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Is There Hysteresis in Unemployment in OECD Countries? Evidence From Panel Unit Root Test With Structural Breaks

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This study tests the hysteresis hypothesis of unemployment in fifteen OECD countries by using panel unit root tests which allow for structural breaks. We apply annual unemployment rates covering 1985-2008 periods. We test whether unemployment rates are stationary by using second generation tests which allow cross section dependency among series and panel unit root test based on structural break advanced by Carrion-i-Silvestre, Barrio-Castro and Lopez-Bazo (2005). We find series as a stationary process with structural breaks according to Carrion-i Silvestre et al. (2005) test, while we find series as unit root process with second generation panel unit root test. According to the Carrion-i Silvestre et al. (2005) test, we find the evidence of absence of hysteresis in analyzed countries. As a result, temporary shocks have temporary effects on unemployment instead of permanent effect. Structural factors can affect the natural rate of unemployment and, therefore, unemployment would be stationary around a process that is subject to structural breaks. So, there still exists a unique natural rate of unemployment to which the economy eventually will converge.

Key words: structural break, unemployment, cross-section dependence, panel unit root tests

Introduction

Unemployment rates have increased since the first oil shock lived in developed countries specially EU countries. Summers(1986) argues that increment in occurring unemployment rate since mid-1960s in U.S. has in large part resulted from high and growing noncompetitive wage differentials. A recession can have permanent effects if it changes the attitudes of those people who become unemployed. For instance, when a worker is laid off in a recession, worker loses his job skills and hence unable to find a new job and reduce the desire to look for employment even after the recession ends (Layard, Nickell, & Jackman, 1991).

The occurring increments have caused to focus on studies in unemployment domain. Friedman (1986), Blanchard and Summers (1986), Brunello (1990), Mitchell (1993) and Phelps (1994) are several of the important studies related unemployment domain.

The natural rate of unemployment hypothesis is one of the important subjects of macroeconomics. The natural rate of unemployment is determined by labor supply and demand. When the fluctuations in demand or

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supply can trigger deviations of actual unemployment rate from natural rate. In turn, these deviations will cause changes in inflation. Changes in inflation lead to the unemployment rate to eventually return to the natural rate (Song, 1998).

Friedman (1968) characterizes unemployment dynamics as a stationary process. According to this, temporary shocks have temporary effects on unemployment instead of permanent effect. In other words, unemployment dynamic tends to be a stationary process that reverts to its long-run equilibrium.

Blanchard and Summers (1986) propose the so-called hysteresis hypothesis of unemployment to describe the long-lasting influence of unemployment on the natural rate. The hypothesis of hysteresis in unemployment assumes that cyclical fluctuations have permanent effects on the level of unemployment. Consequently, the hysteresis of hypothesis in unemployment means that process of unemployment rates is affected permanently from cyclical change[1]. The results suggest the presence of hysteresis in unemployment for majority of analyzed countries.

Brunello (1990) cannot reject the null hypothesis of a unit root using Japanese unemployment data from 1955 to 1987. Mitchell (1993) argues that the natural rate hypothesis can be represented as a trend stationary process, while the hysteresis of hypothesis can be represented as a difference stationary process. Mitchell (1993) deduced that the difference stationary hypothesis cannot be rejected. Mitchell (1993) finds that, for fifteen OECD countries, the null hypothesis of a unit root in unemployment rates cannot be rejected even after accounting for structural breaks in the trend function.

Phelps (1994) characterizes rate of unemployment as a process about varying mean. Phelps (1994) indicates that the majority of shocks to unemployment are temporary, and they are mainly associated with recessions, which can cause a change in the level of the natural rate of unemployment.

Christopoulos and Leon-Ledesma (2007) indicate that lack of capital, dismissal cost can be shown as sources of hysteresis in unemployment. In this case, occurring shock in labor force will be permanent and economy doesn't converge to initial equilibrium level[2].

