# Analysis of Hysteresis in Unemployment Rates with Structural Breaks: the Case of Selected European Countries

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*In recent years, unemployment has become a major problem in many countries. The fluctuations of the unemployment rate as well as its persistence in some countries impose challenges to economic policy makers. In order to implement appropriate policy measures, it is necessary to know the exact character of the unemployment in the observed country – is it structural or cyclical. In the context of economic theory, it is important to examine which concept better represents the behaviour of the unemployment rates – the concept of the natural rate of unemployment or hysteresis hypothesis. The character of unemployment is also influenced by some characteristics of a country under consideration. Therefore, the article examines the presence of hysteresis in monthly unemployment rates from January 2000 to January 2013 in two groups of countries: the selected European OECD countries and selected Central and Eastern European countries in transition. The analysis was conducted by using univariate and panel unit root tests and the structural break analysis. Although the hysteresis hypothesis cannot be rejected for the majority of the countries, when using univariate and panel unit root tests, the results of the structural break analysis indicate that the hysteresis hypothesis can be rejected in the case of OECD countries. In other words, the natural rate of unemployment better represents the movement of unemployment rates in this group of countries in the overall period. On the other hand, the hysteresis hypothesis cannot be rejected in the case of countries in transition. The presence of hysteresis effects in the countries in transition indicates that the application of economic policy directed to the demand side of the economy might have positive effects on reduction of unemployment. In OECD countries it is necessary to implement the institutional measures which could affect the bargaining power of labour unions, unemployment benefits, labour market flexibility, and so on.*

Keywords: *Unemployment Rate, OECD Countries, Countries in Transition, Hysteresis Hypothesis, Unit Root Tests, Structural Breaks.*

## Introduction

Unemployment represents one of the most serious problems of the modern economies. Fluctuations in the unemployment rates are very frequent, but unemployment could also be very persistent in some countries. In that sense, economic policy directed to reduction of unemployment rates is very important. However, in order to implement appropriate measures of the policy, it is necessary to know the exact character of unemployment in the country under consideration.

In the theoretical field, there are two main groups of the unemployment theories. One emphasises the presence of the so-called natural rate of unemployment, which is the result of labour market characteristics (bargaining power of labour unions, unemployment benefits, etc.). Reduction of the actual rate of unemployment below the rate leads to inflation acceleration (Friedman, 1968; Phelps, 1968).

On the other hand, there are theories which point out the possibility that actual unemployment rate "pulls" the natural rate in the same direction, which is known as the hysteresis hypothesis (Blanchard & Summers, 1988; Lavoie, 2004; Stockhammer, 2004). Hysteresis can be represented as follows (Snowdon & Vane, 2005, p. 405):

$$U_{Nt} - U_{Nt-1} = a(U_{t-1} - U_{Nt-1}) \qquad a > 0 \qquad (1)$$

If the actual rate of unemployment in the previous period ($U_{t-1}$) is greater than the natural rate of unemployment in the previous period ($U_{Nt-1}$), the natural rate in the current period ($U_{Nt}$) will be greater than $U_{Nt-1}$. In other words, the actual unemployment rate „pulls" the natural rate in the same direction.

If the unemployment in the observed country exhibits the hysteresis effects, the measures directed to the reduction of unemployment rates should be different than measures which would be adequate in the case when actual rate fluctuates around the natural rate of unemployment. If there are hysteresis effects, the economic policy should affect the actual unemployment rate, e. g. via increasing aggregate demand (by expansionary monetary or fiscal policy, or by combination of the two policies). On the other hand, if the unemployment rate during time tends to gravitate to the natural rate, the institutional solutions will be more appropriate; the natural rate could be reduced by lowering the unemployment benefits or by affecting the power of labour unions. If the increasing of the employed workers' wages is the main objective of a union, then the reduction of its bargaining power can decrease the unemployment rate by lowering the wage to the equilibrium level. However, if the union is dedicated to increasing the

number of employed workers, then the reduction of its power will probably increase the unemployment rate.

In that sense, it is essential to investigate whether the movement of the unemployment rates in the country under consideration is better represented by the hysteresis or by the natural rate theory. Bearing in mind that majority of European OECD countries, as well as the countries in transition, have a problem with high unemployment in the last few years, *the aim* of this article is to examine the character of the unemployment in some of the countries. In other words, the paper analyses two groups of countries: the group of ten European OECD countries (Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Spain, and Great Britain) and the group of ten Central and Eastern European countries in transition (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia and Slovakia). More precisely, we test the following *research hypotheses*:

$H_1$: There is a difference in the character of unemployment in the selected OECD countries and the countries in transition;

$H_2$: The presence of structural breaks has a significant impact on the obtained results about hysteresis hypothesis in both groups of the countries;

$H_3$: The hysteresis hypothesis represents better the movement of unemployment rates in the countries in transition than in the OECD countries.

