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UNEMPLOYMENT AND COMMON SMOOTH TRANSITION TRENDS IN CENTRAL AND EASTERN EUROPEAN COUNTRIES

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Unemployment and common smooth transition trends in Central and Eastern European Countries

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Abstract

In the present paper we analyse the existence of common nonlinear trends in several of Central and Eastern European Countries in order to gain some insight about the degree of labour market integration within the area. In order to do so, we test for the order of integration of the unemployment rates, by applying the Leybourne et al. (1998) and Kapetanios et al. (2003) nonlinear unit root tests. Our results pinpoint the fact that five up to eight unemployment rates are stationary around a nonlinear trend and, by means of Anderson and Vahid (1998) approach, we also find that there is a common trend that drives the long run behaviour of that variable in these countries.

J.E.L. Classification: C32, E24

Key words: Unemployment, Central and Eastern Europe, unit roots, smooth transition, nonlinearities.

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1 Introduction

The study of the long run properties of unemployment rates hasw become one of the corner stones of current applied economics studies. This is not surprising given the important jump in global unemployment rates during the most recent years of the 2008-2009 global financial crisis. Higher unemployment has not only economic but also social and political implications (see for instance Layard et al., 2005).

The phenomenon of unemployment hysteresis has received increasing attention during the past few decades, reflecting the importance of unemployment in modern societies. It is noticeable how persistent unemployment has been in Europe during the last decades, a trend that casts doubt about a natural rate of unemployment (NAIRU) as suggested by Phelps (1968, 1972) and Friedman (1968). According to this theoretical view, there is an equilibrium rate of unemployment in the long run with no trade-off between output and inflation, i.e. the Phillips curve is vertical. However, there is some scope for a trade-off between unemployment and inflation in the short run, implying the existence of a classic Phillips curve relationship. This view point implies that the unemployment rate is a mean reverting process and shocks have only transitory effects. A less restrictive version of the NAIRU theory is the one followed by the structuralists; this assumes that changes in the macroeconomic fundamentals may affect the NAIRU permanently, i.e. structural changes (see Layard et al., 2005, for a summary of this theory), shifting from one equilibrium to another. Statistically, the structuralist theory implies that unemployment rates may be stationary process around a changing or time varying equilibrium value (Papell et al. 2000).

On the other hand, hysteresis in unemployment states that unemployment shocks have permanent effects over the long run path of the variable and therefore the variable will be well characterised as a unit root process. There are a number of possible justifications for explaining unemployment hysteresis. Examples include the existence of unions with enough power, soft protection schemes, too high real wages and social the stigma of being long term unemployed (Phelps, 1972; Blanchard and Summers, 1986, 1987; Clark, 2003, and Layard et al., 2005, amongst others). Also, it is possible to observe a slow speed of adjustment towards the equilibrium (or even moving equilibrium) of unemployment rates. This is the so-called "persistence" hypothesis which implies the unemployment rate may be characterised as a near unit root or a fractional integrated process (Gil-Alana, 2001, 2002, amongst others).

In this paper we focus on the analysis of the unemployment statistical properties for a pool of Central and Eastern European Countries: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic and Slovenia. The selection of this group of countries is based on the relative importance of these economies' labour markets on the future of the European Union's labour markets, given that these countries have recently become member states. Their membership in the EU has important implications to the migration movements from the CEECs to the EU, and vice versa. In this paper we also attempt to analyse whether there is a common trend driving these countries' unemployment rates in order to gain some insights about the apparent co-movement observed between some of them. To achieve our purpose, we apply the Leybourne et al. (1998) unit root test that take into account the possibilities of structural changes approximated by nonlinear smooth transition trends. Further, in order to capture the possibility of an asymmetric adjustment towards the equilibrium along with nonlinear trends, we apply the Kapetanios et al. (2003) (KSS) test which generalises the alternative hypothesis to global stationary nonlinear exponential smooth transition autoregression (ESTAR) process.

In recent contributions, Camarero and Ordóñez (2006) and Franchi and Ordóñez (2008) have analysed whether there is a common trend amongst European Union's unemployment rates by means of applying Bierens' (2000) and Anderson and Vahid's (1998) common nonlinearities methodology, finding that there is a common nonlinear trend that drives European unemployment rates. To the best of our knowledge, the present paper is the first attempt to analyse this issue for a group of CECCs. However, the issue of whether CEECs unemployment fulfils the NAIRU or the hysteresis hypothesis has received rencent attention. For instance, León-Ledesma and McAdam (2004) and Camarero et al. (2005) find evidence against the hysteresis hypothesis applying unit root tests with structural breaks. In addition, Camarero et al. (2008), by means of applying test for the order of integration of CEECs' unemployment rates for panel data taking into account structural changes and find evidence in favour of the shifting NAIRU hypothesis.

