Hysteresis in Unemployment: Evidence from 23 OECD Countries

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Abstract

Unemployment is one of the most important problems that all countries must overcome. As a result, it has become one of the centrally explored issues in macroeconomics, and several theories have been proposed to explain the existence of high unemployment rates. Traditional theories describe movements of unemployment as fluctuations around a natural rate. However, theories that rely on a natural rate of unemployment have been challenged by hysteresis theories. According to hysteresis theories, all shocks have permanent effects on the level of unemployment. This paper tests hysteresis effects in unemployment using panel data for 23 OECD countries covering the period 1963 – 2007. The paper applies both a univariate time series and a panel data unit root test with and without a structural break to test for unemployment hysteresis in OECD countries against the alternative of a natural rate. The results point to the rejection of the hysteresis hypothesis for the OECD and are compatible with structuralist theories as described by the structuralist view.

Keywords: *hysteresis, monetary policy, unemployment, panel unit root test*

JEL Classification: E20, E24, E31

1. Introduction

Over the last 40 years, one of the most serious problems facing OECD economies has been persistently high unemployment. Furthermore, patterns of unemployment over this period have differed between the U.S. and Europe. Both the European and U.S. economies experienced considerably high unemployment during the 1970s. The majority consensus is that supply shocks were the main

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cause of high employment in the 1970s. However, the European unemployment rate has increased to 10 percent since the 1980s despite an absence of supply shocks, a level much higher than the U.S. unemployment rate for the same period (Mitchell and Muysken, 2004). The persistence of high unemployment in Europe during the 1980s poses a puzzle for traditional unemployment theories. Previously, unemployment theories have tried to provide an explanation for why unemployment has been so high and persistent in Europe since the 1980s, and why unemployment has been so much more persistent in Europe than in the U.S. (Snower, 1997).

According to the natural rate of unemployment theory developed by Friedman (1968) and Phelps (1967; 1968), or the non-accelerating inflation rate of unemployment (NAIRU), although output fluctuations generate cyclical movements in the unemployment rate, in the long run, the rate will tend to revert to equilibrium. Friedman (1968, p. 8) stated that, "the natural rate of unemployment is the level which would be ground out by the Walrasian system of general equilibrium equations, provided that there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on". The natural rate of unemployment describes fluctuations in unemployment as movements around the natural rate. This theory characterizes unemployment dynamics as a mean reversion process.

Over the past four decades, the natural rate of unemployment theory has been challenged by the persistence of high unemployment rates in European countries. The unprecedented behavior of the European unemployment rate has led to the development of alternative theories of unemployment. Two such theories have been the most dominant (Papell, Murray and Ghiblawi, 2000). The first is the "structuralist" view advanced by Phelps (1994); this view is in line with the traditional theory of the natural rate of unemployment (Candelon, Dupuy and Alana, 2009). The structuralist view argues that the persistent increase in unemployment is the result of a combination of persistent shocks that raised the natural rate of unemployment (Raurich, Sala and Sorolla 2006, p. 286). Specific supply-side impediments, such as relative oil prices, real interest rates, exchange rates, stock prices (Phelps, 1999) and the rate of productivity growth (Pissadires, 1990) have led to a rise in the natural rate of unemployment. If these supply-side impediments can be removed, the natural rate of unemployment could decline to the original level. This view argues that the unemployment rate is a stationary process subject to occasional but persistent structural changes. It is unsupported by convincing quantitative evidence capable of explaining the high persistent

European unemployment rate (Gordon, 1989, p. 220). Moreover, "all the additional 'suspects' supposed to be responsible for a structural slump – the oil price, the dollar exchange rate and (at least to some extent) the real interest rate – have returned to more 'normal' levels, but the European rate of unemployment remains defiantly at its exceptionally high level" (Røed, 1997, p. 407).

The second alternative theory is known as the hysteresis hypothesis. The hysteresis hypothesis states that cyclical fluctuations have permanent effects on the level of unemployment. Advanced by Blanchard and Summers (1986; 1987), it posits that the natural rate of unemployment follows the path of the actual unemployment rate. According to this view, the level of unemployment is characterized as a non-stationary, or unit root, process.

This paper tests hysteresis effects on unemployment using panel data for 23 OECD countries covering the period 1963 – 2007. The paper is organized as follows. The second section explains the theories of hysteresis. The third section provides a survey of the empirical literature. The fourth and fifth section discusses unit root tests, and data and empirical results, respectively. The sixth section presents the conclusion.