*The research methodology* is based on the application of different statistical tests (univariate and panel unit root tests and structural break tests). *The objective* of the paper is to demonstrate which concept of unemployment is more suitable for explanation of unemployment rates movement in the selected countries. *The practical significance* that stems from that objective lies in the possibility to formulate appropriate policy measures, which can be directed to the reduction of unemployment rates in the observed countries.

The article is organized as follows: the second section presents the theoretical and empirical background derived from the recent literature; the third section describes data and methodology for detecting hysteresis and structural breaks; section four outlines the results and their interpretation; section five presents conclusions.

## A Review of Previous Research

The hysteresis theory was first introduced in a seminal paper by Blanchard & Summers (1986). In economic literature there are three main groups of explanations of hysteresis: the insider-outsider theory, duration theory and capital stock theory. According to the insider-outsider theory, insiders (employed workers) possess market power in determining wages independently of the unemployment in the economy. The duration theory is concerned with the negative effects of unemployment duration on the labour demand and the labour supply of the unemployment. In other words, the long-term unemployed workers are less attractive for firms, because the firms hold the belief that the productivity of those workers has been reduced. The capital stock theory focuses on the impact of adverse demand shocks on reduction of the capital stock, which entails the rise in unemployment. The persistence of the

unemployment is then explained by the fact that it takes a lot of time to increase the capital stock again (Ball, 2009). As a result of all these explanations, the temporary shocks in the economy can have permanent effects on the unemployment.

On the empirical level, the most commonly used tests for testing the hypothesis on the presence of hysteresis are standard univariate unit root tests (Augmented Dickey-Fuller test – ADF, Phillips-Perron test – PP, or some of panel unit root tests: Levin, Lin & Chu test, Im, Pesaran & Shin test, and so on). The presence of a unit root is a signal that the data series on unemployment rates is non-stationary, i.e. that it does not seek its long-term arithmetic mean, which suggests hysteresis. This means that the actual unemployment rate does not seek the natural rate, but the natural rate changes together with the actual rate. The analysis of this type was used in a number of pioneering works in the field (e.g. Blanchard & Summers, 1986; Mitchell, 1993; Roed, 1997).

In many articles examining the presence of hysteresis the results were dependent on the selected countries and tests. Loageay & Tober (2005) investigated the presence of hysteresis in the euro area based on the unemployment data processed by the Kalman filter. The results of the ADF and Elliott-Rothenberg-Stock DF-GLS test confirmed that the hysteresis effects are present in these countries, especially in Germany. The similar results were obtained by Chang (2011) for 17 OECD countries. By analysing annual data that are processed by HP (Holdrick-Prescott) filter, Ball (2009) came to the conclusion that there is hysteresis in unemployment rates in 20 developed countries. Nickell & Nunziata (2005) empirically analysed the movements in unemployment rates in OECD countries from the 1960s to the 1990s, and found that these movements could be explained by changes in labour market institutions, but that there were no significant interactions between the average values of these institutions and various shocks. As the primary cause of rising unemployment they emphasized the unemployment benefits, minimum wage regulations and those of the safety of employees, as well as the power of labour unions. (Chou & Zhang, 2012) analysed data on the unemployment rate in G-20 countries by applying a non-linear panel unit root tests and came to the conclusion that in the case of 9 countries the hysteresis hypothesis could be rejected. (Chang & Lee, 2011) detected the existence of hysteresis in only three of observed G-7 countries by applying the threshold unit root test. Lanzafame (2010) examined the regional unemployment in Italy by using the panel unit root tests and concluded that the hysteresis hypothesis could be rejected for the period 1984−2007. Saint-Paul (2004) analysed the unemployment in some European countries since the 1990s and concluded that the difference between their unemployment rates resulted from the effectiveness of labour market reforms in different countries. (Ewing & Wunnava, 2011) applied unit root method with structural breaks in North American unemployment rates, and concluded that the unemployment rates are trend-stationary around a breaking trend. Jean & Jimenez (2011) examined the impact of immigration for natives' unemployment in OECD countries and found only a temporary influence depending upon the policy framework.

On the other hand, (Camarero & Tamarit, 2004) examined the presence of hysteresis effects in unemployment using panel data from 19 OECD countries by applying augmented ADF tests. They discovered that the hysteresis hypothesis could be rejected for all except 7 of the examined countries. Also, Camarero *et al.,* (2006) tested the hysteresis hypothesis in the same OECD countries by using annual data for unemployment rates in the period 1956–2001. Their analysis included the application of stationary panel tests with breaks and showed that the results support the hypothesis of natural rate of unemployment for the majority of the countries. The similar results for OECD countries were obtained by (Gustavsson & Osterholm 2006; Khim Sen Liew *et al.,* 2009; Kanalici Akay *et al.,* 2011).

