Theoretical and Applied Economics
Volume XXVI (2019), No. 4(621), Winter, pp. 53-62

Unemployment hysteresis analysis for OECD countries

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Abstract. *Unemployment is one of the main problems of many developed and developing countries. The two concepts used to examine the structure of unemployment are unemployment hysteresis and natural unemployment rate. The aim of this study is to investigate the validity of the unemployment hysteresis in 32 OECD countries for the period January 2005 - July 2017. The nonlinear unit root test by Kruse (2011) and the test by Güriş (2018) that take into consideration structural breaks and nonlinearity were used in the analyses. The findings indicate that the unemployment hysteresis in the OECD countries is generally valid according to both test results.*

Keywords: unemployment, unemployment hysteresis, nonlinear unit root test, OECD countries.

JEL Classification: C22, E24, J64.

1. Introduction

Unemployment, which is one of the major problems of today's economies, causes various problems including economic and sociological problems. Policy makers and researchers are developing different approaches and suggestions about the structure of unemployment. Two of the most remarkable of these approaches are the natural unemployment rate and the unemployment hysteresis.

As a concept, unemployment is the presence of labor force that wants to work and can physically work but cannot find jobs. At this point, one of the key concepts is the unemployment rate, which is the percentage of the population that cannot find work in comparison to the total population. Given the natural flow of labor markets, it is not possible to eliminate unemployment altogether. The unemployment rate accepted as normal in each country is called the natural unemployment rate (Güriş et al., 2017, p. 36). The natural unemployment rate was introduced to the literature by Friedman (1968) and Phelps (1968). The natural rate hypothesis is one of the important issues of the market equilibrium theory and distinguishes between long cyclical fluctuations and short cyclical fluctuations in economy. Although the distinction between the natural rate hypothesis and the hysteresis hypothesis is clear in theory, the distinction is somewhat blurred in practice. At this point, the concept of persistence of unemployment is important. Persistence in analytic terms is a special case of the natural rate hypothesis. It takes some time for a strong and continuous economy to adjust to return to the balance after a shock. Hence, even if the natural rate hypothesis is a real model of the economy, continuity implies that the effects of shocks are long and that short-term macroeconomic policy may be effective (Mitchell, 1993, pp. 1489-1490). In the case of natural unemployment rate, it can be said that the unemployment rate is stationary.

The notion of unemployment hysteresis was introduced to the literature by Blanchard and Summers (1986). Unemployment hysteresis indicates that cyclical changes will cause structural changes on unemployment, which, in the long run, will have lasting effects and will thus increase the natural unemployment rate. Highly persistent unemployment rates, which characterize many countries and regions in Europe, are generally perceived as evidence for the hysteresis hypothesis. The traditional view defines unemployment fluctuations as natural cyclical deviations or unemployment rate that does not accelerate inflation, while theories that define unemployment rate as a hysterical process indicate that transient shocks will have lasting effects (Lanzafame, 2012, p. 415). In the case of unemployment hysteresis, it can be said that the unemployment rate is not stationary, that is, it has a unit root.

This study investigating the validity of unemployment hysteresis in OECD countries consists of four parts. In the second part of the study, the studies in the literature on the countries that make up the OECD countries are examined. In the third part, the Kruse (2011) test and the newly proposed Güriş test (2018) from among the non-linear unit root tests will be explained. In the last part, the dataset to be used in the empirical study will be

introduced, the results of the unemployment hysteresis implementation in OECD countries will be given and the results obtained will be evaluated.

2. Literature review

There is not much comprehensive literature on the validity of unemployment hysteresis for country or country groups. When the current literature is examined, it appears that there is no common law for the validity of unemployment hysteresis. The main reasons for this could be the difference between the group of country (or) countries studied, the examination periods and the econometric method used in empirical practice.