2. Theories of Hysteresis

The term hysteresis, taken from physics, "refers to the failure of an object to return to its original value after being changed by an external force, even after the force is removed" (Ball and Mankiw, 2002, p. 119). In labor markets, hysteresis is the term used to explain the long-lasting influence of actual unemployment on the natural rate of unemployment. The hysteresis hypothesis argues that transitory shocks have permanent effects on the rate of unemployment. It is important to note that there is a crucial difference between the concepts of hysteresis and persistence. The concept of hysteresis should not be confused with persistence (León-Ledesma, 2002, p. 95). Persistence is a special case of the natural rate hypothesis, and it implies a slow rate of adjustment towards a long-run equilibrium (Mitchell and Muysken, 2008, p. 101). In the case of persistence, the original equilibrium will be reestablished in a sufficient period of time. From an econometric point of view, whereas hysteresis is characterized by the unit root process, persistence is characterized by a near-unit root process.[1]

[1] Sometimes the unit root process is referred to as "full hysteresis" or "complete hysteresis," and "persistence" is referred to as "short-run" or "partial hysteresis." Layard et al. (1991) tried to develop the idea of short-run hysteresis by deriving a short-run non-accelerating inflation rate of unemployment (NAIRU). They argued that unemployment acts to reconcile competing claims over the functional distribution of income in the current period. (For a clarification of terminology, see Dobbie (2004, p. 6.) However, persistence and hysteresis are considered different concepts in this paper.

Hargreaves Heap introduced the term hysteresis into the literature of economics in 1980. Hargreaves Heap (1980) considered the natural rate of unemployment to be a function that is a weighted average of the actual unemployment rate and the equilibrium rate of the last period. The revival of the term in economics was inspired by the seminal work of Blanchard and Summers (1986; 1987). They emphasized a model in which union behavior can lead to hysteresis. Their model is known as the "insider-outsider" model. They considered equilibrium to be path-dependent. Their model focused on membership and duration theories, which are defined as follows (Blanchard and Summers, 1986, p. 2): "First, membership theories are based on the distinction between insiders and outsiders and explore the idea that wage setting is largely determined by firms' incumbent workers rather than by the unemployed. Second, duration theories are based on the distinction between short term and long term unemployed and explore the idea that the long term unemployed exert little pressure on wage setting."

Lindbeck and Snower (1988; 2001) and Lindbeck (1993) provided the microeconomic rationale for insider market power. The insider-outsider model of Lindbeck and Snower (1988, p. 3) rests on five assumptions. First, due to the existence of labor turnover costs, insiders have market power. Such costs include the costs of hiring and firing labor and the refusal of insiders to cooperate with outsiders (Lindbeck, 1993). The second assumption emphasizes the power of insiders. Insiders pursue their interests in wage negotiations without taking care of the interests of outsiders. The third assumption suggests that outsiders have less market power than insiders. Fourth, when insiders lose their jobs, they immediately become outsiders. Fifth, wage costs are positively related to the insider wage.

In addition to the insider-outsider model, there are many other views that try to explain the sources of hysteresis. One of the attempts to explain the sources of hysteresis emphasizes the depreciation of human capital. This explanation is referred to as duration theory or human capital theory (Mikhail, Eberwein and Handa, 2003, p. 6). Human capital is likely to depreciate in the case of long-term unemployment. A long duration of unemployment may have a demoralizing effect on human behavior. The unemployed may lose their skills and, as a result, they may be less employable. It is known that employers use unemployment duration as a screening device (Lee, 1989, p. 33). Proponents of this theory have noted that, "if the unemployment rate has been high in the recent past, a higher proportion of the unemployed may have suffered such skill erosion and so will be less employable, raising the NAIRU" (Roberts and Morin, 1999, p. 1).

Another view considers a reduction of capital stock as a source of hysteresis. This view argues that adverse shocks do not only cause unemployment, they also lead to a reduction in capital stock. Lower capital stock leads to a subsequent decrease in demand for labor, which causes a protraction of the increase in unemployment. Røed (1997, p. 403) showed that there are two mechanism behind this relationship between the reduction of capital stock and the persistence of unemployment. First, capacity utilization decreases below its target level in a recession, which stimulates capital scrapping. This reduction leads to a higher equilibrium rate of unemployment, which persists even when recessionary shocks are removed. “The second mechanism is related to the strategic type of investment rather than to its level. During recessions, investments are typically aimed at costs reductions (often associated with less labor intensive technologies) rather than capacity augmentation. In booms on the other hand, capacity augmentation has the highest priority. Thus, business cycles contribute to long-lasting changes in the basic input structure in some industries” (Røed, 1997, p. 403).