Bornhorst & Commander (2006) investigated the persistence of regional unemployment in six transition countries. They found that the aggregate unemployment in observation period has been very persistent. The regional unemployment could be reduced by increasing the labour mobility, which could be achieved by using the policies addressing housing market imperfections and information asymmetries. Gozgor (2013) analysed unemployment persistence in 10 Central and Eastern European Countries by using the panel unit root tests in monthly unemployment rates in the period 1998–2012. The results provided evidence for the validity of the hysteresis hypothesis. The similar results were found by (Cuestas *et al.,* 2011) in the case of the eight countries from Central and Eastern Europe which joined the EU in 2004. (Ener & Arica, 2011) showed an absence of hysteresis in Turkey and 15 European countries, based on the panel approach. León-Ledesma & McAdam (2004) investigated the presence of hysteresis effects in 12 transition countries and used an EU-15 aggregate as a benchmark. By using stationarity tests they found that the unit root hypothesis could be rejected after controlling for structural changes and business cycle effects. (Bukowski *et al.,* 2013) investigated the impact of shocks and the rigidities of the labour market in Central and Eastern European transition countries and concluded that the labour demand shocks were the main determinant of unemployment variability in the short run, but also found the wage rigidities being very important factors.

It is obvious that the results in aforementioned papers are quite different; the selection of countries and applied tests has significant impact on the results. *The novelty* of this paper in comparison with the papers analysing the character of unemployment is threefold: *first*, the paper deals with comparative analysis of the selected OECD countries (that traditionally function as a market economy) and selected countries in transition (which, to a lesser or greater extent, follow suit); *second*, the time span covered over a decade and data are on a monthly basis; *third,* the impact of structural breaks on the results of the unit root test has also been examined, making them more robust.

## Data and Methodology

As already mentioned, the research included ten European OECD countries and ten countries in transition. We used monthly unemployment data from Eurostat and the OECD database, which included the percentage of unemployed persons in the total civilian labour force, from January 2000 to January 2013. The time span was determined by the availability of data for countries in transition.

Examination of hysteresis in unemployment rates was conducted by using the following unit root tests: parametric ADF test – Augmented Dickey–Fuller test (Dickey & Fuller, 1979), non-parametric PP test – Phillips–Peron test (Phillips & Perron, 1988), and KPSS test-Kwiatkowski–Phillips–Schmidt–Shin test (Kwiatkowski *et al.,* 1992). ADF and PP tests test the null hypothesis that the observed data series (unemployment rates) has a unit root. The presence of the unit root, with the appropriate level of significance, is sufficient evidence of the hysteresis existence. KPSS test complements the ADF test and tests the null hypothesis that the data series is stationary. If the data series is stationary (it has no unit root), we can conclude that there are no hysteresis effects and unemployment rates seek long-term arithmetic mean (natural rate). In addition to the univariate unit root tests, we also used the panel unit root tests: Levin, Lin & Chu test (Levin *et al.,* 2002), which assume that there is a common unit root process (autoregression coefficients are identical in cross-sectional data), and Im, Pesaran & Shin test (Im *et al.,* 2003), Fisher-ADF and Fisher PP test (Maddala & Wu, 1999; Choi, 2001), in which autoregressive coefficients' value is allowed to vary. All of these tests examine the null hypothesis that the data series has a unit root.

Except for the overall time period, the unit root tests could also be applied on two or more sub-periods, in order to confirm or reject the obtained results. In that sense, the robustness of the results was tested with Quandt-Andrews break-point test, which indicates the point in time series at which the structural break most likely occurred. Quandt-Andrews test is designed to test the null hypothesis that there is no structural break in the observed time interval. The structural break represents the point in time series when the significant change happened, which could have an impact on the results of applied tests. In the case of unemployment rates, that change could be linked with the occurrence of some critical events (shocks) which could cause an economic crisis, or with the application of some instruments of economic policy. When there is a structural break, the overall observation period is divided into two sub-periods (before and after the break date), and the panel unit root tests were applied to each of them. The Quandt-Andrews test is performed in the following way: for each time point in the interval (in our case, for each month), test statistic for the so-called Chow test is calculated as follows:

$$F = \frac{\left(\tilde{u}'\tilde{u} - \left(u_1'u_1 + u_2'u_2\right)\right)/k}{\left(u_1'u_1 + u_2'u_2\right)/(T - 2k)} \tag{2}$$