According to Camarero, Carrion-i Silvestre and Tamarit (2004), hysteresis of hypothesis states that cyclical fluctuations have permanent effects on the level of unemployment due to labor market rigidities and, therefore the level of unemployment can be characterized as a non-stationary process. The issue of whether unemployment dynamics have nonstationary process is analyzed by conventional unit root tests (Cross, 1995). Blanchard and Summers (1986), Brunello (1990), Neudorfer, Pichelmann and Wagner, (1990), and Røed (2002) used the Dickey-Fuller (DF) type tests in order to examine whether unemployment series contains a unit root (Liew, Chia, & Puah, 2009). Røed (2002) find evidence of hysteresis for ten OECD countries by using Augmented Dickey Fuller (ADF) and KPSS unit root tests.

There are many studies analyzing structural of unemployment as our study. For example Arestis and Mariscal (2000) test using Perron (1997) unit root test for 22 OECD countries. They accepted to presence hysteresis for 10 OECD countries.

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[1] Blanchard and Summers (1986) specially focused on wage bargaining. According to Blanchard and Summers, wage bargaining determines the nominal wage, with firms being free to choose employment ex post. They started with the pure insider case, in which the wage is set by insiders, with no pressure from outsiders on wage setting and then considered the more general case where outsiders exert some pressure. It is assumed to be an importance role of insider. It is assumed that wages are set primarily with regard to interest of incumbent workers (insiders) which is easily justified.

[2] Incumbent workers are likely to have bargaining power because of the fixed costs of hiring new worker, threat of strike. Hence, incumbent worker prevents to be employed outsider. As a result, employer wants to hire worker from other firms. In existing labor force it doesn't occur an increasing, so rate of unemployment will be continuity (Christopoulos & Leon-Ledesma, 2007).

Camarero and Tamarit (2004) analyze hysteresis over 1956-2001 period for 19 OECD countries. They find that unemployment dynamics have stationary process, i.e., it was accepted to presence hysteresis of unemployment.

Gustavsson and Österholm (2006), Kapetanios, Shin and Snell (2003) examine rates of unemployment for Australia, Canada, Finland, Sweden, U.S. using nonlinear unit root test. The results suggested that hysteresis is no validity in all countries except Australia. Lee and Chang (2008) investigated whether rate of unemployment is stationary using LM unit root test and deduced that rate of unemployment has stationary structure.

Roed (1996) investigate that the presence of unemployment hysteresis in 16 OECD countries. The results suggest that only in the USA, the presence of unemployment hysteresis is strongly consistently rejected.

Song and Wu (1997) demonstrate that unemployment rates in the United States are stationary by employing the Levin and Lin (1992)'s test. Their finding is confirmed by Leon-Ledesma's (2002) by using the Im, Pesaran and Shin (2003) test (Mohan, Kemegue, & Sjuib, 2007). Song and Wu (1998) state no evidence of hysteresis in unemployment over the period of 1972-1992 for 15 OECD countries by using Levin and Lin (1992) panel unit root test.

The aim of this paper is to examine the validity of hysteresis of unemployment. In this paper, we analyze unemployment hysteresis for 15 OECD countries using a panel-based unit root tests. The test exploits the cross-section variations and is more powerful. With this aim, the rest of this study is organized as follows. Section 2 describes the econometric methodology used in this paper. Section 3 presents and discusses the finding of this study.

Data and Empirical Methodology

As mentioned above, our central interest lies on testing whether the unemployment rate contains a unit root for each country analyzed. The annual data covering the period of 1985-2008 for 15 OECD countries are used for empirical analysis.

The countries consist of Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, United Kingdom, United States and Turkey.

We obtain rate of unemployment from Organization for Economic Co-operation and Development OECD database.

This paper uses cross-sectionally augmented dickey fuller (thereafter CADF) testing as second generation test and Carrion-i Silvestre et al. (2005) test (PANKPSS) in measuring presence of structural break. Firstly, it has to be controlled whether there is dependency across cross-section in regression. Thus, we test Breusch and Pagan (1980)'s cross-section LM testing. Since the number of cross-section observation is smaller than the number of time series observation in our model, it takes into accounted CDLM1 test of Pesaran (2004). CDLM1 test statistic is following as:

$$CDLM_1 = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^2 \sim \chi^2_{N(N-1)/2}$$

where $\hat{\rho}_{ij}$ is correlation of coefficient across residuals obtained from each regression estimated by OLS estimator. One of second generation tests is CADF testing. Pesaran (2003) presents a new procedure for testing unit root in dynamic panels subject to possibly cross-sectionally dependent in addition to serially correlated errors. Pesaran (2003) proposes a test based on standard unit root statistics in a CADF regression. CADF process can be reduced with estimated to this equation:

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{i,t} - 1 + \sum_{j=1}^{pi} \delta_{ij} \Delta Y_{i,t-j} + d_i \tau + c_i \overline{Y}_{t-1} + \sum_{j=0}^{pi} \varphi_{ij} \Delta \overline{Y}_{i,t-j} + \varepsilon_{it}$$

where

$$\overline{Y}_t = N^{-1} \sum_{j=1}^{N} Y_{jt}\ ,\quad \Delta \overline{Y}_{i,t} = N^{-1} \sum_{j=1}^{N} \Delta Y_{jt}$$

and ε_{it} is regression errors. Let $CADF_i$ be the ADF statistics for the i-th cross-sectional unit given by the t-ratio of the OLS estimate $\hat{\beta}_i$ of β_i in the CADF regression. Individual CADF statistics are used to develop a modified version of IPS t-bar test (denoted CIPS for cross-sectionally augmented IPS) that simultaneously takes account of cross-section dependence and residual serial correlation:

$$CIPS = N^{-1} \sum_{i=1}^{n} CADF_i$$

Hypothesis of both *CADF* and *CIPS* is the same. The null hypothesis is formulated as:

$H_o : \beta_i = 0$ This hypothesis implies that all the time series are non-stationary, and the alternative hypothesis may be:

$H_A : \beta_i \prec 0$ This hypothesis implies that all the time series are stationary process.

The other second generation panel unit root test is seemingly unrelated regression augmented Dickey Fuller (thereafter SURADF). SURADF test is developed by Breuer et al. (2002). The test involves the estimation of the ADF regression in a SUR framework. This procedure also handles heterogeneous serial correction across panel members. The SURADF test is based on the system of ADF equations that can be expressed as:

$$\begin{aligned}
\Delta Y_{1,t} &= \alpha_1 + \beta_1 Y_{1,t-1} + \sum_{j=1} \Theta_j \Delta Y_{1,t-j} + u_{1,t} \\
\Delta Y_{2,t} &= \alpha_2 + \beta_2 Y_{2,t-1} + \sum_{j=1} \Theta_j \Delta Y_{2,t-j} + u_{2,t} \\
&\vdots \\
\Delta Y_{N,t} &= \alpha_N + \beta_N Y_{N,t-1} + \sum_{j=1} \Theta_j \Delta Y_{N,t-j} + u_{N,t}
\end{aligned}$$

where $\beta_j = (\rho_j - 1)$, ρ_j is the autoregressive coefficient for series j and $t = 1, \ldots, T$. This system of equation is estimated by the SUR procedure with the null and the alternative hypothesis is tested as:

$$\begin{aligned}
&H_{0_1} : \beta_1 = 0; H_{A_1} : \beta_1 \prec 0 \\
&H_{0_2} : \beta_2 = 0; H_{A_2} : \beta_2 \prec 0 \\
&\vdots \\
&H_{0_N} : \beta_N = 0; H_{A_N} : \beta_N \prec 0
\end{aligned}$$

with the test statistics computed from SUR estimation while the critical values are generated by Monte Carlo simulations. The SURADF test statistic for each of these series was then computed as the t-statistics individually for the coefficient on the lagged level. The critical values for SURADF will be different for each series, since the SURADF estimation takes into account of the error correlation (Tang & Lau, 2009). To obtain the critical values, the experiments were replicated 10,000 times.

Carrion-I Silvestre et al.'s (2005) Panel Stationary Test With Structural Breaks

So far, unit root tests analyzed have assumed that data is produced by a linear process and a structural break occurs in data generating process. But when we ignore the presence of break, we can obtain biased results. Im and Lee (2001) and Carrion-i Silvestre et al. (2001, 2002) are pioneer to this addition. Im and Lee (2001) analyzed the case of structural break that changes mean of series in individual effects and model which has trending regressor. Carrion-i Silvestre et al.'s (2005) panel stationary test allows for multiple structural breaks through the incorporation of dummy variables in the deterministic model. Carrion-i Silvestre et al. (2005) allowed for structural changes to shift the mean and trend of individual time series. Further, they allow that each individual in the panel can have different number of breaks located in different dates. In this case, under the null hypothesis the data generating process for the variable is assumed to be:

$$Y_{i,t} = \alpha_{i,t} + \delta_{i,t} + u_{i,t} \tag{1}$$

$$\alpha_{i,t} = \sum_{k=1}^{m_i} \varphi_{i,k} D(T_{b,k}^i)_t + \sum_{k=1}^{m} \phi_{i,k} DU_{i,k,t} + \alpha_{i,t-1} + \varepsilon_{i,t} \tag{2}$$

$$\alpha_{i,0} = \alpha_i$$

where $\varepsilon_{i,t}$ ~i.i.d$(0, \sigma_{\varepsilon_i}^2)$ and $\alpha_{i,0} = \alpha_i$ a constant, with i = (1, …, N) individuals and t = (1, …, T) time periods. The dummy variables $D(T_{b,k}^i)_t$ and $DU_{i,k,t}$ are defined as:

$$D(T_{b,k}^i)_t = \begin{cases} 1 & \mathrm{t} = T_{b,k}^i + 1 \\ 0 & elsewhere \end{cases}$$

$$DU_{i,k,t} = \begin{cases} 1 & \mathrm{t} \succ T_{b,k}^i \\ 0 & elsewhere \end{cases}$$

where $T_{b,k}^i$ is date of the break for i-th individual. m is allowed to be max number of breaks since k = 1, …, m. It is assumed that $u_{i,t}$ and $\varepsilon_{i,t}$ are independent as in Hadri's test. But their null of hypothesis different from panel data test of Hadri (2000), $H_0 : \sigma_{\varepsilon,i}^2 = 0$ under null of hypothesis, which the model given by equation (1) and equation (2) becomes:

$$Y_{i,t} = \alpha_i + \sum_{k=1}^{m_i} \varphi_{i,k} DU_{i,k,t} + \sum_{k=1}^{m_i} \Theta_{i,k} DT^*_{i,k,t} + \delta_i t + u_{i,t} \tag{3}$$

where

$$\begin{cases} DT^*_{i,k,t} = \mathrm{t} - T_{b,k}^i, \ \mathrm{t} > T_{b,k}^i \\ DT^*_{i,k,t} = 0, \ elsewhere \end{cases}$$

The model (3) includes individual structural break effect (shifts in the mean caused by structural breaks), temporal effects (for $\delta_i \neq 0$), temporary structural break effect (for $\Theta_{i,k} \neq 0$ that is only there are changes in individual time trends).

The specification given by equation (3) is general enough to allow three characteristics:

(1) The structural breaks have different effects on each individual time series. These effects are measured by $\Theta_{i,k}$ and $\varphi_{i,k}$; (2) Structural breaks may occur in different dates for each individual time series; (3) The number of structural break may change from individual to individual. That is $m_i \neq m_j$, $\forall_i \neq j, \{i, j\} = \{1, ..., T\}$.

The test null of hypothesis of a stationary panel ($\sigma_{\varepsilon,i}^2 = 0$) that proposed by Hadri (2000) and advanced Carrion-i Silvestre et al. (2005) with representation given by:

$$LM_{\mathrm{hom}(\lambda)} = N^{-1} \sum_{i=1}^{N} (\hat{\omega}^{-2} T^{-2} \sum_{t=1}^{T} S_{i,t}^2) \tag{4}$$

where $S_{i,t} = \sum_{j=1}^{t} \hat{u}_{i,j}$ and $S_{i,t}$ denote the partial sum process that obtained when it is used the estimated OLS residuals of equation (3) and where $\widehat{\omega}_i^2$ is a consistent estimate of the long-run variance $\varepsilon_{i,t}$. λ in equation (4) denotes the dependence of LM statistic on the dates of break. For each individual *i*, it is defined as the vector $\lambda_i = (\lambda_{i,1},...,\lambda_{i,m_i})' = (T_{b,1}^i / T,...,T_{b,m_i}^i / T)'$ which indicates the relative positions of the dates of the breaks on the entire the period, *T*. If variance is allowed to change across cross-section individual, then LM test statistic is can be expressed as:

$$\mathrm{LM}_{\mathrm{het}(\lambda)} = N^{-1}\sum_{i=1}^{N}(\hat{\omega}_i^{-2}T^{-2}\sum_{t=1}^{T}S_{i,t}^2) \quad (5)$$