The contribution of this paper is twofold. First, we apply unit root tests that take into account two sources of nonlinearities, i.e. in the deterministic components and in the autoregressive parameter; and second, we test whether there is a common nonlinear trend between those stationary unemployment rates.

The remainder of this paper is organised as follows. In the next section we present a summary of the econometric methodology applied to test of unit roots and common nonlinear trends. Section 3 presents the results and the final section, summarises the main conclusions.

2 Econometric methodology

In order to analyse the existence of common trends among CEECs unemployment rates, we first need to test for unit roots in the data.

A number of authors have provided evidence about the fact that traditional (linear) unit root tests may suffer from power problems when the data generating process (DGP) is in fact nonlinear. Thus, nonlinearities in the DGP may be present in two different, though not exclusive, ways. First, nonlinearities may affect the variable in the form of structural changes in the deterministic components (see Phillips and Perron, 1988, and West, 1987 among others). This supports the structuralist view of unemployment rates, i.e. changes in the fundamentals may shift the natural rate of unemployment in a permanent way. However, a broken time trend is a particular case of a nonlinear deterministic trend. Following Leybourne et al. (1998) and Bierens (1997), among others, even unit root tests that control for structural changes may tend to overaccept the null hypothesis of unit root when the deterministic components in the auxiliary regressions are not properly specified. This makes economic sense bearing in mind that some macroeconomic variables, such as the unemployment rates, may shift smoothly rather than suddenly between different equilibrium values. Therefore, in this article we follow Leybourne et al. (1998) approach in other to approximate a nonlinear trend for the unemployment rates for the CEECs. For the economic point of view, the fact that the unemployment was a stationary process around a nonlinear deterministic trends, implies a time varying equilibrium unemployment. Leybourne et al. (1998) developed a unit root test against the alternative hypothesis of stationarity around a logistic smooth transition (LSTR) nonlinear trend. That is,

$$H_0 : u_t = u_{t-1} + \varepsilon_t$$

versus the alternative

$$H_1 : u_t = \alpha_1 + \alpha_2 S_t(\gamma, \tau) + \beta_1 t + \beta_2 t S_t(\gamma, \tau) + v_t$$

The function S_t is a logistic one, as follows

$$S_t = \frac{1}{1 + e^{-\gamma(t-\tau T)}} \tag{2.1}$$

where u_t is the unemployment rate and v_t is an *IID* stationary process, t is time and T is the total number of observations. Note that equation (2.1) implies the existence of two regimes, and the shifts bewteen regimes is smooth rather than sudden. This makes sense from the economic point of view, provided that at the aggregate level, agents do not tend to make decisions at the same time (Leybourne et al, 1998). In particular, workers' behaviour need not be the same, bearing in mind that differen individuals may have different job hunting skills, depreciation skills, etc. Further, firms' decisions of hiring/firing workers are not necessarily taken at the same time, reflecting the fact that this decision is normally taken in regards to the marginal revenue of the labour force, which is likely to differ between different companies.

In order to perform this test in practise, Leybourne et al. (1998) propose a procedure that involves two steps. In the first step, the series are detrended by means of a Nonlinear Least Squares regression, i.e. $u_t = \hat{\alpha}_1 + \hat{\alpha}_2 S_t(\hat{\gamma}, \hat{\tau}) + \hat{\beta}_1 t + \hat{\beta}_2 S_t(\hat{\gamma}, \hat{\tau}) + \hat{v}_t$. The second step consists of applying the Augmented Dickey-Fuller (ADF) test to the residuals $\hat{v}_t$. Given that the ADF test is applied to the detrending series, Leybourne et al. (1998) obtain the critical values by Montecarlo simulations.

The second type of nonlinearities is related to the possibility of an asymmetric speed of adjustment towards the equilibrium, i.e. the further the variable deviates from its fundamental equilibrium, the faster will be the speed of mean reversion[1]. Intuitively, and in the case of the unemployment, this implies that the unemployment rate may be a unit root process for a given threshold of values (inner regime), but a unit root when the variable reaches the outer regime. So, given that there are cost associated to hiring/firing workers, firms will not change their staff for small changes in the fundamentals (policy measures) (see Kapetanios et al., 2003 (KSS), among others), and the variable behaves as a unit root in the inner regime.

