables, the results of the FADF, FKSS, ADF, or KSS unit root tests are included. Additionally, after considering the original forms of the unemployment rate variables, analysis results for the short, medium, and long-run components obtained through wavelet transformations are provided. First, the test findings for the original forms of the unemployment rate variables are presented in Table 2.

Table 2.

Testing the Unemployment Hysteresis Hypothesis for Original Unemployment Rate Series

Variable	Linearity Test	Optimal Frequency	F-Test	FADF	FKSS	ADF	KSS	Critical Values		
								1%	5%	10%
TUR	8.79**	2	133.634*	-	-3.57** (12)	-	-	-3.86	-3.26	-2.100
FUR	3.00	1	372.757*	-2.51 (12)	-	-	-	-4.36	-3.78	-3.48
MUR	13.41*	2	149.599*	-	-5.19* (10)	-	-	-3.86	-3.26	-2.99
YUR	3.73	2	125.655*	-1.97 (12)	-	-	-	-3.88	-3.28	-2.95

YFUR	22.36*	1	346.066*	-	-3.09 (13)	-	-	-4.19	-3.60	-3.29
YMUR	13.7*	2	159.835*	-	-3.39** (12)	-	-	-3.86	-3.26	-2.100
AUR	4.12	2	124.024*	-2.32 (12)	-	-	-	-3.88	-3.28	-2.95
AFUR	4.99***	1	396.414*	-	-1.83 (12)	-	-	-4.19	-3.60	-3.29
AMUR	8.28**	2	143.143*	-	3.58** (12)	-	-	-3.86	-3.26	-2.100

Note: *, **, and *** denote, respectively, the significance levels of 1%, 5%, and 10%, indicating the stationarity, presence of significant structural breaks, and non-linearity in the variables.

Additional notes: 1) The values in parentheses indicate the optimal number of lags, determined using the general-to-specific t-information criterion. 2) The linearity test employed the test developed by Harvey et al. (2008), with critical values as follows: 9.21 (1%), 5.99 (5%), and 4.60 (10%). 3) The critical values for the FADF and FKSS tests were obtained from Table 1 and Table 2 in Christopoulos and Leon-Ledesma (2010), respectively. 4) For the ADF unit root test, critical values are based on MacKinnon's (1996) study. 5) Critical values for the KSS unit root test were obtained from Table 1 in Kapetanios et al. (2003). 6) The F-test was conducted to test the significance of the trigonometric terms, indicating the effectiveness of structural breaks in the series if significant.

Upon reviewing Table 2, it is evident that based on the findings of the FADF unit root test, all variables exhibit a unit root, implying the presence of unemployment hysteresis. Regarding the FKSS unit root test results, the test statistic for the male unemployment rate surpasses the critical value in the table, thereby failing to reject the hypothesis of stationarity. At the 5% significance level, the total unemployment rate, youth male unemployment rate, and adult male unemployment rate are deemed stationary. Similarly, the hypothesis of unit roots in the series of youth female unemployment rate and adult female unemployment rate is not rejected based on the FKSS unit root test findings. Considering the original unemployment rate series, the test outcomes indicate the stationarity of the total unemployment rate, male unemployment rate, youth male unemployment rate, and adult male unemployment rate. This suggests that economically, these variables revert to their mean in response to shocks occurring within the economy. The series of female unemployment rate, youth unemployment rate, youth unemployment rate, youth female unemployment rate, adult unemployment rate, and adult female unemployment rate are non-stationary. In this context, it indicates that the effects of shocks in the economy are persistent, causing the series to deviate from their equilibrium points. The findings suggest that the variables exhibit hysteresis, where the impact of past events influences their current behavior, aligning with existing literature. Following these results, the distinguishing aspect of this study lies in its approach to analyzing the unemployment rate variables through wavelet transformations, considering short, medium, and long-run

components. The analysis of short-run unemployment rate series findings is presented in Table 3.

Table 3.

Testing the Unemployment Hysteresis Hypothesis for Short-run Unemployment Rate Series

Variable	Linearity Test	Optimal Frequency	F-test	FADF	FKSS	ADF	KSS	Critical Values		
								1%	5%	10%
TUR	15.07*	5	0.003	-	-	-	-3.36** (14)	-3.48	-2.93	-2.66
FUR	0.92	4	0.00005	-	-	-7.11* (14)	-	-3.46	-2.87	-2.57
MUR	10.22*	5	0.003	-	-	-	-3.09** (14)	-3.48	-2.93	-2.66
YUR	9.95*	5	0.001	-	-	-	-3.03** (12)	-3.48	-2.93	-2.66
YFUR	24.20*	5	0.0001	-	-	-	-4.92* (14)	-3.48	-2.93	-2.66
YMUR	3.03	5	0.002	-	-	-7.31* (14)	-	-3.46	-2.87	-2.57
AUR	4.43	5	0.002	-	-	-8.33* (13)	-	-3.46	-2.87	-2.57
AFUR	0.68	4	0.0002	-	-	-9.03* (12)	-	-3.46	-2.87	-2.57
AMUR	5.22***	5	0.002	-	-	-	-2.33 (14)	-3.48	-2.93	-2.66