Blanchard and Summers (1986) studied the validity of unemployment hysteresis in France, Germany, the UK and the USA using the data from 1953-1984. As a result of the analysis using Dickey-Fuller and Augmented Dickey-Fuller tests, it was concluded that the unemployment hysteresis is valid for France, Germany and the UK. Papell, Murray and Ghiblawi (2000) studied the validity of the unemployment hysteresis for 16 OECD countries for the period 1955-1997. As a result of the analysis carried out using the unit root tests with structural breaks of Zivot and Andrews (1992), it was concluded that the unemployment hysteresis for Belgium, Canada, Denmark, Finland, Ireland, Norway, Sweden, Spain and the USA is not valid. Røed (2002) studied the validity of unemployment hysteresis for 10 OECD countries using the data for the period 1960-1995. The analyses were carried out using the ADF and KPSS unit root tests and it was concluded that the natural unemployment rate applied for the United States and that the unemployment hysteresis applied for the nine other countries. In the study by León-Ledesma (2002), it was investigated whether the unemployment hysteresis was valid for 51 US states and 12 European countries for the period 1985-1999. According to the results of the ADF unit root test and the analyses made using the Im, Pesaran and Shin (1997) test, the unemployment hysteresis was valid for European countries and the natural unemployment rate was valid for the USA. Camarero and Tamarit (2004) examined the validity of unemployment hysteresis for 19 OECD countries. The ADF, MADF and SURADF unit root tests were used in the analyses for the period 1956-2001. According to the findings, the unemployment hysteresis was valid in Germany, Austria, Sweden, Italy, Japan, Norway and New Zealand. Another study was carried out by Chang et al. (2005) on 10 European countries. Analyzes were made for the period 1961-1999, and classical and panel unit root tests were used. The result was that the unemployment hysteresis was valid in countries other than Belgium and the Netherlands. The validity of the unemployment hysteresis by Gustavsson and Österholm (2006) was investigated for Australia, Canada, Finland, Sweden and the USA. Linear and nonlinear unit root tests were used in the examinations of different periods for the relevant countries. Gustavsson and Österholm (2006) found the hysteresis impact in Australia, Canada and Sweden based on linear unit root tests, and based on nonlinear unit root test, only Australia displayed the hysteresis impact. In the study by Yılancı (2008), the validity of the unemployment hysteresis in 17 OECD countries was examined using the ADF unit root test and the nonlinear unit root tests by Kapetanious,

Shin and Snell (2003). The data ranges of 17 OECD countries differ in the analyses made. According to the results of the analysis, the unemployment hysteresis applied for Germany, Australia, Finland, Japan, Canada, Luxembourg, Norway, Slovakia and Turkey. Khraief et al. (2015) investigated the validity of the unemployment hysteresis in 29 OECD countries for the period 1980-2013. According to analyses using univariate and panel unit root tests, the unemployment hysteresis in OECD countries was strongly rejected. The empirical studies made clearly demonstrate that there is no common result about the acceptance or disapproval of the unemployment hysteresis.

3. Econometric method

Investigating the stationarity of the variables studied in the analysis of economic issues is one of the important issues in terms of reliability of the work done. In empirical studies, linear unit root tests appear to be more commonly used than nonlinear unit root tests. Two important reasons for this are the use and the interpretation of linear unit root tests being easier than nonlinear tests. However, in the literature, the studies by Terasvirta, Van Dijk and Mederios (2005), Baillie and Kapetanios (2007), Yoon (2009), Yoon (2010), Chen and Lin (2014), Yılancı and Tıraşoğlu (2016) have come to the conclusion that many economic variables exhibit nonlinear properties. Nonlinear unit root tests that do not have a very long history appear to be in rapid development. Nonlinear unit root tests with different properties continue to be introduced to the literature during this process. Some of these are the Kapetanios, Shin and Snell (2003) test (hereafter referred to as KSS) and the Kruse test (2011) which is an improved version of this test. However, Güriş (2018) is another nonlinear Fourier unit root test introduced in the literature recently.