LM statistics is standardized as:

$$Z(\lambda) = \frac{\sqrt{N}(LM(\lambda) - \bar{\xi})}{\bar{\varsigma}} \sim N(0,1)$$

They showed that $Z(\lambda)$ statistic normally distributed as firstly $T \to \infty$ followed by $N \to \infty$. For variable $Z(\lambda)$, the expectation (ξ_i) and variance (ς_i^2) are given by:

$$\xi_i = A\sum_{k=1}^{m_i+1}(\lambda_{i,k} - \lambda_{i,k-1})^2$$

$$\varsigma^2_i = B\sum_{k=1}^{m_i+1}(\lambda_{i,k} - \lambda_{i,k-1})^4$$

Carrion-i Silvestre et al. (2005) accepted to being $\lambda_{i,0} = 0$, $\lambda_{i,m+1} = 1$, $A = 1/6$, $B = 1/45$ under restriction to $\alpha_i = \Theta_{i,k} = 0$ while they accept to being $A = 1/15$, $B = 11/6300$ under hypothesis of $\alpha_i \neq \Theta_{i,k} \neq 0$.

Estimating and Testing Breaks

Since computed to $Z(\lambda)$ statistics, it must be detected the breaks in each one of the individual time series. Carrion-i Silvestre et al. (2005) determine endogenously structural break. Thus they follow Bai and Perron's (1998) the global minimization of sum of squared residuals process (SSR). They choose as the estimate of the dates of the breaks the argument that minimizes the sequence of individual SSR $(\hat{T}_{b,1}^i,..., \hat{T}_{b,mi}^i)$ computed from equation (3).

$$(\hat{T}_{b,1}^i,..., \hat{T}_{b,mi}^i) = \arg\min_{T_{b,1}^i,...,T_{b,mi}^i} SSR\,(T_{b,1}^i,..., T_{b,mi}^i)$$

After the dates for all possible $m_i \leq m^{\max}$, $i = (1,\dots, N)$ have been estimated, the point is to select the suitable number of structural breaks and optimal value is determined for m_i. Bai and Perron (1998) propose this concern using two different procedures. The first procedure makes use of information criteria or more specifically the Bayesian Information criterion (BIC) and the modified Schwarz Information criterion (LWZ) of Liu et al. (1997). The second procedure is based on sequential computation of structural breaks with the application of pseudo *F*-type test statistics. Bai and Perron (2001) compare the procedures and conclude that second one outperforms the first one. Thus, in line with their recommendation, when there are trending regressors, the number of structural breaks should be estimated using BIC and LWZ information criteria. On the other hand, when model doesn't include trending regressors, the number of structural breaks should be estimated using sequential procedure.

Empirical Results

Firstly, we test whether rate of unemployment has cross-section dependency about choosing of first generation panel unit root test or second generation panel unit root test. Thus, we test Breusch and Pagan's (1980) cross-section LM testing. Since the number of cross-section observation is smaller than the number of time series observation in our model, it is taken into account CDLM1 test of Pesaran (2004). According to Table 1, probability value of CDLM1 test converges to zero. Since probability value is at smaller significance level (0.05), we reject to presence of cross-sectional independence. Thus, we must rely on second generation unit root tests instead of first generation unit root tests. First generation tests depend crucially upon the independence assumption across individuals, and hence not applicable since cross sectional correlation is present. So, we must consider results of Table 2 and Table 3.

Table 1

Results of Cross-Section Dependence Tests in Panel

	Without trend		With trend	
	T stat.	Prob.	*T* stat.	Prob.
CDLM2	4.11	0.0000194	3.796	0.0000733
CDLM1	164.62	0.00018	160.018	0.00043
CDLM	-0.92	0.179	-0.749	0.2268

Table 2

Results of Cross-Sectionally Augmented Dickey Fuller Test (CADF) for Unemployment