Note: *, **, and *** denote, respectively, the significance levels of 1%, 5%, and 10%, indicating the stationarity, presence of significant structural breaks, and non-linearity in the variables. The additional notes in Table 2 are valid for this table.

Upon examining the values in Table 3, it is evident that different results were obtained in the linearity test analysis. The F-test, which assesses the significance of trigonometric terms, indicated that structural breaks were not effective. Therefore, both linear and non-linear unit root test analyses were conducted accordingly. The KSS unit root test was applied to non-linear variables, while the ADF unit test was applied to linear series. In the short-run analysis of unemployment variables, it is concluded that only the adult male unemployment series deviates from its mean value. All other variables are inferred to return to their previous equilibrium levels in the short run, indicating the absence of hysteresis effects. The results of the hysteresis hypothesis applied to the medium-run of the unemployment series are presented in Table 4.

In Table 4, it was determined that significant structural breaks were not effective in the examined variables. The KSS unit root test was applied to non-linear variables such as male unemployment, youth unemployment, and adult male unemployment, revealing their stationarity at the 5% significance level. As for the total unemployment rate, female unemployment rate, youth female unemployment rate, youth male unemployment rate, adult unemployment rate, and adult female unemployment rate series, the ADF unit root test was conducted, indicating stationarity. All variables exhibited test statistic values greater than the critical value in absolute terms, thereby failing to reject the hypothesis of stationarity. The unit root test results for the medium run indicated the stationarity of all variables, suggesting that the series reverted to their means.

Table 4.

Testing the Unemployment Hysteresis Hypothesis for Medium-run Unemployment Rate Series

Variable	Linearity Test	Optimal Frequency	F-test	FADF	FKSS	ADF	KSS	Critical Values		
								1%	5%	10%
TUR	0.01	5	0.0573	-	-	-5.63* (14)	-	-3.46	-2.87	-2.57
FUR	3.23	4	0.010	-	-	-4.41* (14)	-	-3.46	-2.87	-2.57
MUR	7.04**	5	0.755	-	-	-	-3.24** (14)	-3.48	-2.93	-2.66
YUR	7.68**	5	0.443	-	-	-	-3.09** (14)	-3.48	-2.93	-2.66
YFUR	3.23	5	0.037	-	-	-5.27* (14)	-	-3.46	-2.87	-2.57
YMUR	2.22	5	0.731	-	-	-6.24* (14)	-	-3.46	-3.87	-2.57
AUR	0.57	5	0.480	-	-	-5.53* (14)	-	-3.46	-2.87	-2.57
AFUR	0.38	4	0.058	-	-	-4.91* (14)	-	-3.46	-2.87	-2.57
AMUR	9.43*	5	0.657	-	-	-	-3.08** (14)	-3.48	-2.93	-2.66

Note: *, **, and *** denote, respectively, the significance levels of 1%, 5%, and 10%, indicating the stationarity, presence of significant structural breaks, and non-linearity in the variables. The additional notes in Table 2 are valid for this table.

For the long run, the unit root test results applied to the unemployment series are presented in Table 5.

Table 5.

Testing the Unemployment Hysteria Hypothesis for Long-run Unemployment Rate Series

Variable	Linearity Test	Optimal Frequency	F-test	FADF	FKSS	ADF	KSS	Critical Values		
								1%	5%	10%
TUR	6.43**	4	126.618*	-	-1.81 (14)	-	-	-3.58	-3.04	-2.77
FUR	1.17	3	63.16*	-2.58 (14)	-	-	-	-3.68	-3.03	-2.71
MUR	5.35***	4	148.218*	-	-2.02 (14)	-	-	-3.58	-3.04	-2.77
YUR	11.06*	4	64.214*	-	-3.05** (13)	-	-	-3.58	-3.04	-2.77
YFUR	1.15	3	59.458*	-2.20 (14)	-	-	-	-3.68	-3.03	-2.71
YMUR	5.40***	4	96.885*	-	-2.31 (14)	-	-	-3.58	-3.04	-2.77
AUR	3.95	4	138.356*	-3.09** (14)	-	-	-	-3.54	-2.93	-2.64
AFUR	0.59	3	69.676*	-2.87*** (14)	-	-	-	-3.68	-3.03	-2.71
AMUR	3.62	4	163.088*	-3.68* (14)	-	-	-	-3.54	-2.93	-2.64

Note: *, **, and *** denote, respectively, the significance levels of 1%, 5%, and 10%, indicating the stationarity, presence of significant structural breaks, and non-linearity in the variables. The additional notes in Table 2 are valid for this table.