In order to take into account the possibility of asymmetric speed adjustment towards equilibrium when testing for unit roots, we apply the KSS unit root test to the detrended[2] series $\hat{v}_t$. These authors propose a unit root test that takes into account the possibility of smooth transitions between regimes. Thus, the null hypothesis of unit root is tested against the alternative of a globally stationary exponential smooth transition autoregressive (ESTAR) process, i.e.

$$x_t = \beta x_{t-1} + \phi x_{t-1}(1 - e^{-\theta x_{t-1}^2}) + \epsilon_t \tag{2.2}$$

where $\epsilon_t \sim iid(0, \sigma^2)$. Equation (2.2) can be reparameterised as

[1] Asymmetric speed of adjustment differs from the concept of asymmetric adjustment, i.e. the latter implies that the variable reacts in a different manner depending on the sign of the shock. This is a characteristic of logistic smooth transition functions.

[2] We use for the detrending the same LSTR functions than for the Leyborune et al.'s (1998) tests.

$$\Delta x_t = \alpha x_{t-1} + \gamma x_{t-1}(1 - e^{-\theta x_{t-1}^2}) + \epsilon_t. \tag{2.3}$$

KSS impose $\alpha = 0$, implying that the variable is a nonstationary process in the central regime. In order to test the null hypothesis of unit root $H_0 : \theta = 0$ against $H_1 : \theta > 0$ outside of the threshold[3], Kapetanios et al. (2003) propose a Taylor approximation of the ESTAR model since, in practice, the coefficient γ cannot be identified under H_0. Thus, under the null, the model becomes

$$\Delta x_t = \delta x_{t-1}^3 + \eta_t \tag{2.4}$$

where η_t is an error term. Now, it is possible to apply a t-test to analyse whether x_t is a nonstationary process, $H_0 : \delta = 0$, or is a nonlinear stationary process, $H_1 : \delta < 0$. Given that the critical values for the KSS test are not valid for the detrending series using the nonlinear specification, we have obtained the critical values by Montecarlo simulations. By means of applying the KSS test for the detrended series, we are taking into account nonlinearities in the deterministic components and in the autoregressive parameter at the same time.

Finally, in order to test for common logistic smooth transition autoregression (LSTAR) nonlinearities, we apply Anderson and Vahid's (1998) approach, which consists in the

[3]The process is globally stationary provided that $-2 < \phi < 0$.

following. Let

$$y_t = \pi_{A0} + \pi_A(L)y_t + F(z_t)[\pi_{B0} + \pi_B(L)y_t] + \epsilon_t \qquad (2.5)$$

be the multivariate version of a smooth transition autoregression (STAR)(p) model, where y_t is the 5×1 vector of unemployment rates, $\pi_i(L)$, $i = A, B$, is a matrix polynomial of degree p in the lag operator, ϵ_t is *IID*, and $F(z_t)$ is a diagonal matrix containing the transition functions $S_t(\gamma, \tau)$ for each series. Testing for common nonlinearities consists in testing whether there exist α such that $\alpha' y_t$ is linear in mean. The test statistic is based on canonical correlations and is asymptotically distributed as $\chi^2_{(3p-1)5s+s^2}$; non-rejection of the null hypothesis provides evidence of the presence of at most $n-s$ common nonlinearities.

3 Empirical results

3.1 Unit root analysis

In this section we analyse whether the unemployment rates for the aforementioned pool of CEECs, i.e. Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic and Slovenia, are stationary processes around a nonlinear logistic trend. In this paper we have used the monthly harmonised and seasonally adjusted unemployment rates for 1998:1-2007:12 from *Eurostat*. Note that by starting in 1998, we are analysing the unemployment co-movement in the aftermaths of the Russian crisis.

In Table 1 we display the results of the Leybourne et al. (1998) unit root test. Hence, we find evidence of stationarity around a nonlinear trend for Hungary, Latvia, Poland and Slovenia. As noted already, we have applied the KSS test for the remaining countries, bearing in mind that not taking into account the possibility of an asymmetric speed of adjustment, may affect the power of the test. In Table 2 we summarise the results; we only find evidence of a globally stationary process around a nonlinear trend for the case of the Slovak Republic.

In Figure 1 we display the graphs of the stationary series along with the estimated nonlinear components. It can be seen that the long run paths of the Latvia's and Slovenia's unemployment rates are quite similar. Also, there appears to be a clear co-movement between Poland's and Slovak Republic's rates of unemployment. A different picture appears to emerge from the Hungarian unemployment rate. In the next section we test for the existence of common nonlinearites among these five countries.