According to Blanchard (2003, pp. 4 – 5), capital stock is a conventional channel for the explanation of hysteresis effects. He argued that there is a strong relationship between capital accumulation and monetary policy by way of real interest rates. If monetary policy affects real interest rates for a long period of time, this will lead to a change in capital accumulation. He believes that this relationship has an important role in accounting for unemployment in Europe over the last thirty years (Blanchard, 2003, p. 5): “Low real interest rates in the 1970s probably partly mitigated the increase in labor costs on profit, limiting the decline in capital accumulation, and thus limiting the increase in the natural rate of unemployment in the 1970s. High real interest rates in the 1980s had the reverse effect of leading to a larger increase in the natural rate of unemployment during that period. And the decrease in real interest rates since the mid-1990s is probably contributing to the slow decline in unemployment in Europe.”

Another view that is used to explain hysteresis is based on a model in which unemployment carries a stigma effect (Sessions, 1994; Christopoulos and León-Ledesma, 2007, p. 81; Roberts and Morin, 1999, p. 1). High unemployment for a long period may reduce the social stigma of being unemployed. Stigma effects may depend on current as well as previous levels of unemployment. The stigma effect is related to the efficiency wage model of the shirking type in the following manner (Røed, 1997, p. 401): “An increase in unemployment affects the workers’ temptation to shirk in two ways. First, the reemployment probability is reduced and that increases the fear of being detected and reduces the level of the efficiency wage. Secondly, the social stigma associated with unemployment is reduced, and that reduces the fear of being detected and increases the level of the efficiency wage.”

Ball (1999; 2009) offered another empirically outstanding explanation of unemployment in support of the hysteresis hypothesis. His analysis discussed the major problems of the supply-side, and he developed an explanation based on demand-side influences (Gottschalk, 2005, p. 229; Mitchell and Muysken, 2008, p. 100). According to Ball, "demand influences actual unemployment, U, which in turn influences the natural rate through hysteresis channels" (Ball, 2009, p. 5). In examining the recessions of the early 1980s and 1990s and the recovery of mid 1980s, Ball discussed the effect of monetary policy and labor market policies on the level of unemployment (Stockhammer and Sturn, 2008, p. 7). He demonstrated that hysteresis exists and that it is dependent on monetary policy (Stockhammer, 2004, p. 72).

Ball (1999, p. 190) believes that there are two specific aspects of hysteresis. The first concerns the role of monetary policy. He argued that reactions of policy makers can be used to explain differences in unemployment rates between different countries in the 1980s. In countries where monetary policy is tight, the unemployment rate is permanently high. On the other hand, in countries where expansionary monetary policy is applied, the unemployment rate is low. The second concerns the reverse operation of hysteresis. He argued that demand expansion can produce permanent decreases in unemployment.

Because Ball focused on the role of monetary policy, his analysis has policy implications. According to Ball (2009, pp. 25 – 26): "If hysteresis exists, a broad lesson is that it is dangerous for central banks to focus policy too heavily on inflation, either through explicit inflation targeting or otherwise. If the natural rate is independent of monetary policy, then focusing on inflation can at worst exacerbate short run unemployment movements. With hysteresis, by contrast, a given inflation target is consistent with more than one level of unemployment, even in the long run. A central bank might achieve its inflation target but create needlessly high unemployment in the process."

3. Survey of the Empirical Literature

A number of authors have investigated empirically the existence of hysteresis in OECD countries. The usual conclusion is that cyclical fluctuations have permanent effect on unemployment. Blanchard and Summers (1986), Brunello (1990), Neudorfer, Pichelmann and Wagner (1990), Jaeger and Parkinson (1994) and Røed (1996) used Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests for testing hysteresis. Generally, these studies found that the unemployment series is non-stationary. In other words, according to these studies, the unemployment series has a hysteresis effect.

According to Leslie, Pu, and Wharton (1995), the reason for this finding of a hysteresis affect is the use lower power pure unit root tests in the analysis (Strazicich, Tieslau and Lee, 2001, p. 5). For this reason, they reconsidered hysteresis with more powerful tests. These new tests are (1) unit root tests with structural breaks and (2) panel unit root tests with and without structural breaks.

Mitchell (1993), Arestis and Mariscal (1999; 2000), Papell, Murray and Ghiblawi (2000), Ewing and Wunnava (2001) and Summers (2003) suggested that there are structural breaks in unemployment rate series. Because of such structural breaks, they argued that hysteresis hypothesis is not valid. Their results strongly reject the hysteresis null hypothesis.