Upon examining Table 5, it is observed that the adult unemployment, adult female unemployment, and adult male unemployment series, to which the FADF unit root test was applied, are stationary. However, the female unemployment and young female unemployment variables contain unit roots. According to the FKSS unit root test results, the youth unemployment series is found to be stationary. The total unemployment rate, male unemployment rate, and young male unemployment rate variables are determined to be non-stationary, indicating the presence of unit roots. Considering all the findings, it is observed that, except for the adult unemployment rate, all variables in their original forms support the natural rate hypothesis through the analysis. However, in the long-run components, these variables exhibit the hysteresis effect. The results indicate that while the hysteresis hypothesis holds for the original forms of youth unemployment, adult unemployment, and adult female

unemployment rates, the long-run components of these variables support the natural rate hypothesis. Table 6 provides a summary of all the findings of the analysis in a tabular format.

Table 6.

Summary of the Analysis Findings

Variable	Original Series			Short-run			Middle-run			Long-run		
	NL	SB	S	NL	SB	S	NL	SB	S	NL	SB	S
TIO	✓	✓	✓	✓	✗	✓	✗	✗	✓	✓	✓	✗
KIO	✗	✓	✗	✗	✗	✓	✗	✗	✓	✗	✓	✗
EIO	✓	✓	✓	✓	✗	✓	✓	✗	✓	✓	✓	✗
GIO	✗	✓	✗	✓	✗	✓	✓	✗	✓	✓	✓	✓
GKIO	✓	✓	✗	✓	✗	✓	✗	✗	✓	✗	✓	✗
GEIO	✓	✓	✓	✗	✗	✓	✗	✗	✓	✓	✓	✗
YIO	✗	✓	✗	✗	✗	✓	✗	✗	✓	✗	✓	✓
YKIO	✓	✓	✗	✗	✗	✓	✗	✗	✓	✗	✓	✓
YEIO	✓	✓	✓	✓	✗	✗	✓	✗	✓	✗	✓	✓

Notes: NL: Non-linear, SB: Structural Break, S: Stationarity ✓: Present, ✗: Absent

When the analysis findings are generally evaluated, it is observed that there are structural breaks in both the original series and the long-run component series. Additionally, it has been determined that 3 out of the 9 original series exhibit non-linear characteristics. Furthermore, the findings reveal that some unemployment rates are also non-linear in their short, medium, and long-run components. The causes of these structural breaks and nonlinearity can be attributed to economic, political, and other factors experienced both in Türkiye and globally during the study period. The 2008 global financial crisis and the COVID-19 pandemic in 2020, which are within our study period, have particularly influenced the long-run, leading to structural breaks and rendering the variables non-linear by altering their trends. These events, as seen in the analysis findings, reveal the hysteresis effect on the unemployment rates of disadvantaged groups within society, particularly women and youth. The evidence of the hysteresis effect in long-run female unemployment, young female unemployment, and young male unemployment rates is a significant indicator of this phenomenon. Moreover, the emergence of the hysteresis effect in the general (total) unemployment rate and the male unemployment rate is the most important indicator that unemployment in Turkey has not reverted to its previous average in the long run. The appearance of the hysteresis effect in general and male unemployment rates

suggests that the hysteresis effect in the subcategories of unemployment drives the hysteresis effect observed in these unemployment rates.

6. Conclusion

This study investigates whether the unemployment hysteresis hypothesis varies in Türkiye by age, gender, and period. For this purpose, the unemployment rates for general, female, male, youth, young female, young male, adult, adult female, and adult male categories from January 2005 to October 2023 were used. In addition to the original forms of the unemployment rate variables, their short, medium, and long-run components were also considered when testing for the hysteresis effect. Wavelet transformation was applied to the original unemployment rate variables to derive their short (2-8 months), medium (8-32 months), and long (32 months and beyond) components. Thanks to these components, the unemployment hysteresis hypothesis could be tested periodically. Before testing the unemployment hysteresis hypothesis, the linearity of the variables was examined. Additionally, potential structural breaks in the variables were not overlooked. In this context, the process proposed by Yılcı et al. (2024) was followed, and the FADF and FKSS unit root tests developed by Christopoulos and Leon-Ledesma (2010) were applied to the series, which may have linear/non-linear characteristics and structural breaks. The ADF and KSS unit root tests were applied for series without structural breaks to gather findings on the unemployment hysteresis hypothesis. Considering both linearity and structural breaks strengthens the reliability of the findings obtained in this study. The results of these analyses can be summarized as follows:

- When considering the original forms of the series, the hysteresis effect is found in female, youth, young female, adult, and adult female unemployment rates.
- In the short run, the hysteresis effect is observed only in the adult male unemployment rate.
- In the medium run, no evidence of the hysteresis effect is found in any unemployment rate.
- In the long run, the hysteresis effect is present in the general (total), female, male, young female, and young male unemployment rates.

Based on these findings, it is demonstrated that the unemployment hysteresis hypothesis in Türkiye varies by age, gender, and period. The results obtained from analyses considering the original forms align with the findings of numerous previous studies conducted for Türkiye, such as those by Çemrek and Şeker (2020), Çiçen (2020), Önal (2021), Atamer et al. (2023), Üçler et al. (2023), and Özen Atabey (2024).

The presence of the hysteresis effect only in the short-run adult male unemployment rate may be attributed to the prolonged adjustment process for adult males to secure new employment opportunities. Structural unemployment could play a significant role in this context. Evolving modes of production and technological advancements create demand for individuals with new skills and capabilities, leading to increased employment opportunities for such individuals. However, the lack of skills among adult males, coupled with deficiencies in other required competencies for the new mode of production, may result in short-run unemployment for them. This unemployment may persist in the short-run due to the inability to address these skill deficiencies promptly. Therefore, developing in-service training policies may alleviate the short-run hysteresis effect among adult males. The absence of short-run hysteresis effect in adult females may be attributed to their low employment rates and tendency to work in more traditional occupations. Similarly, no hysteresis effect is observed in the long-run for adult female unemployment rates. Additionally, the absence of the unemployment hysteresis hypothesis in other subcategories of unemployment in the short-run and across all unemployment rates in the medium term can be interpreted as an indication of the effectiveness of short and medium-term active and passive employment policies in addressing unemployment.

In the long-run, hysteresis effects are evident in general, female, male, young female, and young male unemployment rates. Indeed, previous studies mainly indicate the validity of hysteresis effects (e.g., Karagöz & Saraç, 2016; Tekin, 2018; Bayat et al., 2020; Çoşkun, 2021; Ulucak, 2021). However, this study finds that the hysteresis effect in the general unemployment rate is persistent in the long-run. This finding contributes significantly to the literature. As highlighted by Ben-Salha & Mrabet (2019) and Turyareeba et al. (2020), this enduring hysteresis effect in the general unemployment rate, as observed in many countries, including Türkiye, signifies that economic growth is not accompanied by job creation. In Türkiye, the employment rate is below 50%. Globally, there is a trend of declining employment rates (World Bank, 2024a).

In the long-run, there are significant reasons behind the concentration of unemployment hysteresis, especially among certain groups. As noted by Ayta& Şen (2023) in their study on female employment in Türkiye, issues such as traditional mindset, the role of women in the household, the assigned role of women in the labour force, wage inequalities, and education contribute to both the low employment rates among women and the persistence of unemployment rates among them. In particular, the female employment rate in Türkiye is at a

lower level, around 30%. For instance, this rate is 64% in advanced countries like Norway (World Bank, 2024b). Policies aimed at addressing these issues and the challenges women face in the active labour force, such as the glass ceiling syndrome, queen bee syndrome, and Cinderella syndrome, could lead to the elimination of unemployment hysteresis among women in the long-run.

The implemented economic and educational policies are among the most significant reasons for the persistence of youth unemployment. Due to educational policies that are implemented without considering current conditions and future needs, many young graduates face unemployment issues. Frey & Osborne (2017) emphasize that with the development of technology and computerization, many occupations currently active will require little to no need in the future. This underscores the importance of educational policies. Moreover, reductions in vocational training exacerbate the issue of youth unemployment becoming permanent. Çavuşoğlu (2021) highlights the emphasis on the shortage of vocational training in studies related to youth unemployment.

In conclusion, the findings indicate that active and passive employment policies in Türkiye effectively address short- and medium-term unemployment issues. However, it is observed that they are not effective in the long-run, both in general and among subcategories of unemployment rates. Experiences from countries where hysteresis is less prevalent can be examined to mitigate the hysteresis effect on unemployment. Additionally, the welfare state approach in Nordic countries may effectively reduce the hysteresis effect. To achieve sustainable reductions in unemployment, there is a need for education policies that enhance labor productivity, fixed capital investment increases that allow for productivity and real wage growth, and an organized labor force. Eliminating the hysteresis effect in unemployment without sustainable and inclusive growth is difficult. Therefore, reducing the hysteresis effect should be a primary objective of new industrialization policies. Starting with education, the country's institutional structure should be formed and regulated according to this purpose, including exchange rate, monetary, and fiscal policies.