The KSS (2003) unit root test is an improved version of the linear ADF unit root test for nonlinear structure. This unit root test is based on the smooth transition autoregressive (STAR) model structure. The KSS (2003) test assumes that the position parameter c is zero. Kruse (2011) suggested that the probability of nonzero position parameters in real world examples is more probable and modified the KSS (2003) test. The nonlinear time series model to allow a non-zero position parameter (c) in the exponential transition following the operation of the KSS (2003) can be shown as follows.

$$\Delta y_t = \phi y_{t-1}(1-\exp\left\{-\gamma(y_{t-1}-c)^2\right\}) + \varepsilon_t$$

By applying the first degree Taylor approach, $G(y_{t-1};\gamma,c) = (1-\exp\left\{-\gamma(y_{t-1}-c)^2\right\})$ around $\gamma = 0$. The test regression continues as follows:

$$\Delta y_t = \beta_1 y_{t-1}^3 + \beta_2 y_{t-1}^2 + \beta_3 y_{t-1} + u_t$$

Following the KSS (2003) study, the power of the test could be further developed by applying $\beta_3 = 0$.

$$\Delta y_t = \beta_1 y_{t-1}^3 + \beta_2 y_{t-1}^2 + u_t$$

Here, $\beta_1 = \gamma\phi$ and $\beta_2 = -2c\gamma\phi$. The Wald test statistics modified by Kruse (2011) is based on the Hessian matrix. The τ test statistics that belong to the test could be expressed as follows:

$$\tau = t_{\beta_2^{\perp}=0}^2 + 1(\hat{\beta}_1 < 0) t_{\beta_1=0}^2$$

Kruse (2011) showed that Monte Carlo simulation is superior to the KSS (2003) test in most cases.

The concept of structural break has become important in unit root literature with the Perron (1989) study. The tests that take structural breaks into account for different structures have become available. The test introduced in the literature by the Güriş (2018) the nonlinear unit root test was developed using the Fourier functions. The most important advantage of this improved test is that it takes into consideration both structural breaks and nonlinearities in the test procedure.

In the Güriş (2018) test, the Fourier function considered besides the ESTAR nonlinearity is based on the Becker, Enders and Lee (2006) study. Becker, Enders and Lee (2006) propose to use a Fourier series expansion to approximate the unknown number of breaks. Güriş (2018) proposed a test procedure similar to that of Christopoulos and Leon-Ledesma (2010). In the first step, a nonlinear deterministic component is specified.

$$y_t = \alpha_0 + \alpha_1 \sin\left(\frac{2\pi k^* t}{T}\right) + \alpha_2 \cos\left(\frac{2\pi k^* t}{T}\right) + v_t$$

k^* indicates the suitable frequency and the k ranging between 1 to 5 is obtained by minimizing the total of the squares of error terms by using OLS. The error terms of the estimated equation can be obtained as follows.

$$v_t = y_t - \alpha_0 - \alpha_1 \sin\left(\frac{2\pi k^* t}{T}\right) - \alpha_2 \cos\left(\frac{2\pi k^* t}{T}\right)$$

The test statistics are calculated in the second phase. These statistics are calculated by using the (v_t) equation based on the error terms obtained in the first phase.

$$\Delta v_t = \delta_1 v_{t-1}^3 + \delta_2 v_{t-1}^2 + \sum_{j=1}^{p} \varphi_j \Delta v_{t-j} + \varepsilon_t$$

In the third stage, the hypothesis tests are carried out. If the unit root hypothesis is rejected, the $H_1 : \alpha_1 \neq \alpha_2 \neq 0$ alternative hypothesis is tested against the $H_0 : \alpha_1 = \alpha_2 = 0$ null hypothesis using the F test. If the null hypothesis is rejected here, the result is that the variable is stationary around a deterministic function that is broken.

Güriş (2018) calculated the critical values for the Fourier Kruse test. The critical values were obtained using T = 50, 100, 250, 500 and 50,000 repetitions for k = 1, 2, 3, 4 and 5. In addition, Güriş (2018) used the Monte Carlo simulations for the size and power analyses. It has been found that this test has got higher power than the KSS (2003) and Kruse (2011) tests. Especially in the case of small sampling, the recommended size and power performance of the test is very good.