where $\tilde{u}'\tilde{u}$ is the restricted sum of squared residuals; $u_i'u_i$ is the sum of squared residuals from the sub-sample $i$; $T$ is the total number of observations; and $k$ is the number of parameters in the equation. For each time point (each month), the calculation of Chow test statistic assumes dividing the total sample into two sub-samples – before and after the time point. The sum of squared

residuals is obtained by adjusting separate equations to each sub-sample of the data, and then compared with the sum of squared residuals obtained by adjusting a single equation to the entire sample. Quandt-Andrews test implies finding the time point with the highest value of the Chow test statistic between two dates, for instance $\tau_1$ and $\tau_2$:

$$MaxF = \max_{\tau_1 \leq \tau \leq \tau_2} \left( F(\tau) \right) \qquad (3)$$

where the two test statistics are calculated: Likelihood Ratio *F*-statistic (LR *F*-statistic, based on the comparison of the restricted and unrestricted sums of squared residuals), and Wald *F*-statistic, calculated from a standard Wald test provided that parameter coefficients in the equation are the same in all sub-samples. As Hansen's method (1997) suggested, 15 % of observations (the first

and the last 7,5 %) were excluded from the overall sample to prevent degeneration of the test statistic values.

## Empirical Results and Discussion

The results of the summary statistics of monthly unemployment rates in the observation period in both groups of countries are shown in Table 1. As we can see, their mean values are significantly different; in the countries in transition average unemployment rates are higher with double-digit values in the case of six countries. In the group of OECD countries, the highest average unemployment rates are in Spain and France, and the lowest in Norway and the Netherlands. In the second group, the highest average values of unemployment rate are in Slovakia and Poland and the lowest in Slovenia and Romania.

Table 1

**Descriptive statistics of monthly unemployment rates in the period 2000:01–2013:01**

| | OECD countries | | | | | | | | | | Countries in transition | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | Mean | Median | Max. | Min. | Std. dev. | Skewness | Kurtosis | Jarque-Bera | *p* - value | Observ. | Country | Mean | Median | Max. | Min. | Std. dev. | Skewness | Kurtosis | Jarque-Bera | *p* - value | Observ. |
| Belgium | 7,68 | 7,70 | 8,70 | 6,30 | 0,59 | -0,30 | 2,19 | 6,67 | 0,036 | 157 | Bulgaria | 11,72 | 11,30 | 19,90 | 5,10 | 4,20 | 0,40 | 2,22 | 8,23 | 0,016 | 157 |
| Denmark | 5,31 | 5,00 | 7,80 | 3,10 | 1,45 | 0,47 | 1,89 | 13,89 | 0,001 | 157 | Czech R. | 7,13 | 7,30 | 9,30 | 4,30 | 1,20 | -0,87 | 3,18 | 19,81 | 0,000 | 157 |
| Finland | 8,24 | 8,30 | 10,00 | 6,20 | 0,91 | -0,47 | 2,39 | 8,19 | 0,017 | 157 | Estonia | 10,29 | 10,30 | 19,00 | 3,90 | 3,60 | 0,12 | 2,56 | 1,68 | 0,432 | 157 |
| France | 9,05 | 9,20 | 10,80 | 7,40 | 0,73 | -0,16 | 2,41 | 2,95 | 0,229 | 157 | Hungary | 7,88 | 7,40 | 11,30 | 5,50 | 2,11 | 0,52 | 1,70 | 18,03 | 0,000 | 157 |
| Germany | 8,34 | 8,10 | 11,50 | 5,40 | 1,69 | 0,03 | 2,19 | 4,28 | 0,118 | 157 | Latvia | 12,48 | 12,40 | 21,30 | 6,00 | 4,08 | 0,31 | 2,46 | 4,46 | 0,108 | 157 |
| Italy | 8,25 | 8,20 | 11,90 | 5,80 | 1,30 | 0,37 | 2,90 | 3,71 | 0,156 | 157 | Lithuania | 11,82 | 12,90 | 18,50 | 3,50 | 4,73 | -0,44 | 1,93 | 12,61 | 0,002 | 157 |
| Netherlands | 4,02 | 4,10 | 6,00 | 2,50 | 0,92 | 0,05 | 1,82 | 9,20 | 0,010 | 157 | Poland | 13,79 | 13,70 | 20,30 | 6,80 | 4,74 | 0,03 | 1,34 | 18,13 | 0,000 | 157 |
| Norway | 3,46 | 3,40 | 4,70 | 2,30 | 0,61 | 0,14 | 2,30 | 3,61 | 0,165 | 157 | Romania | 6,99 | 7,00 | 8,60 | 5,60 | 0,60 | -0,10 | 2,82 | 0,45 | 0,798 | 157 |
| Spain | 13,78 | 11,40 | 26,40 | 7,90 | 5,45 | 0,92 | 2,42 | 24,31 | 0,000 | 157 | Slovenia | 6,50 | 6,40 | 9,60 | 4,20 | 1,23 | 0,34 | 3,14 | 3,09 | 0,213 | 157 |
| G. Britain | 5,98 | 5,30 | 8,40 | 4,60 | 1,29 | 0,70 | 1,73 | 23,38 | 0,000 | 157 | Slovakia | 15,23 | 14,60 | 19,70 | 8,80 | 3,17 | -0,23 | 1,87 | 9,76 | 0,008 | 157 |