	Only intercept			With trend		
Country	P Lag number	CADF test stat.	CV (5%)	P Lag number	CADF test stat.	CV (5%)
Austria	1	-1.107	-3.36	1	-1.9560	-3.88
Belgium	2	-2.419	-3.36	2	0.6818	-3.88
Canada	3	1.315	-3.36	3	-1.309	-3.88
Denmark	3	0.6448	-3.36	3	-2.80	-3.88
Finland	5	-3.599	-3.36	5	-1.04	-3.88
France	3	-2.716	-3.36	2	-3.79	-3.88
Germany	1	0.9886	-3.36	1	0.43	-3.88
Italy	2	-2.521	-3.36	2	-2.34	-3.88
Japan	1	-0.44	-3.36	1	-1.76	-3.88
Netherlands	4	-2.419	-3.36	4	-2.82	-3.88
Norway	4	-0.806	-3.36	4	-4.85	-3.88
Sweden	5	0.323	-3.36	1	-2.80	-3.88
U.K	3	-0.614	-3.36	3	-0.89	-3.88
U.S	3	-2.091	-3.36	3	-1.88	-3.88
Turkey	1	-2.122	-3.36	3	-1.78	-3.88
CIPS stat.		-1.172	-2.25		-1.929	-2.76

Note. Critical values are obtained from Tables in article of Pesaran (2003).

The results of the CADF test are presented in Table 2. As it is seen from Table 3, results show that null of a unit root unemployment series can be rejected at the 5% significance level without trend model, except for Finland in all countries. At the same time, when we analyze from CIPS stat., still we could reject to null hypothesis of a unit root in all countries at the 5% significance level. Results with trend of CADF indicate that null of a unit root unemployment series can be reject at the 5% level, except for Norway in all countries.

Table 3

Results of SURADF for Unemployment

	Only intercept			With trend		
Country	P Lag number	SURADF test stat.	CV (5%)	P Lag number	SURADF test stat.	CV (5%)
Austria	2	-4.14	-9.66	2	-4.01	-12.98
Belgium	3	-6.47	-5.91	3	-6.75	-8.88
Canada	4	-1.22	-7.53	4	-11.44	-10.33
Denmark	4	-2.93	-5.68	4	-6.31	-8.87
Finland	6	-7.40	-7.58	6	-9.66	-11.93
France	4	-3.42	-8.55	3	-5.42	-9.78
Germany	2	-5.41	-9.19	2	-4.67	-12.21
Italy	3	-3.05	-4.75	3	-2.29	-10.44
Japan	2	-2.23	-9.23	2	-2.39	-13.23
Netherlands	5	-1.66	-11.83	5	-3.94	3.56
Norway	5	-2.33	-9.80	5	-5.75	-9.32
Sweden	6	-8.98	-4.20	2	6.59	-12.02
U.K	4	-2.08	-19.31	4	-3.83	-9.49
U.S	4	-3.45	-6.11	4	-3.48	-12.55
Turkey	2	-4.99	-20.89	4	-3.48	-10.85

Note. The column SURADF test stat. presents the estimated augmented dickey-fuller statistics based on SUR estimation.

The results of SURADF test is presented in Table 3. As is seen from Table 3, results show that null of a unit root unemployment series can be rejected at 5% level without trend model except for Belgium and Sweden. When we investigate results of with trend model, we obtain that unemployment series are non-stationary except for Canada and Netherlands in all countries.

Carrion-i-Silvestre et al. (2005) and Carrion-i-Silvestre (2005), all of whom conclude that the unit root hypothesis can be strongly rejected once the level and/or slope shifts are taken into account. In light of these considerations, in this paper, we apply the test of Carrion-i Silvestre et al. (2005). The empirical analysis first specifies a maximum of $m_{\max} = 5$ structural breaks, which appears to be reasonable given the number of time observations ($T = 24$) in our study.

Table 4 and Table 5 show the results of panel stationary test considering structural breaks for unemployment rate. Table 4 presents the date of break for each cross section of constant and constant-trend models. Schwarz information criterion is used in determining the date of breaks.

Table 5 presents the results of PANKPSS test. Under the assumption of heterogeneous, the null of stationary can be rejected in all countries analyzed at 5% significance level the without trend model. The null of stationary of unemployment series can be rejected by either the homogeneous or the heterogeneous long-run version of test in the model without trend, if we use the bootstrap critical values, as shown in Table 5. If we consider the model with trend, then we accept the null of stationary unemployment series for heterogeneous long-run version of test. However, if we consider the model with trend for homogeneous long-run version of test, then we obtain that unemployment series are stationary consistently with other our findings in OECD countries analyzed. Consequently, our results suggest that the panel data set of unemployment rate is stationary when we introduce structural break into the model.