4. Empirical analysis

The validity of the unemployment hysteresis in OECD countries has been investigated using current nonlinear time series methods. Data from 32 OECD countries were used in the empirical study. Monthly data for the January 2005 - July 2017 period were used in the analysis. The data used in the study were obtained from the OECD database. Kruse (2011) and Güriş (2018) nonlinear unit root tests were used to examine whether the unemployment hysteresis is valid in OECD countries and the results are tabulated in Table 1 and Table 2.

Table 1. *Unit Root Test Results with Demeaned*

Country	**Kruse (2011)**		**Güriş (2018)**			
	Lag	*Test Sta.*	*Lag*	*k*	*F Sta.*	*Test Sta.*
Australia	0	1.8999	0	1	126.760	2.2818
Austria	12	1.3881	12	1	99.7043	1.3967
Belgium	5	5.4012	5	3	57.4151	2.2956
Canada	11	5.7288	12	1	51.0902	3.5734
Chile	6	2.0458	6	1	67.4303	2.7492
Czech Rep.	5	2.2980	2	3	43.3472	2.2608
Denmark	7	2.1069	7	1	243.189	5.0677
Estonia	8	7.4488	8	1	79.7013	9.3712
Finland	5	2.6923	2	1	93.5337	1.9642
France	5	2.3251	1	1	328.543	1.2901
Germany	3	8.0170	3	1	91.2854	10.103
Greece	5	2.0779	5	1	128.243	3.6853
Hungary	1	0.6495	3	1	47.3478	1.9930
Iceland	3	0.5463	2	1	337.651	2.8584
Ireland	6	1.4201	4	1	124.381	6.966
Italy	12	1.5180	4	1	67.9214	1.2261
Japan	0	0.5092	0	1	124.661	1.4153
Korea	4	4.2679	8	2	55.4946	7.0102
Latvia	4	2.8448	4	1	109.265	6.0698
Luxembourg	12	2.2429	12	1	145.860	0.7110
Mexico	3	1.2992	3	1	301.432	1.9549
Netherlands	6	3.5357	3	1	44.5424	1.5007
Norway	7	2.4776	7	1	95.2560	2.9707
Poland	9	5.6158	2	2	55.7380	5.1051
Portugal	2	1.4432	2	1	74.9542	0.7878
Slovak Rep.	8	6.2390	1	3	35.2611	1.8314
Slovenia	8	2.2391	6	1	96.0951	0.9967
Spain	4	1.2256	4	1	100.720	0.8852

Country	Kruse (2011)		Güriş (2018)			
	Lag	*Test Sta.*	*Lag*	*k*	*F Sta.*	*Test Sta.*
Sweden	11	6.7774	11	1	47.7004	12.042
Turkey	5	7.4203	6	2	168.887	2.3850
UK	10	1.4319	12	1	83.2994	0.1958
USA	6	4.0978	5	1	389.876	4.0586

Note: *k* represents the frequency selected for the approximation. The * indicate rejection of the null hypothesis of unit root at the 10% level. The critical values were obtained from the studies by Kruse (2011), Becker, Enders and Lee (2006) and Güriş (2018).

Table 1 shows the results of the analysis for the demeaned structure. According to the results obtained, the unit root null hypothesis for the 32 OECD countries was not rejected in the Kruse (2011) test. Similarly, the Güriş (2018) test results support this. According to the Güriş test (2018), the unit root null hypothesis cannot be rejected in all countries. According to the test results, the unemployment rate series in OECD countries is not stationary. These results show that the unemployment hysteresis is valid in the OECD countries for the demeaned structure.