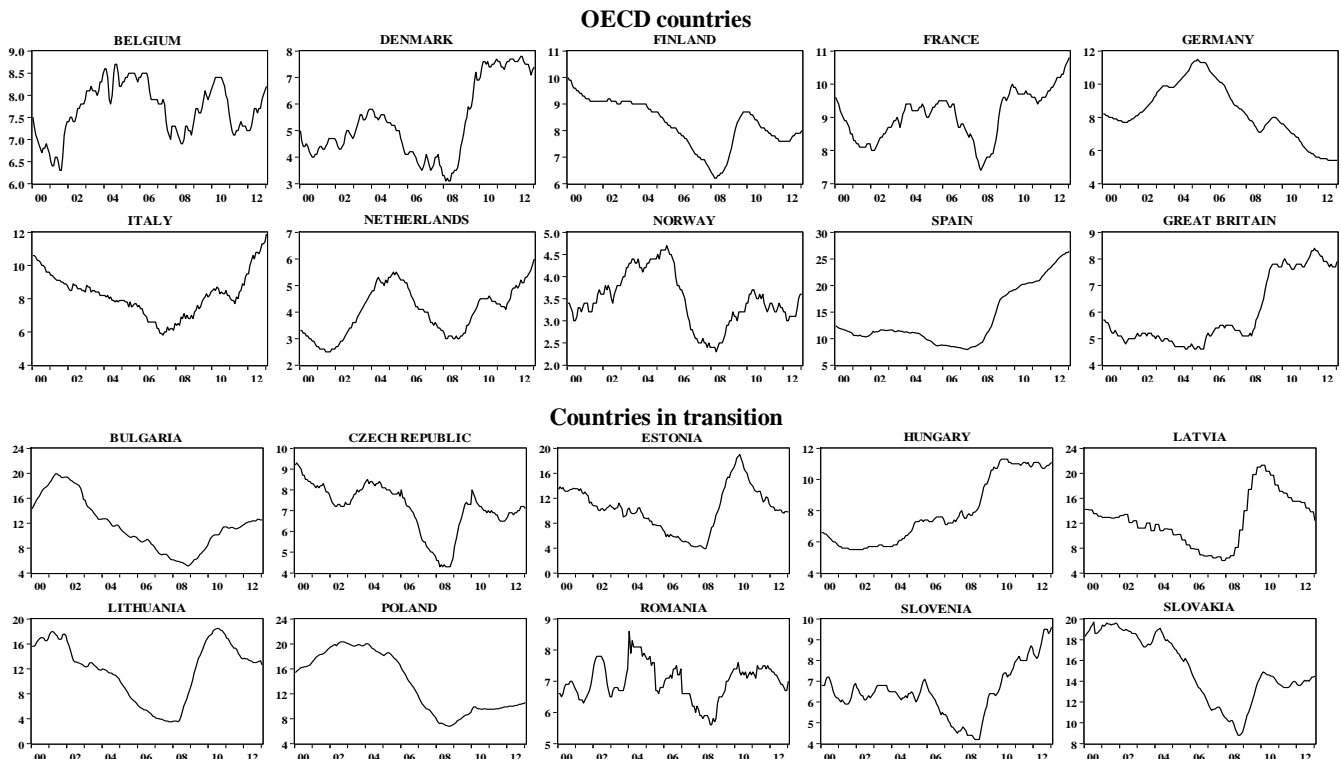*Source: Eurostat, OECD Database, authors' calculation.*



**Figure 1.** The graphical presentation of monthly unemployment rates in observed countries in the period 2000:01−2013:01

The results of standard deviation should also be noted. In OECD countries, the values of standard deviation (as the unemployment rates deviations from their mean values) are much lower than in the countries in transition, indicating that the unemployment fluctuations have been more prominent in these countries.

The monthly unemployment rates in the analysed countries in the period 2000:01–2013:01 are presented in Figure 1. It can be seen that there were significant fluctuations in the unemployment rates, but the unemployment patterns are similar in each group of the countries. The impact of the Great Recession on the unemployment rates is more persistent in the case of the countries in transition, indicating that the

character of unemployment in these countries might be different in comparison with OECD countries.