Table 4

Dates of Structural Break

Dates of structural break (without trend or with only constant)					
Austria	1992				
Belgium	1992	2002	2005		
Canada	1992	1995	1998	2002	2005
Denmark	1992	2003			
Finland	1988	1992			
France	1990	1997			
Germany	1987				
Italy	1988	1992	1998		
Japan	1987	1990	1997		
Netherlands	1988	1996			
Norway	1991	1997			
Sweden	1992	1999			
U.K.	1988	1995	2005		
U.S.A	1998				
Turkey	1989	1992			
Dates of structural break (with trend)					
Austria					
Belgium	2003				
Canada	1988	1998	2004		
Denmark	1988	1997	2000	2005	
Finland	1991	1994	2002		
France	1992				
Germany	1988	1993	1997	2000	2005
Italy	1999	2004			
Japan	1992	1999			
Netherlands	1991	1994	1999	2004	
Norway	1988	1992	1995	2000	
Sweden	1987	1990	1994	1999	2004
U.K.	1988	1992	2000		
U.S.A	1988	1993			
Turkey	1990				

Conclusions

In this empirical study, we employ the Carrion-i Silvestre et al.'s (2005) panel stationary test with structural breaks to assess validity of hysteresis in unemployment rates for 15 countries using annual data for the period 1985-2008.

Carrion-i Silvestre et al.'s (2005) panel stationary test indicates that a unit root in rate of unemployment is rejected for 15 countries we study here. This finding has been interpreted as support for none of hysteresis of hypothesis in countries analyzed. The results indicate that shocks to unemployment are not permanent and unemployment rate will return to its mean value. So, there still exists a unique natural rate of unemployment to which the economy eventually will converge.

Consequently, the issue of whether unemployment dynamics have stationary process is very important implication for both researchers and policy makers because unemployment movements that will occur in future depend on past unemployment movements.

Table 5

Panel Stationary Test Based on Structural Break (PANKPSS) (The Test of Carrion-i Silvestre et al., 2005)

Constant		Time trend			
		Test stat.	P Val.	Test stat.	P Val.
LM (λ)	Hom.	5.162	0.000	7.852	0.0000
LM (λ)	Het.	8.554	0.000	273.446	0.0000

Significance level	Boots CV. (constant)		Boots CV. (time trend)	
	Hom	Het	Hom	Het
0.01	2.187	6.514	3.745	20.605
0.025	3.222	7.961	4.277	23.701
0.05	4.076	9.541	4.869	26.366
0.10	4.956	11.483	5.669	30.396
0.90	12.871	31.719	16.518	79.436
0.95	14.842	36.573	19.224	92.941
0.975	16.153	42.907	21.022	104.394
0.99	17.968	51.193	22.495	116.882

Notes. The finite sample critical values are computed by means of Monte Carlo simulations using 10.000 replications. LM (λ) (hom) and LM(λ) (het) denote the Carrion-i-Silvestre et al. (2005) KPSS test assuming homogeneity and heterogeneity, respectively, in the estimation of the long-run variance.

References

Arestis, P., & Biefang-Frisancho Mariscal, I. (2000). OECD unemployment: Structural breaks and stationarity. *Applied Economics, 32*.

Bai, J., & Perron, P. (1998). Estimating and testing linear models with multiple structural changes. *Econometrica, 66*(1), 47-78.

Bai, J., & Perron, P. (2001). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics, 18*(1), 1-22.

Barbieri, L. (2006). Panel unit root tests: A review. Quaderni del Dipartimento di Scienze Economiche e Sociali, Serie Rossa, No.43, Università Cattolica del Sacro Cuore, Piacenza.

Blanchard, O., & Summers, L. (1986). Hysteresis and the European unemployment problem. *NBER Macroeconomics Annual, 1*. Cambridge, MA: MIT Press.

Brunello, G. (1990). Hysteresis and the Japanese unemployment problem: A preliminary investigation, *Oxford Economic Papers, 42,* 483-500.