3.2 Co-movement analysis

In the last section we gave evidence of nonlinear trend-stationary behaviour for five out of eight unemployment rates. Next we test whether the apparent co-movement between the observed unemployment rates (see Figure 2) for Latvia, Poland, Slovenia and Slovak Republic can be adequately described by a common nonlinear component[4]. In order to

[4]Although the Hungarian unemployment rate exhibits nonlinear trend-stationarity behaviour, it does not present a clear co-movement with the rest of the countries. For this reason Hungary has been excluded in the analysis of common nonlinearities. Yet, if the Hungarian unemployment rate is included

address this issue we test for common LSTAR nonlinearities following the methodology proposed by Anderson and Vahid(1998).

The results are presented in Table 3 and have been obtained using the trend as the (common) transition variable. The test for common LSTAR nonlinearity rejects the null that there are no nonlinear factors in the system in favour of the alternative of at least one common LSTAR nonlinearity. Furthermore, the test fails to reject the null that there is at most one such factor at the 5% significance level. Thus, the tests provide evidence that a common force generates nonlinear behaviour in each of the unemployment rates.

Our results pinpoint the fact that following the aftermath of the Russian crisis, these five unemployment rates have been driven by common factors, probably by the effect of the integration process towards a unified European labour market.

4 Conclusion

Aimed at contributing to the empirical literature on the unemployment rates' properties of the CEECs, we have analysesd (1) whether the unemployment rates on this group of countries is a stationary process around a nonlinear trend and (2) whether there is a common nonlinear deterministic trends amongst those stationary ones. Our results point to the hypothesis of a time varying NAIRU for five out to eight countries, accepting also the hypothesis that there is a common nonlinear trend that drives the unemployment

in the analysed set of countries, results do not vary.

rates.

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Table 1: **Leybourne et al. (1998) unit root tests results**

Country	**lags**	**ADF(t)**
Czech Republic	12	-2.06
Estonia	2	-2.63
Hungary	9	-3.17^{*}
Latvia	9	-3.28^{**}
Lithuania	5	-2.61
Poland	5	-5.07^{***}
Slovak Republic	0	-2.18
Slovenia	0	$-2.90^{(*)}$

Note: The order of lag to compute the test has been chosen using the AIC. The critical values are at the 10%, 5% and 1%, -2.94, -3.29 and -3.89. Rejection of the null hypothesis at the 10%, 5% and 1% significance level is given by *, ** and ***, respectively. The critical values for the above tests have been computed by Monte Carlo simulation based upon 10,000 replications.

Table 2: Kapetanios et al. (2003) nonlinear unit root test results over the residuals

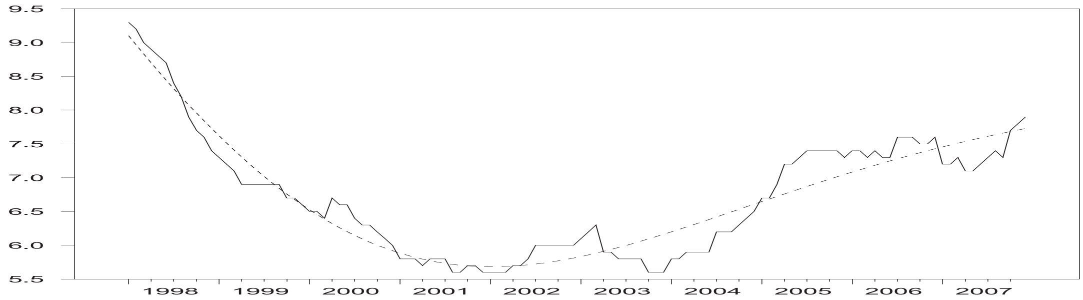
Country	**Lags**	**KSS(t)**
Czech Republic	12	-1.42
Estonia	4	-2.69
Lithuania	0	-2.02
Slovak Republic	12	-4.20**

Note: The order of lag for the auxiliary regression has been selected by the AIC. Critical values at the 10%, 5% and 1% for the KSS(t)test are -3.55, -4.19 and -5.49, respectively and have been computed by Monte Carlo simulation with 10,000 replications. Rejection of the null hypothesis at the 10%, 5% and 1% significance level are given by the symbols *, ** and ***, respectively.