Table 2 presents the results of the univariate unit root tests. According to the ADF test, the hysteresis is confirmed in all OECD countries. On the other hand, the results of the ADF test indicate the presence of hysteresis in all of the transition countries except in Bulgaria, Estonia and Romania. The results of the KPSS test did not confirm the non-stationarity (hysteresis) in unemployment rates only in Estonia, Lithuania and Romania. Evidently, the hysteresis hypothesis cannot be rejected for the majority of the countries.

Table 2

**Results of the selected univariate unit root tests in the period 2000:01–2013:01**

| OECD countries | | | | Countries in transition | | | |
|---|---|---|---|---|---|---|---|
| **Country** | **ADF test** | **KPSS test** | **PP test** | **Country** | **ADF test** | **KPSS test** | **PP test** |
| Belgium | -2,1754 (5) | 0,2147 [10] | -1,8488 [8] | Bulgaria | -2,6594 (7) [*] | 0,8594 [10] [***] | -1,0177 [9] |
| Denmark | -2,3123 (9) | 0,6802 [10] [**] | -0,5294 [5] | Czech Rep. | -2,3727 (5) | 0,6243 [10] [**] | -1,9900 [8] |
| Finland | -2,1711 (3) | 0,8404 [10] [***] | -1,9951 [9] | Estonia | -2,9637 (7) [**] | 0,2248 [10] | -1,6203 [8] |
| France | -2,3516 (9) | 0,5199 [10] [**] | -0,9431 [7] | Hungary | -0,1651 (4) | 1,3595 [10] [***] | 0,2193[7] |
| Germany | -0,8344 (2) | 0,7487 [10] [***] | -0,0406 [9] | Latvia | -1,4769 (12) | 0,3723 [10] [*] | -1,4522[8] |
| Italy | -0,3765 (12) | 0,3587 [10] [*] | -0,3686 [8] | Lithuania | -2,3641 (13) | 0,3047 [10] | -1,3562 [9] |
| Netherlands | -2,0234 (9) | 0,4191 [10] [*] | -0,5529 [8] | Poland | -1,5005 (5) | 1,1604 [10] [***] | -0,6029 [9] |
| Norway | -2,0086 (5) | 0,3648 [10] [*] | -1,5045 [7] | Romania | -3,0531 (3) [**] | 0,1150 [10] | -2,6215 [6] [*] |
| Spain | -0,1085 (2) | 0,9841 [10] [***] | 1,4182 [9] | Slovenia | 0,4482 (4) | 0,3859 [10] [*] | 0,0488 [4] |
| G. Britain | -0,6057 (4) | 1,1557 [10] [***] | -0,2321 [8] | Slovakia | -1,3221 (1) | 1,0127 [10] [***] | -1,2006 [8] |

*Notes: For ADF test, the number in parenthesis indicates the lag order selected based on the Akaike information criterion. The number in brackets (for KPSS and PP test) indicates the truncation for the Bartlett Kernel, as suggested by the Newey-West test (Newey & West, 1987). For PP test were calculated the one-sided p-values.*
*\*, \*\* and \*\*\* denotes test statistic significance at the 10 %, 5 % and 1 %, respectively.*
*Source: Eurostat, OECD Database, authors' calculations.*

Apart from these tests, some of the panel unit root tests can be applied as well. These tests include the interdependence between the unemployment rates in the observed countries. The results are presented in table 3 and they indicate that the hysteresis effects are present in the group of OECD countries, while the hysteresis hypothesis can be rejected in two out of four tests (Levin, Lin & Chu

t\* test and ADF - Fisher Chi-square test) when we analyse the group of the countries in transition. However, bearing in mind that some of crisis events occurred during the observation period, the validity of the results needs to be checked, since the presence of structural breaks may lead to wrong conclusions.

Table 3

**Results of panel unit root tests in the period 2000:01–2013:01**

| OECD countries | | | Countries in transition | | |
|---|---|---|---|---|---|
| **Test** | **Statistic** | **p-value** | **Test** | **Statistic** | **p-value** |
| Null: Unit root (assumes common unit root process) | | | Null: Unit root (assumes common unit root process) | | |
| *Levin, Lin & Chu t\** | 0,2477 | 0,5978 | *Levin, Lin & Chu t\** | -2,1178 | 0,0171 |
| | | | | | |
| Null: Unit root (assumes individual unit root process) | | | Null: Unit root (assumes individual unit root process) | | |
| *Im, Pesaran and Shin W-stat* | 0,0344 | 0,5137 | *Im, Pesaran and Shin W-stat* | -0,9095 | 0,1815 |
| *ADF - Fisher Chi-square* | 19,4368 | 0,5137 | *ADF - Fisher Chi-square* | 29,3542 | 0,0810 |
| *PP - Fisher Chi-square* | 7,2899 | 0,9956 | *PP - Fisher Chi-square* | 12,7857 | 0,8864 |