Peer-review: Externally peer-reviewed.

Conflicts of Interest: There is no potential conflict of interest in this study.

Contribution Rate Statement: Corresponding author: 50% Other author: 50%

REFERENCES

- Akyüz, H. E. (2023). Panel birim kök testleri: MIST ülkelerinde işsizlik histerisi hipotezinin incelenmesi. Gülay Örmeci Güney (Ed.) *Ekonomi, Sürdürülebilir Kalkınma ve İşletme Alanında Akademik Çalışmalar*, 111-123. Ankara: Gazi Kitabevi.
- Arı, A., Zeren, F., & Özcan, B. (2013). Unemployment hysteresis in East Asian and Pacific Countries: A panel data approach. *Marmara University Journal of Economic and Administrative Sciences*, 35(2), 105-122, <https://dergipark.org.tr/en/pub/muiibd/issue/494/4368>
- Atabey, A. Ö., & Karakuş, M. (2023). Hysteria effect in labor markets for BRICS-T countries: Time Series and panel data analyses with current approaches. *JOEEP: Journal of Emerging Economies and Policy*, 8(2), 67-82.
- Atamer, M. A., Uçar, M., & Ülger, M. (2023). The analysis of the validity of the unemployment hysteresis hypothesis in Türkiye economy: The period of 1988-2020. *Journal of Research in Economics, Politics & Finance*, 8(2), 283-304. <https://doi.org/10.30784/epfad.1231956>
- Aydin, M. (2020). Testing the unemployment hysteresis hypothesis with wavelet-based unit root tests for Turkey. *Journal of Academic Inquiries (AID)*, 15(1), 171-186. <https://doi.org/10.17550/akademikincelemeler.695500>
- Aydin, M., & Pata, U. K. (2020). Are shocks to disaggregated renewable energy consumption permanent or temporary for the USA? Wavelet based unit root test with smooth structural shifts. *Energy*, 207, 118245. <https://doi.org/10.1016/j.energy.2020.118245>
- Ayta, F., & Şen, M. (2023). General outlook of women's employment in Türkiye: examples of selected countries within the scope of increasing employment. *International Journal of Economics and Innovation*, 9(2), 421-454. <https://doi.org/10.20979/ueyd.1327737>
- Azazi, H., & Ateş, S. (2022). A comparative analysis of unemployment hysteria for Türkiye. *Journal of Entrepreneurship and Development*, 17(1), 27-36.
- Bayat, T., Temiz, M., & Konat, G. (2020). An empirical study on validity of unemployment hysteria hypothesis in Turkey (1923-2019). *Pearson Journal Of Social Sciences & Humanities*, 5(7), 1-8.
- Becker, R., Enders, W., & Lee, J. (2006). A stationarity test in the presence of an unknown number of smooth breaks. *Journal of Time Series Analysis*, 27(3), 381-409. <https://doi.org/10.1111/j.1467-9892.2006.00478.x>
- Belke, M. (2020). Testing the hypotheses of hysteresis and naturel rate of unemployment for youth and female unemployment: Evidence from fourier panel unit root tests for European Union Countries. *Gümüşhane University Journal of Social Sciences (GUSBID)*, 11(Ek), 56-73. <https://doi.org/10.36362/gumus.820092>
- Ben-Salha, O., & Mrabet, Z. (2019). Is economic growth really jobless? Empirical evidence from North Africa. *Comparative Economic Studies*, 61(4), 598-624. <https://doi.org/10.1057/s41294-018-00082-9>
- Blanchard, O., Cerutti, E., & Summers, L. (2015). *Inflation and Activity—Two Explorations and Their Monetary Policy Implications*. National Bureau of Economic Research. <https://www.nber.org/papers/w21726>
- Blanchard, O. J., & Summers, L. H. (1986). Hysteresis and the european unemployment problem. *NBER Macroeconomics Annual*, 1, 15-78. <https://doi.org/10.1086/654013>