Song and Wu (1997; 1998) considered the hysteresis effect with panel data. Song and Wu (1997; 1998) employed Levin and Lin's (1992) panel unit root test to reject the existence of a hysteresis effect in the USA and in sixteen European Union (EU) countries. However, when León-Ledesma (2002) used Im, Pesaran and Shin's (2003) panel unit root test, he did not find hysteresis in the US case, but found support for the validity of the hysteresis hypothesis in EU countries. Smyth (2003) applied both a pure time series and a panel data approach for Australia. Smyth (2003) indicated that the hysteresis effect is valid for a pure time series, but according to the panel data, the hysteresis effect is not valid. Osterholm (2004) also used Im, Pesaran and Shin's (2003) (IPS) panel unit root test and his results are in line with León-Ledesma's (2002). Chang et al. (2007) applied Levin, Lin and Chu (2002) (LLC), IPS and Taylor and Sarno's (1998) panel unit root tests, and they rejected the validity of the hysteresis effect for Taiwan's 27 regions. Mohan Kemegue and Sjuib (2007) used the ADF-Fisher, IPS, LLC and Breitung panel unit root tests and showed that there is no hysteresis effect in three regions of Massachusetts.

Strazicich, Tieslau, and Lee (2001) used a panel unit root test with structural breaks to investigate the hysteresis effect for OECD countries. Their results rejected the existence of hysteresis effects in OECD countries. However, Camarero et al. (2006) found that the hysteresis effect is valid for nineteen OECD countries.

4. Unit Root Tests

If y_t indicates the unemployment rate, an ADF (p) (Dickey and Fuller, 1979; 1981) regression can define a frame of pure time series as follows:

$$\Delta y_t = \mu + \beta t + \delta y_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta y_{t-j} + \varepsilon_t \tag{1}$$

where ε_t is a white noise process, with $iid(0, \sigma_\varepsilon^2)$. The number of p can be determined using different strategies, such as Akaike info Criteria (AIC), Schwarz info Criteria (SIC), General to specific or Specific to general (Ng and Peron, 1995, pp. 268 – 281). Consequently, if we false choice the number of lags, the estimated parameters will be biased.

The second motivation for the alternative unit root test is to allow for a disturbance process ε_t that is not $iid(0,\sigma_\varepsilon^2)$. Philips-Perron generalized the Dickey-Fuller tests to situations where, for example, the ε_t are serially correlated rather than augmenting the initial regression with lagged dependent variables as in the ADF procedure (Phillips and Perron, 1988, pp. 335 – 346). Their approach is nonparametric with respect to nuisance parameters and thereby allows for a very wide class of weakly dependent and possibly heterogeneously distributed data. The Philips-Perron versions of the Dickey-Fuller tests are flexible in that the serial correlation between disturbances can be of an autoregressive or moving average form. However, where the autocorrelations of ε_t are predominantly negative, the Philips-Perron tests suffer severe size distortions, with the actual size being much greater than the nominal size. With correction for this distortion in size, it appears that the Philips-Perron tests can deliver more power than the ADF tests (Schwert, 1989, pp. 147 – 160).

Levin, Lin and Chu (2002) developed a new panel unit root test with more power than standard ADF unit root tests. If the panel data frame y_{it} for $i = 1,\ 2,...N$ and $t = 1,\ 2,...T$ indicates the unemployment rate for individuals, and ADF(p) with an intercept can be shown as follows:

$$\Delta y_{i,t} = \alpha_i + \rho y_{i,t-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta y_{i,t-j} + \xi_{i,t} \tag{2}$$

where the test hypothesis is $\rho = 0$ versus $\rho < 0$ for $i = 1,\ 2,...N$. Here, common unit root tests are applied for all cross-sectional individuals. However, Im, Pesaran and Shin (2003) (IPS) developed a panel unit root test in which ρ can change for all cross-sectional individuals. Therefore in an IPS test with a null of $\rho_i = 0$ versus the alternative of $\rho_i < 0$ hypothesis for hysteresis for $i = 1,\ 2,...N$.

$$\Delta y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta y_{i,t-j} + \xi_{i,t} \tag{3}$$