Camarero, M., & Tamarit, C. (2004). Hysteresis vs. natural rate of unemployment: New evidence for OECD countries. *Economics Letters, 84*(3), 413-417.

Carrion-i-Silvestre, J. L. (2005). Health care expenditure and GDP: Are they broken stationary? *Journal of Health Economics, 24*(5), 939-854.

Carrion-i-Silvestre, J. L., Tomas del Barrio-Castro, & Lopez-Bazo, E. (2005). Breaking the panels. An application to the GDP per capita, *Econometrics Journal, 8,* 159-175.

Choi, In. (2001). Unit roots tests for panel data. *Journal of International Money and Finance, 20,* 229-272.

Christopoulo, D. K., & Leon-Ledesma, M. (2007). Unemployment hysteresis in EU countries: What do we really know about it? *Journal of Economic Studies, 34*(2), 80-89.

Cross, R. (1995). *The natural rate of unemployment: Reflections on 25 years of the hypothesis*. New York and Melbourne: Cambridge University Press.

Güloğlu, B., & İspir, S. (2008). Yeni Gelişmeler Işığında Türkiye'de Satın Alma Gücü Paritesi Hipotezinin Panel Birim Kök Sınaması. Makro Ekonomik Zaman Serileri Analizi, Eşbütünleşme ve Modelleme Yöntemleri, Edit Kitap, *DEU Yayınları*, İzmir

Gustavsson, M., & Österholm, P. (2006). Hysteresis and non-linearities in unemployment rates. *Applied Economics Letters, 13*(9), 545-548.

Hadri, K. (2000). Testing for stationarity in heterogenous panels. *Econometrics Journal, 3,*148-161.

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics, 115,* 53-74.

Kapetanios, G., Shin, Y., & Snell, A. (2003). Testing for a unit root in the nonlinear STAR framework. *Journal of Econometrics, 112*(2), 359-379.

Khim-Sen, L. V., Chee-Jiun, C. R., & Chin-Hong, P. (2009). Does hysteresis in unemployment occur in OECD countries? Evidence from parametric and non-parametric panel unit roots tests. MPRA paper 9915, University Library of Munich, Germany.

Layard, R., Nickell, S., & Jackman, R. (1991). *Unemployment: Macroeconomic performance and the labour market.* Oxford, U.K.: Oxford University Press.

Levin, A., & Chien-Fu, L. (1992). *Unit root tests in panel data: Asymptotic and finite-sample properties.* University of California, San Diego, mimeo.

Levin, A., Lin, C. F., & Chu, C. S. (2002). Unit root in panel data: Asymptotic and finite-sample properties. *Journal of Econometric, 108,* 1-24.

Maddala, G. S., & Shaoven, W. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics, 61,* 631-652.

Mitchell, W. E. (1993). Testing for unit roots and persistence in OECD unemployment rates. *Applied Economics, 25,* 1489-1501.

Mohan, R., Kemegue, F., & Sjuib, F. (2007). Hysteresis in unemployment: Panel unit roots tests using state level data. University Library of Munich, Germany/MPRA paper. No.5580.

Neudorfer, P., Pichelmann, K., & Wagner, M. (1990). Hysteresis, NAIRU and long term unemployment in Austria. *Empirical Economics, 15,* 217-229.

Newey, W., & West, K. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica, 55,* 703-708.

Perron, P. (1997). Further evidence on breaking trend functions in macroeconomic variables. *Journal of Econometrics, 80*(2), 355-385.

Phelps, E. (1994). *Structural slumps: The modern equilibrium theory of unemployment, interest, and assets.* Cambridge, Harvard University Press.

Roed, K. (2002). Unemployment hysteresis and the natural rate of vacancies. *Empirical Economics, 27,* 687-704.

Song, F. M., & Wu, Y. (1997). Hysteresis in unemployment: Evidence from 48 states. *Economic Inquiry, 35,* 235-244.

Song, F. M., & Wu, Y. (1998). Hysteresis unemployment: Evidence from OECD countries. *The Quarterly Review of Economics and Finance, 38,* 181-192.

Tang, T., & Lau, E. (2009). An empirical investigation on the sustainability of balancing item of balance of payment accounts for OIC member countries. *Journal of Economic Cooperation and Development, 30*(1), 1-16.