- Bostanci, F. C., & Koç, S. (2022). Is the unemployment hysteresis valid in the Balkan Countries?: An Empirical study with fourier unit root tests. *Papers on Social Science*, 2022(2), 119-131. <https://doi.org/10.56337/sbm.1167668>
- Caporale, G. M., Gil-Alana, L. A., & Trejo, P. V. (2022). Unemployment persistence in europe: Evidence from the 27 EU Countries. *Heliyon*, 8(2), e08898. <https://doi.org/10.1016/j.heliyon.2022.e08898>
- Carrion-i-Silvestre, J. L., Kim, D., & Perron, P. (2009). GLS-Based unit root tests with multiple structural breaks under both the null and the alternative hypotheses. *Econometric Theory*, 25(6), 1754-1792. <https://doi.org/10.1017/S0266466609990326>
- Çavuşoğlu, O. (2021). Youth Unemployment: A review of graduate thesis and an evaluation in the context of social policy. *Journal of Social Health*, 1(1), 81-115.
- Christopoulos, D. K., & León-Ledesma, M. A. (2010). Smooth breaks and non-linear mean reversion: Post-Bretton Woods real exchange rates. *Journal of International Money and Finance*, 29(6), 1076-1093. <https://doi.org/10.1016/j.jimonfin.2010.02.003>
- Coşkun, N. (2021). Test ing the hysteresis in youth unemployment: The case of Turkey. *Bulletin of Economic Theory and Analysis*, 6(1), 97-112. <https://doi.org/10.25229/beta.892482>
- Çemrek, F., & Şeker, T. (2020). Investigation of women unemployment ratios in Turkey with structural breaks unit root tests. *Ankara Hacı Bayram Veli University, Journal of the Faculty of Economics and Administrative Sciences*, 20th International Symposium on Econometrics, Operations Research and Statistics EYI 2020 Special Issue, 117-132.
- Çiçen, Y. B. (2020). Lasting impact of the crisis on unemployment in Turkey: The global crisis period. *Journal of the Human and Social Science Researches [itobiad]*, 9(2), 1936-1956. <https://doi.org/10.15869/itobiad.678064>
- Dedeoğlu, M. (2021). Examination of unemployment in the framework of hysteresis and natural rate in OECD countries: Evidence from alternative panel unit root tests. *EKOIST Journal of Econometrics and Statistics*, 35, 129-145. <https://doi.org/10.26650/ekoist.2021.35.0000>
- Erdogan, S., & Solarin, S. A. (2021). Stochastic convergence in carbon emissions based on a new Fourier-based wavelet unit root test. *Environmental Science and Pollution Research*, 28(17), 21887-21899. <https://doi.org/10.1007/s11356-020-12033-y>
- Fan, Y., & Gençay, R. (2010). Unit Root tests with wavelets. *Econometric Theory*, 26(5), 1305-1331.
- Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, 114, 254-280. <https://doi.org/10.1016/j.techfore.2016.08.019>
- Friedman, M. (1968). The role of monetary policy, *American Economic Review*, 58(1), 1-17
- Fruoka, F. (2017). A new approach to testing unemployment hysteresis. *Empirical Economics*, 53(3), 1253-1280. <https://doi.org/10.1007/s00181-016-1164-7>
- Galadima, M. D., & Aminu, A. W. (2020). Non-linear unit root and non-linear causality in natural gas - economic growth nexus: Evidence from Nigeria. *Energy*, 190, 116415. <https://doi.org/10.1016/j.energy.2019.116415>