Equations (2) and (3) test the unit root but ignore structural breaks. Therefore, a new panel data unit root test can be interpreted with and without structural breaks. The panel LM unit root test was developed by Im, Lee and Tieslau (2005). To illustrate the underlying model and testing procedure, the following data generating process (DGP) is considered:

$$y_{it} = \delta' z_{it} + \gamma_t + x_{it},\ x_{it} = \beta_i x_{i,t-1} + \varepsilon_{it} \tag{4}$$

where y_{it} is the i-th cross-section unit in the panel measured in period t, and z_{it} is a vector of exogenous variables. $A(L)\varepsilon_{it} = B(L)u_{it}$, where $A(L)$ and $B(L)$ are finite order polynomials. The test for the unit root null hypothesis is based on the parameter β_i, while ε_{it} is a zero mean error term that allows for a heterogeneous variance structure across cross-sectional units but assumes no cross-correlations. The parameter β_i allows for heterogeneous measures of persistence. Structural breaks are incorporated into the model using the criteria as in the univariate case (Lee and Strazicich, 2001, 2003). The panel LM test statistic is obtained by averaging the optimal univariate LM unit root t-test statistic estimated for each country. This is denoted as $LM_{\tau i}$:

$$\overline{LM}_{NT} = \frac{1}{N}\sum_{i=1}^{N} LM_{\tau i} \tag{5}$$

Im, Lie and Tieslau (2005) then construct a standardized panel LM unit root test statistic by letting $E(L_T)$ and $V(L_T)$ denote the expected value and variance of $LM_{\tau i}$, respectively, under the null hypothesis. They then compute the following:

$$\Gamma_{LM} = \frac{\sqrt{N}\left[\overline{LM}_{NT} - E(L_T)\right]}{\sqrt{V(L_T)}} \tag{6}$$

Im et al. (2005) provide the numerical values for $E(L_T)$ and $V(L_T)$. The asymptotic distribution of this test is unaffected by the presence of structural breaks and is standard normal.

Another panel unit root test that considers a structural break is the PANKPSS test. The Carrion-i-Silvestre, Barro-Castro and Lopez-Bazo (2005) panel stationary test is a modification of Hadri's (2000) stationarity test that allows for multiple structural breaks through the incorporation of dummy variables in the deterministic specification of the model. In this case, under the null hypothesis the data generating process (DGP) for the variable is assumed to be:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{m_i}\theta_{i,k}DU_{i,k,t} + \beta_i t + \sum_{k=1}^{m_i}\gamma_{i,k}DT^*_{i,k,t} + \varepsilon_{i,t} \tag{7}$$

with dummy variable $DT^*_{ikt} = t - T^i_{b,k}$ for $t > T^i_{b,k}$ and 0 elsewhere; another dummy variable $DU_{i,k,t} = 1$ for $t > T^i_{b,k}$ and 0 elsewhere, with denoting the *k, t, h* date of the break for the *i, t, h* individual, $k = \{1,\ 2,...m_i\}$ and $m_i > 1$. The model in eq. (7) includes individual effects, i.e., individual structural break effects (shifts in the mean caused by the structural breaks), temporal effects if $\beta_i \neq 0$ and temporal structural break effects if $\gamma_{i,k} \neq 0$ (when there are shifts in the individual time trend).

According to Carrion-i-Silvestre, Barro-Castro and Lopez-Bazo (2005), the specification given by (7) is general enough to allow for the following characteristics: (i) it permits individuals to have a different number of structural breaks; (ii) the structural breaks may have different effects on each individual time series – the effects are measured by $\theta_{i,k}$ and $\gamma_{i,k}$; and (iii) they may be located at different dates. The applied test of the null hypothesis of a stationary panel follows that proposed by Hadri (2000), with the expression given by:

$$LM(\lambda) = N^{-1} \sum_{i=1}^{N} \left(\hat{\omega}_i^{-2} T^{-2} \sum_{t=1}^{T} S_{i,t}^2 \right) \tag{8}$$

where $S_{i,t} = \sum_{j=1}^{T} \hat{\varepsilon}_{i,j}$ denotes the partial sum process that is obtained with the use of the estimated OLS residuals of (7), and where $\hat{\omega}_i$ is a consistent estimate of the long-run variance of $\varepsilon_{i,t}$. The homogeneity of the long-run variance across and individual time series can also be imposed during the testing process. Finally, we use λ in (8) to denote the dependence of the test on the dates of the break. For each individual *i*, it is defined as the vector $\lambda_i = \left(\lambda_{i,1},\ \lambda_{i,2}, \ldots \lambda_{i,m_i}\right)' =$ $= \left(T_{b,1}^i / T, \ldots T_{b,m_i}^i / T\right)'$, which indicates the relative positions of the dates of the breaks during the entire time period T.