*Notes: Probabilities for Fisher test are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.*
*Source: Eurostat, OECD Database, authors' calculation.*

Quandt-Andrews test was applied at unemployment rate data, which enables determination of date point at which the structural break occurred. Table 4 shows the test results for both groups of countries. The first step included the whole period (2000:01–2013:01). In the group of OECD countries, the date point with the highest value of

LR and Wald F-statistic is June 2007 (2007:06). So, based on this structural break, the overall observation period could be divided into two sub-periods: 2000:01–2007:05 and 2007:07–2013:01. Since the break date in the first sub-period (2002:07) has greater value of the test statistic, it is included in the table. The break dates in this group of

countries can be associated with the well-known crisis events: in July and September 2002 the escalation of stock market crisis occurred, which affected the real sector across the North American and European economies and led to the increase in the unemployment rate. The second break date (2007:06) could be related to the beginning of the Great Recession, which also resulted in the large growth of unemployment.

In the group of transition countries, the date point with the highest value of LR and Wald F-statistic is in December 2005 (2005:12). Hence, the overall observation period can be divided into two sub-periods: 2000:01–

2005:11 and 2006:01–2013:01. The break date in the second sub-period (2009:07) has greater value of the test statistic and it is included in Table 4. The first break date (2005:12) can be explained by the fact that eight out of ten observed countries in transition joined the European Union in 2004, and that the break date represents the response of unemployment rates to that event. The second break date in the countries in transition (2009:07) can be associated with delayed reaction of unemployment rates on the effects of the Great Recession which started in 2007.

Table 4

**Results of Quandt-Andrews test of structural break**

| OECD countries | | | | Countries in transition | | | |
|---|---|---|---|---|---|---|---|
| Observed period | Break date | Maximum LR F-stat. [*p*-value] | Maximum Wald F-stat [*p*-value] | Observed period | Break date | Maximum LR F-stat. [*p*-value] | Maximum Wald F-stat [*p*-value] |
| 2000:01-2013:01 | 2007:06 | 20,6389 [0,0000] | 206,3889 [0,0000] | 2000:01-2013:01 | 2005:12 | 73,9329 [0,0000] | 739,3285 [0,0000] |
| 2000:01-2007:05 | 2002:07 | 13,5655 [0,0000] | 135,6551 [0,0000] | 2006:01-2013:01 | 2009:07 | 27,1545 [0,0000] | 271,5451 [0,0000] |

*Notes: Probabilities calculated using Hansen's (1997) method.*
*Source: OECD Database, authors' calculation.*

Respecting the results of the Quandt-Andrews test, the series of panel unit root test could be applied to sub-periods obtained by dividing the overall period by structural break dates. For each group of countries there are three sub-periods (because we found two significant break dates). Table 5 presents the results of the panel unit root tests for both groups. In the case of OECD countries, the hysteresis hypothesis can be rejected for the first and the third sub-period (2000:01–2002:06 and 2007:07–2013:01, respectively). According to *p*-values, there is no evidence

that hysteresis hypothesis can be rejected for the sub-period 2002:08–2007:05. Since the sub-period covers several years before the Great Recession, when the unemployment rates were declining in many countries, it could be concluded that the actual rate of unemployment "pulled" the natural rate downwards, which explains the existence of hysteresis in that sub-period. Hence, we can conclude that the natural rate hypothesis better represents the movement of unemployment rates in OECD countries.

Table 5

**Results of the panel unit root tests for sub-periods**

| OECD countries | | | | | | | Countries in transition | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test | 2000:01–2002:06 | | 2002:08–2007:05 | | 2007:07–2013:01 | | Test | 2000:01–2005:11 | | 2006:01–2009:06 | | 2009:08–2013:01 | |
| | Statistic | *p*-value | Statistic | *p*-value | Statistic | *p*-value | | Statistic | *p*-value | Statistic | *p*-value | Statistic | *p*-value |
| Null: Unit root (assumes common unit root process) | | | | | | | Null: Unit root (assumes common unit root process) | | | | | | |
| Levin, Lin & Chu t* | -3,0674 | 0,0011 | 3,3402 | 0,9996 | -4,46980 | 0,0000 | Levin, Lin & Chu t* | 1,6773 | 0,9533 | -1,2583 | 0,1041 | -2,5119 | 0,0060 |
| Null: Unit root (assumes individual unit root process) | | | | | | | Null: Unit root (assumes individual unit root process) | | | | | | |
| Im, Pesaran and Shin W-stat | -1,6193 | 0,0527 | 4,4286 | 1,0000 | -1,86996 | 0,0307 | Im, Pesaran and Shin W-stat | 2,0019 | 0,9774 | 1,4417 | 0,9253 | -1,8544 | 0,0318 |
| ADF – Fisher Chi-square | 29,4657 | 0,0790 | 5,8553 | 0,9991 | 45,5512 | 0,0009 | ADF – Fisher Chi-square | 21,4480 | 0,3712 | 12,9061 | 0,8814 | 37,7908 | 0,0094 |
| PP - Fisher Chi-square | 47,8495 | 0,0004 | 7,3167 | 0,9955 | 18,6435 | 0,5451 | PP - Fisher Chi-square | 13,0654 | 0,8746 | 21,5810 | 0,3637 | 39,2465 | 0,0062 |