- Gençay, R., Gradojevic, N., Selçuk, F., & Whitcher, B. (2010). Asymmetry of information flow between volatilities across time scales. *Quantitative Finance*, 10(8), 895-915. <https://doi.org/10.1080/14697680903460143>
- Göcen, S. (2021). The effect of economic shocks on unemployment rates: Analysis of female and male unemployment rates by education levels. *Ankara Hacı Bayram Veli University, Journal of the Faculty of Economics and Administrative Sciences*, 23(2), 553-572.
- Guliyev, H. (2023). Nexus between renewable energy and economic growth in G7 countries: New insight from non-linear time series and panel cointegration analysis. *Journal of Cleaner Production*, 424, 138853. <https://doi.org/10.1016/j.jclepro.2023.138853>
- Güriş, B. (2019). A new non-linear unit root test with fourier function. *Communications in Statistics - Simulation and Computation*, 48(10), 3056-3062. <https://doi.org/10.1080/03610918.2018.1473591>
- Ha, J., Tan, P.-P., & Goh, K.-L. (2018). Linear and non-linear causal relationship between energy consumption and economic growth in China: New Evidence Based on Wavelet Analysis. *PLOS ONE*, 13(5), e0197785. <https://doi.org/10.1371/journal.pone.0197785>
- Harris, D., McCabe, B., & Leybourne, S. (2003). Some Limit theory for autocovariances whose order depends on sample size. *Econometric Theory*, 19(05). <https://doi.org/10.1017/S0266466603195060>
- Harvey, D. I., Leybourne, S. J., & Xiao, B. (2008). A Powerful Test for Linearity When the Order of Integration is Unknown. *Studies in Non-linear Dynamics & Econometrics*, 12(3). <https://doi.org/10.2202/1558-3708.1582>
- Kapetanios, G. (2005). Unit-root testing against the alternative hypothesis of up to m structural breaks. *Journal of Time Series Analysis*, 26(1), 123-133. <https://doi.org/10.1111/j.1467-9892.2005.00393.x>
- Kapetanios, G., Shin, Y., & Snell, A. (2003). Testing for a unit root in the non-linear STAR framework. *Journal of Econometrics*, 112(2), 359-379.
- Kar, B. B. (2019). Is natural rate of unemployment or unemployment hysteresis? An analysis for different varieties of capitalism. *Bolu Abant İzzet Baysal University Journal of Graduate School of Social Sciences*, 19(2), 271-298. <https://doi.org/10.11616/basbed.v19i47045.519287>
- Karagöz, K., & Saraç, T. B. (2016). İşsizlikte Histeri Etkisinin Kalman Filtresi Yaklaşımıyla İncelenmesi: Türkiye Örneği. *Aydın İktisat Fakültesi Dergisi*, 1(2), 59-72.
- Kiliç, E., Ergen, E., & Yavuz, E. (2022). Examining unemployment hysteresis in OECD countries: Evidence from non-linear fourier unit root tests. *Nişantaşı University Journal of Social Sciences*, 10(1), 27-48. <https://doi.org/10.52122/nisantasisbd.1090723>
- Koç, S., & Güner, G. (2020). Testing the Unemployment Hysteresis Effect in Selected Emerging Economies. *Kocaeli University Journal of Social Sciences*, 40, 151-164. <https://doi.org/10.35343/kosbed.847158>
- Komşu, M. S., & Komşu, U. C. (2021). Unemployment Hysteresis: A Study on the BRICS-T Countries. *Osmaniye Korkut Ata University Journal of Economics and Administrative Sciences*, 5(2), 74-85.
- Lee, H.-Y., Wu, J.-L., & Lin, C.-H. (2010). Hysteresis in east asian unemployment. *Applied Economics*, 42(7), 887-898. <https://doi.org/10.1080/00036840701720895>

- Lumsdaine, R. L., & Papell, D. (1997). Multiple trend breaks and the unit-root hypothesis. *The Review of Economics and Statistics*, 79(2), 212-218.
- Malcıoğlu, G. & Aydın, M. (2020). Corrigendum to “Analysis of Market Efficiency at Borsa İstanbul: Harvey Linearity Test” [Journal of Accounting, Finance and Auditing Studies 2/1 (2016) 113-124]. *Journal of Accounting Finance and Auditing Studies (JAFAS)*, 6(4), 188-193. <https://doi.org/10.32602/jafas.2020.035>
- OECD. (2023). Unemployment Rate (30 October 2023). <https://stats.oecd.org/index.aspx?queryid=36324#>. (2023a).
- Önal, M. (2021). Cinsiyete göre Türkiye'de işsizlik histerisi. *Biga İktisadi ve İdari Bilimler Fakültesi Dergisi*, 2(1), 29-41
- Özbek, S., & Türkmen, S. (2021). Is unemployment hysteresis or natural rate of unemployment? New evidence from E7 and G7 countries. *Bingöl University Journal of Social Sciences Intitute*, 22, 643-662. <https://doi.org/10.29029/busbed.930288>
- Özen Atabey, A. (2024). Analysis of the hysteresis effect in unemployment by different groups in Türkiye: Evidence from multiple structural breaks and fourier unit root tests. *Gümüşhane University Journal of Social Sciences*, 15(1), 76-88.
- Özpolat, A., & Özsoy, F. N. (2018). Unemployment Hysteresis According to Gender: A Cross Country Analysis. *Cumhuriyet University Journal of Economics and Administrative Sciences*, 19(1), 44-59.
- Öztürk, M. (2020). Validity of The Unemployment Hysteresis Hypothesis in Turkey: Multidimensional and Asymmetrical Approach. *OPUS International Journal of Society Researches*, 15(1), 4882-4910. <https://doi.org/10.26466/opus.725553>
- Paramasivam, S., Pl, S. A., & Sathyamoorthi, P. (2022). Maximal overlap discrete wavelet transform-based power trace alignment algorithm against random delay countermeasure. *ETRI Journal*, 44(3), 512-523. <https://doi.org/10.4218/etrij.2021-0074>
- Perron, P. (1989). The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Econometrica*, 57(6), 1361-1401. <https://doi.org/10.2307/1913712>
- Phelps, E. S. (1968). Phillips curves, expectations of inflation and optimal unemployment over time. *Economica*, 254-281.
- Phillips, A. W. (1958). The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861-1957. *economica*, 25(100), 283-299.
- Rhif, M., Ben Abbes, A., Farah, I. R., Martínez, B., & Sang, Y. (2019). Wavelet transform application for/in non-stationary time-series analysis: A review. *Applied Sciences*, 9(7), Article 7. <https://doi.org/10.3390/app9071345>
- Røed, K. (1996). Unemployment hysteresis—Macro evidence from 16 OECD countries. *Empirical Economics*, 21(4), 589-600. <https://doi.org/10.1007/BF01180703>
- Said, S. E., & Dickey, D. A. (1984). Testing for unit roots in autoregressive-moving average models of unknown order. *Biometrika*, 71(3), 599-607.