We estimate the number of structural breaks and their positions by following the procedures put forth by Bai and Perron (1998) that compute the global minimization of the sum of the squared residuals (SSR). Here, we make use of these procedures and chose the estimate of the dates of the breaks. We do this based on the argument that minimizes the sequence of individual $SSR\left(T_{b,1}^i, \ldots, T_{b,m_i}^i\right)$ computed from eq. (7). Once we estimate the dates of all possible $m_i \leq m^{\max}$ ($i = 1, 2, \ldots N$), we select the most suitable number of structural breaks for each i, if there are any to obtain the optimal. Bai and Perron (1998) address this concern via two different procedures. Briefly stated, 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, Wu and Zidek (1997). The second procedure is based on the sequential computation and detection of structural breaks with the application of pseudo F-type test statistics. After comparing both procedures, Bai and Perron (2001) concluded that the second procedure outperforms the first. Thus, in line with their recommendation, when the model under the null hypothesis of panel stationarity does not include trending regressors, the number of structural breaks should be estimated using the sequential procedure. On the other hand, when there are trending regressors, the number of structural breaks should be estimated using the Bayesian (BIC) and the modified Schwarz (LWZ) information criteria. Bai and Perron (2001) conclude that the LWZ criterion performs better than the BIC criterion.

5. Data and Empirical Results

The mixed results from unit root tests in previous research on unemployment hysteresis suggest that the question remains as to whether the theory is empirically valid. In order to provide a robust analysis, we compare both univariate and panel root test results with and without structural breaks. To perform our tests, we used annual data on unemployment rates from 23 OECD countries over the period 1963 – 2007. This data is advantageous as it covers a fairly long time span of 45 years and comes from the same (OECD) source.

5.1. Pure Time Series Unit Root Tests

Table 1 gives the ADF, KPSS, and LM unit root test results, which ignore structural breaks. The ADF test shows that we cannot reject the null of the hysteresis hypothesis for all unemployment series. Only Turkey and the U.S. are stationary at the 10% significance level. The KPSS test reveals 17 unemployment series out of 23 countries are non-stationary. Similarly, the LM unit root test indicates that 18 unemployment series out of 23 countries are non-stationary. The results shown in Table 1 indicate that the ADF, KPSS and LM unit root tests all fail to reject the hysteresis hypothesis for unemployment series.

The pure time series unit root tests in Table 1 do not consider structural breaks, whereas the 1963 – 2007 periods consist of a relatively long time dimensions. During these periods, there were a number of economic and financial crises. These crises influence unemployment series and can be a cause of structural breaks. The unemployment dynamics is assumed to include a reaction to a number of shocks, but at the same time, the unemployment dynamics can be also subject to structural breaks. These breaks can be caused by economic or financial crises.

However, the crises themselves can be considered as shocks. This endogenous status requires the use of more powerful unit root tests, which consider structural breaks and the endogenously determined break points. Table 2 gives the KPSS and LM unit root test results with structural breaks.

T a b l e 1

Pure Time Series Unit Root Test Results: Ignoring Structural Breaks

Countries	*ADF*	*KPSS*	*LM*
Australia	–1.594 (2)	0.504*	–2.125 (8)
Austria	–0.881 (0)	0.760**	–2.038 (0)
Belgium	–2.229 (1)	–0.483**	–2.217 (1)
Canada	–2.342 (1)	0.378*	–2.350 (1)
Denmark	–1.976 (1)	0.343	–1.933 (1)
Finland	–1.715 (2)	0.590**	–1.956 (2)
France	–1.862 (1)	0.719**	–1.906 (9)
Germany	–1.335 (2)	0.811**	–3.521** (1)
Greece	–1.586 (1)	0.634**	–1.894 (1)
Iceland	–2.138 (1)	0.544**	–2.310 (1)
Ireland	–1.420 (1)	0.204	–1.450 (1)
Italy	–1.234 (3)	0.521**	–1.087 (3)
Japan	–1.940 (3)	0.725**	–3.371** (3)
Netherlands	–2.001 (1)	0.256	–1.800 (1)
New Zealand	–1.580 (1)	0.577**	–1.382 (5)
Norway	–1.988 (1)	0.636**	–2.179 (1)
Portugal	–2.364 (1)	0.344	–2.552 (1)
Spain	–1.757 (1)	0.487**	–2.180 (9)
Sweden	–1.767 (2)	0.615**	–3.227** (1)
Switzerland	–0.799 (2)	0.750**	–3.069** (1)
Turkey	–2.822* (2)	0.121	–1.293 (7)
UK	–1.715 (2)	0.360*	–1.970 (9)
USA	–2.856* (2)	0.189	–2.884* (1)

Notes: Unit root test results according to model with intercepts. The critical values for the LM unit root test at the 5% and 10% levels are –3.06 and –2.77, respectively (Strazicich, Tieslau and Lee, 2001, p. 19). ** significant at 5%,* significant at 10%.