Table 2. *Unit Root Test Results with Detrended*

Country	Kruse (2011)		Güriş (2018)			
	Lag	*Test Sta.*	*Lag*	*k*	*F Sta.*	*Test Sta.*
Australia	4	6.1258	1	3	89.5397	2.3738
Austria	12	3.0822	12	1	70.0303	1.4871
Belgium	5	5.8419	5	3	72.1049	2.5655
Canada	11	6.1929	12	1	48.5467	3.2579
Chile	5	4.6926	6	2	115.597	1.8323
Czech Rep.	5	4.5375	5	1	179.265	5.9063
Denmark	7	2.5500	7	1	145.726	3.7439
Estonia	8	7.3133	8	1	78.9481	9.3474
Finland	6	4.7805	2	3	58.5575	1.3999
France	5	4.0892	1	1	106.3771	1.1846
Germany	3	7.5736	3	1	142.913	4.4407
Greece	10	5.9279	3	1	70.8960	5.7089
Hungary	1	0.4391	3	1	160.717	0.8748
Iceland	3	0.3447	2	1	331.731	2.3240
Ireland	6	1.6095	4	1	118.833	3.6402
Italy	8	4.0527	1	1	287.89	0.4109
Japan	0	2.0885	0	1	150.869	1.7006
Korea	4	4.0119	8	1	54.6866	6.6779
Latvia	4	2.8408	4	1	107.127	5.7268
Luxembourg	12	5.7065	12	1	39.643	0.7768
Mexico	3	1.0008	3	1	285.664	1.8071
Netherlands	6	3.7328	3	1	53.3562	0.4536
Norway	9	7.3068	7	1	63.7103	3.3567
Poland	10	11.254*	3	1	303.242	2.2681
Portugal	2	1.5332	2	1	53.1996	1.1201
Slovak Republic	8	6.2390	8	1	232.384	10.478
Slovenia	8	2.5591	6	1	55.4954	1.2026
Spain	4	0.5442	4	1	117.408	0.0588
Sweden	11	7.2356	11	1	58.3250	12.062

Country	Kruse (2011)		Güriş (2018)			
	Lag	*Test Sta.*	*Lag*	*k*	*F Sta.*	*Test Sta.*
Turkey	6	4.4920	6	2	150.668	2.3889
UK	10	1.4295	12	1	95.5572	0.3118
USA	6	4.0732	5	1	387.152	4.0433

Note: *k* represents the frequency selected for the approximation. The * indicate rejection of the null hypothesis of unit root at the 10% level. The critical values were obtained from the studies by Kruse (2011), Becker, Enders and Lee (2006) and Güriş (2018).

Table 2 shows the results of the analysis for the detrended structure. According to the results obtained, the unit root null hypothesis for 32 OECD countries was rejected only for Poland in the Kruse (2011) test. The natural unemployment rate applies in Poland. The unemployment hysteresis applies in the other 31 OECD countries. According to the Güriş (2018) test result, the unit root null hypothesis cannot be rejected in all countries. These results demonstrate the validity of the unemployment hysteresis in the OECD countries (except for one test for Poland) for the detrended structure.

5. Conclusion

Unemployment is one of the major problems of many developed and developing countries' economies. Two of the concepts on unemployment that draw attention are the unemployment hysteresis and the natural unemployment rate. The natural unemployment rate was introduced to the literature by Friedman 1968 and Phelps (1968), and the concept of unemployment hysteresis was introduced by Blanchard and Summers (1986).

The purpose of this study is to analyze whether the unemployment hysteresis is valid in OECD countries using up-to-date non-linear time series methods. For this reason, the Kruse (2011) test, which is an improved version of the KSS (2003) test, and the test developed by Güriş (2018) were used in this analysis. The most important advantages of the Güriş test (2018) are that it takes into consideration structural breaks and nonlinearity together in the test procedure.

In the analysis carried out for the OECD countries for the period January 2005-July 2017, it was found that the unemployment hysteresis was valid when the non-linearity of the OECD countries was taken into consideration, according to the results of both tests. The findings show that the shocks experienced in the economies of the OECD countries and the stabilization policies applied cause permanent changes in the natural unemployment rate. Findings also indicate that unemployment is moving in a non-stationary manner around the changing mean over time. The validity of the unemployment hysteresis can be detrimental to the economic structure by affecting unemployment related macroeconomic variables. For this reason, it is necessary for countries to take necessary measures in combating unemployment taking into account their own economic structures.

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