- Samuelson, P. A., & Solow, R. M. (1960). Problem of achieving and maintaining a stable price level. *American Economic Review*, 50, 177-194.
- Songur, M. (2020). Unemployment hysteresis in OECD countries: New evidence from fourier panel KPSS Test. *Dicle University Social Sciences Intitute Journal*, 25, 51-63.
- Şak, N. (2021). Unemployment hysteresis in Turkey: An overview of men and women unemployment. *Academic Review of Economics and Administrativer Sciences*, 14(2), 467-477. <https://doi.org/10.25287/ohuiibf.714090>
- Tawiah, K., Daniyal, M., & Qureshi, M. (2023). Pakistan CO2 emission modelling and forecasting: A linear and non-linear time series approach. *Journal of Environmental and Public Health*, 2023, 1-15. <https://doi.org/10.1155/2023/5903362>
- Tekin, İ. (2018). Unemployment hysteresis in Turkey: Stationarity tests with Fourier Functions. *Dokuz Eylül Üniversitesi İktisadi İdari Bilimler Fakültesi Dergisi (İzmir Journal of Economics)*, 33(1), 97-127. <https://doi.org/10.24988/deuiibf.2018331685>
- Turyareeba, D., Ainomugisha, P., Mbabazize, R., Ssebbaale, M. E., Sabiiti, M., Wemesa, R., Wagima, C., & Bakaki, I. (2020). Employment–growth nexus in Uganda. *Archives of Business Research*, 8(7), 39–57. <https://doi.org/10.14738/abr.87.8463>
- Ulucak, Z. Ş. (2021). Hysteresis or natural rate? Evidence from the long term unemployment experience of Turkey. *Iğdır Üniversitesi Sosyal Bilimler Dergisi*, 10(İCOMEP Özel Sayısı), 299-315. <https://doi.org/10.54600/igdirsosbilder.991738>
- Üçler, Y. T., Yildirim, M., Akcan, A. T., & Ak, Ö. K. (2023). Unemployment hysteria of young women and young men in Turkey. *Journal of Mehmet Akif Ersoy University Economics and Administrative Sciences Faculty*, 10(2), 1071-1082. <https://doi.org/10.30798/makuiibf.1100513>
- World Bank (2024a). Employment to Population Ratio 15+, total (14 December 2023). <https://data.worldbank.org/indicator/SL.EMP.TOTL.SP.ZS?locations=1W-TR> .
- World Bank (2024b). Employment to Population Ratio 15+, Female (07 December 2023). <https://data.worldbank.org/indicator/SL.EMP.TOTL.SP.FE.ZS?locations=1W-TR-NO> .
- Yaya, O. S., Ogbonna, A. E., & Mudida, R. (2019). Hysteresis of unemployment rates in Africa: New findings from Fourier ADF test. *Quality & Quantity*, 53(6), 2781-2795. <https://doi.org/10.1007/s11135-019-00894-6>
- Yılanıcı, V., Kırca, M., Canbay, Ş., & Sağlam, M. S. (2024). Unraveling unemployment hysteresis in Nordic countries: A multifaceted analysis of age, gender and frequency differentials. *International Journal of Manpower*, 45 (6), 1093-1111 <https://doi.org/10.1108/IJM-03-2023-0147>
- Yılanıcı, V., Ozkan, Y., & Altınsoy, A. (2020). Testing the unemployment hysteresis in G7 countries: A fresh evidence from fourier threshold unit root test. *Romanian Journal of Economic Forecasting*, 23(3), 49-59.
- Zivot, E., & Andrews, D. W. K. (1992). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business & Economic Statistics*, 10(3), 251-270. <https://doi.org/10.2307/1391541>