Source: Our own computation.

The results in Table 2 show the LM unit root tests with one or two structural breaks developed by Lee and Strazicich (2001; 2003) and the KPSS unit root test with multiple structural breaks, as proposed by Carrion-i Silvestre, Barro-Castro and Lopez-Bazo (2005). The Test process for the LM unit root test is as follows. The optimal number of breaks in each country is determined by sequentially examining the t-statistic for each break coefficient to see if it is significant at the approximate 10% level in an asymptotic normal distribution. We begin with the two break LM test. If less than two break points are significant, then the one-break LM test is employed. If less than one break is significant, we employ the no-break LM unit root test of Schmidt and Phillips (1992). The corresponding LM unit root test statistic is then chosen after determining the optimal number of breaks. At first glance, the LM unit root test statistics seem to offer mixed results. More to the point, they show non-stationarity for most countries, with the exceptions of the Germany, Japan, Sweden, Switzerland and the U.S.

The KPSS test results indicate that the null of stationarity in variance cannot be rejected for the countries considered, with the exception of New Zealand at the

5% level. If there are more than two structural breaks in unemployment series, the LM test includes specification errors when considering at most two structural break points. Likewise, if we examine the number of break points in KPSS, it can be shown that there are more than two structural breaks in 17 unemployment series from the 23 countries.

Table 2

Pure Time Unit Root Test Results: Considering Structural Breaks

Countries	*KPSS*	*m*	*TB1-TB2-TB3-TB4-TB5*	*10 %*	*5 %*	*LM*	*TB1-TB2*
Australia	0.026	3	1974-1981-1998	0.203	0.239	–2.125 (8)	–
Austria	0.061	2	1981-2001	0.180	0.236	–2.707 (9)	1992
Belgium	0.041	5	1974-1980-1986-1992-1998	0.428	0.458	–2.217 (1)	–
Canada	0.079	3	1974-1981-1997	0.194	0.223	–3.246 (1)	1974-1981
Denmark	0.032	2	1974-1996	0.171	0.214	–2.907 (2)	1980-1993
Finland	0.071	3	1975-1992-1997	0.377	0.422	–2.967 (2)	1994
France	0.062	4	1974-1981-1992-1999	0.091	0.101	–3.157 (9)	1975-1995
Germany	0.039	3	1974-1981-1992	0.173	0.186	–3.521** (1)	–
Greece	0.066	3	1970-1981-1992	0.219	0.259	–1.894 (1)	–
Iceland	0.091	2	1991-1997	0.230	0.294	–2.310 (1)	–
Ireland	0.105	4	1974-1982-1989-1997	0.148	0.176	–1.450 (1)	–
Italy	0.048	3	1975-1982-1991	0.255	0.280	–1.087 (3)	–
Japan	0.020	3	1974-1981-1997	0.266	0.291	–4.080** (5)	1996-2003
Netherlands	0.056	4	1974-1980-1988-1997	0.072	0.078	–3.256 (9)	1975-1993
New Zealand	0.196**	4	1980-1988-1994-2000	0.121	0.139	–1.382 (5)	–
Norway	0.039	4	1971-1981-1988-1996	0.331	0.362	–2.179 (1)	–
Portugal	0.026	3	1975-1987-2001	0.197	0.217	–3.148 (1)	1974
Spain	0.049	3	1973-1980-1999	0.243	0.282	–2.180 (9)	–
Sweden	0.152	2	1991-1998	0.269	0.352	–4.043** (1)	1995
Switzerland	0.050	2	1982-1991	0.173	0.224	–5.302** (1)	1990-1995
Turkey	0.037	4	1969-1975-1994-2001	0.172	0.192	–1.293 (7)	–
UK	0.126	4	1974-1980-1987-1997	0.154	0.165	–2.686 (9)	1976-1990
USA	0.114	2	1974-1994	0.165	0.199	–5.097** (1)	1974-1984

Notes: Unit root test results according to model with intercepts. The critical values for the LM unit root test at the 5% and 10% levels are –3.06 and –2.77, respectively. The LM unit root test with one structural break at the 5% and 10% levels are –3.566 and –3.211, respectively. The LM unit root test with two structural breaks at the 5% and 10% levels are –3.842 and –3.504, respectively (Strazicich, Tieslau and Lee, 2001:19). ** significant at 5%, * significant at 10%.

Source: Our own computation.