*Notes: Probabilities for Fisher test are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.*
*Source: OECD Database, authors' calculation.*

On the other hand, in the case of the countries in transition the results indicate the strong evidence of the hysteresis effects in the first and the second sub-period (2000:01–2005:11, and 2006:1–2009:6). The hysteresis hypothesis can be rejected only for the sub-period 2009:07–2013:01. It could be explained by the fact that the impact of the Great Recession on the countries in transition is still present and, as a result, the unemployment rates became stationary at higher levels.

## Conclusion

In order to propose appropriate policy measures, it is essential to establish the exact character of unemployment in a given country. The presence of hysteresis effects on unemployment indicates that economic policy could be effective; by increasing aggregate demand, the actual rate of unemployment could be reduced, together with the natural rate. However, if unemployment rate patterns are in accordance with the natural rate concept, then this structural unemployment can be decreased by applying

selected institutional measures (labour training and education, the reduction of unemployment benefits, increasing the labour market flexibility and the mobility of labour, and so on). The reduction of unemployment can also be achieved by affecting the bargaining power of labour unions. If a union is able to raise the minimum wage for their members above the equilibrium wage, then wages will be higher but fewer workers will be employed. In that case, the solution might be the reduction of labour union power. However, if the goal of the union is an increase in the number of employed workers, than the lowering of the union power might increase the unemployment rate.

In this paper, the character of unemployment was examined in two groups of countries: the selected European OECD countries and Central and Eastern European countries in transition. By applying univariate and panel unit root tests on monthly unemployment rates for overall period, the analysis showed that the hysteresis effects are present in the majority of the observed countries. However, bearing in mind that the observation period was characterised by the presence of significant crisis events, the robustness of the results has been checked by the application of structural break analysis.

The analysis showed that there are two significant break dates in each group of countries. In the case of selected OECD countries, these dates are July 2002 and June 2007. Both dates can be associated with two crisis events (the escalation of stock market crisis in 2002 and the Great Recession in 2007). In the countries in transition, the significant break dates are December 2005 and July 2009. The first break date is related with a process of accessing of the majority of these countries to the European Union in 2004, and represents delayed reaction of unemployment rates. The second break date represents the delayed effect of the Great Recession on the countries in transition.

By including the structural breaks in unemployment rates in the overall observation period, we can conclude that panel tests, excluding one sub-period (2002:08–2007:05), indicate the absence of hysteresis in analysed OECD countries. In other words, the results show that the hypothesis of the natural rate of unemployment is more

acceptable. On the other hand, the results for the countries in transition indicate that the hysteresis hypothesis cannot be rejected for overall period.

Bearing in mind our research hypothesis, we can make the following conclusions. According to the results of the panel unit root tests, the first hypothesis cannot be rejected. In other words, the hysteresis effects are discovered in both groups of countries. However, when we include the structural breaks into analysis, there is a difference in the character of unemployment: in OECD countries the concept of the natural rate of unemployment better represents the movement of unemployment, while the hysteresis hypothesis is more suitable for explanation of unemployment rate movement in the countries in transition. Accordingly, the second hypothesis can be accepted, as well. Namely, the introduction of structural breaks into analysis has significant effects on the results of hysteresis; when we eliminate the impact of the break dates of the unit root tests, the results are quite different. Finally, according to the results of the unit root tests with structural breaks, we can conclude that the third hypothesis can be accepted: the movement of unemployment rates in the countries in transition can be explained by hysteresis hypothesis, while the natural rate concept can be used to explain the unemployment in OECD countries.

However, there are some limitations of the research that should be mentioned. In order to propose proper policy measures for decreasing the unemployment rates, it is necessary to respect the differences among the countries. First of all, the characteristics of labour markets are not the same in all the countries (the level of competition on the market, market flexibility, the goals of labour unions, etc.). In addition, in some countries there are some institutional arrangements, e.g. minimum wage policy, which narrow the scope for acting of the implemented measures for unemployment reduction. Some of the future research, incorporating these variables as well, could come to more complete data. In addition, higher data availability in the countries in transition related to union density, long-term unemployed, etc. will allow much more comprehensive research.

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