5.2. Panel Unit Root Tests

In considering the power of test results, we test the hysteresis hypothesis using a panel data approach, which incorporating country-specific effects into account. In Table 3, we test four panel unit root tests. The first two tests do not take into consideration structural breaks, but we can consider structural breaks in the panel LM and panel KPSS (PANKPSS) tests.

Let us first focus on the results without structural breaks. The first test given in Table 3 is the Fisher-ADF test, which includes the Fisher Chi-Square and

Choi Z statistics. Maddala and Wu (1999) suggest that the Fisher Chi-Square test shows that the null of non-stationary cannot be rejected. However, Choi (2001) Z statistics rejects the null hypothesis at the 10% significance level. In the second test, the Hadri (2000) panel unit root test rejects the null hypothesis of stationarity for both homogeneous and heterogeneous cases. It can be concluded that by incorporating cross-country variations, the unemployment series of 23 OECD economics are non-stationary. The first two test results support the hysteresis hypothesis in unemployment rates.

T a b l e 3

Panel Unit Root Test Results

Panel Tests	***Test Statistics***
Fisher-ADF Test: Fisher Chi-Square & Choi Z Statistics	52.063 & –1.632*
Hadri Test: Homogeneous & Heterogeneous	10.436** & 10.794**
Panel LM Test	–6.811**
PANKPSS: Homogeneous & Heterogeneous	1.028 & 3.236

Notes: Unit root test results according to models with intercepts. The critical values for the panel LM unit root tests with and without structural breaks for the 5% and 10% levels are –1.645 and –1.282, respectively (Strazicich, Tieslau and Lee, 2001, p. 19). The bootstrap critical values for homogeneous and heterogeneous PANKPSS unit root tests for the 5% and 10% levels are 15.694 and 17.422 and 16.637 and 18.454, respectively ** significant at 5%, * significant at 10%.

Source: Our own computation.

The last two tests are the panel LM and PANKPSS tests, which consider structural breaks. The calculated panel LM test strongly rejects a unit root in the unemployment rate for the 23 OECD countries. If we combine the individual information to compute the PANKPSS test in Table 3, the null hypothesis of stationarity in variance cannot be rejected when the test is computed using homogeneous and heterogeneous long-run variance estimates. The results of the panel unit root test with structural breaks point to the absence of hysteresis in the unemployment rates of the 23 OECD countries analyzed.

Overall, the results point to the rejection of the hysteresis hypothesis and are compatible with structuralist theories as described by Phelps (1994). This implies that the majority of shocks to unemployment are temporary, but occasionally, as a result of recessions, can provoke a change in the level of the natural rate of unemployment. The results in the literature support the structuralist view of unemployment, implying that shocks have highly persistent but not permanent effects on unemployment. Therefore, structural factors can influence the natural unemployment rate, which could be characterized as a stationarity in the variance process subject to structural changes.

Conclusion

The conventional natural rate of unemployment – or its approximate synonym, the NAIRU – describes fluctuations in unemployment as movements around a natural rate. This hypothesis characterizes unemployment dynamics as a mean reversion process. The NAIRU has changed between the 1970s and 1990s. Attempts to explain what causes the NAIRU to change over time have led to the development of hysteresis theories. Hysteresis can be described as a high degree of dependence of the current employment level on the past. Hysteresis theories argue that temporary shocks have permanent effects. This paper has outlined some major theories that account for the existence and the sources of hysteresis. There are a number of channels through which hysteresis may affect the economy. Five of these channels, namely insider-outsider theory, capital stock theory, human capital theory, stigma effect and demand side effects, have been discussed.

From the survey of empirical literature it is obvious that testing the stationarity of the unemployment process delivers mixed results and sometimes highly controversial ones even for the same countries and periods. Therefore, conclusions in the literature about the presence of hysteresis in unemployment dynamics are ambigious. The mixed results from unit root tests in previous research on unemployment hysteresis suggest that the question remains as to whether the theory is empirically valid. In order to provide a robust analysis, we compare both univariate unit root tests with and without structural breaks, which are ADF, KPSS, and LM, and panel unit root tests with and without structural breaks, which are Fisher-ADF, Hadri, LM, and PANKPSS to test for unemployment hysteresis in OECD countries against the alternative of a natural rate. The results point to the rejection of the hysteresis hypothesis for the OECD and are compatible with structuralist theories as described by the structuralist view. The results in the literature support the structuralist view of unemployment, implying that shocks have highly persistent but not permanent effects on unemployment. Therefore, structural factors can influence the natural unemployment rate, which could be characterized as a stationarity in the variance process subject to structural changes.

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