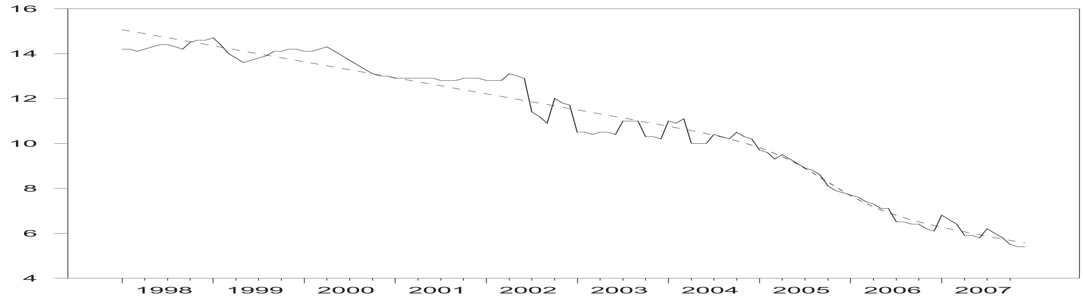
Table 3: Tests for common LSTAR nonlinearities

Null hypothesis	**Alternative hypothesis**	**p-value**
The system of unemployment rates is linear	At least one of the unemployment rates has an LSTAR nonlinearity	0.001
Unemployment rates have at most 1 common LSTAR nonlinearity	Unemployment rates have at least 2 of these LSTAR nonlinearities	0.983
Unemployment rates have at most 2 common LSTAR nonlinearity	Unemployment rates have at least 3 of these LSTAR nonlinearities	0.977
Unemployment rates have at most 3 common LSTAR nonlinearity	Unemployment rates have at least 4 of these LSTAR nonlinearities	0.963

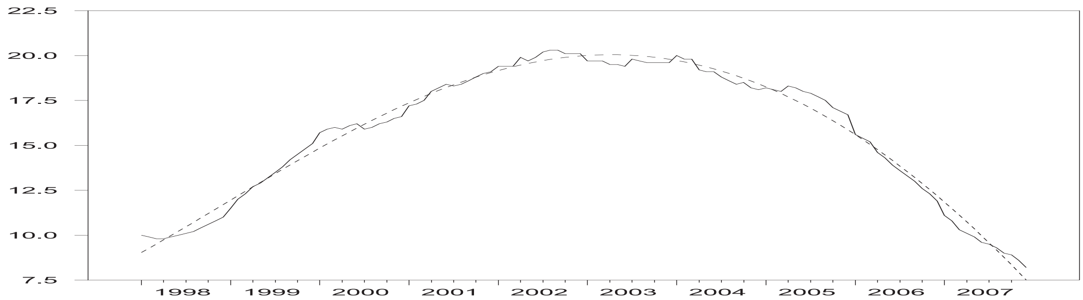
Figure 1: Unemployment rates and nonlinear trends



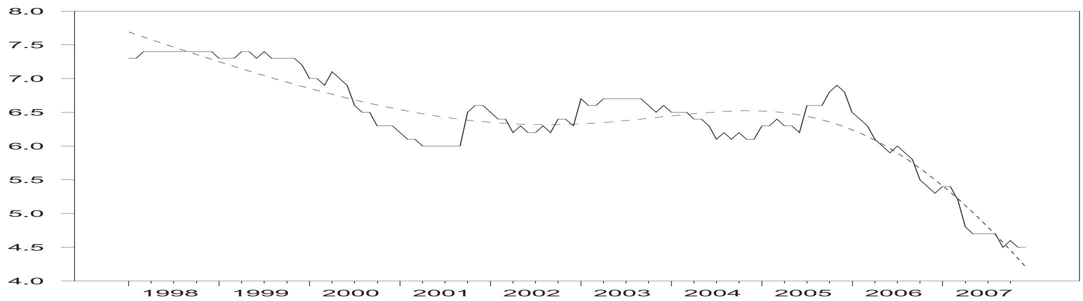
(a) Hungary



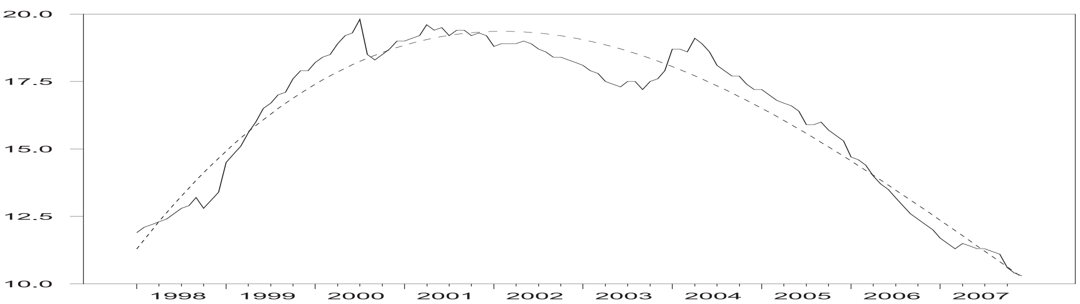
(b) Latvia



(c) Poland

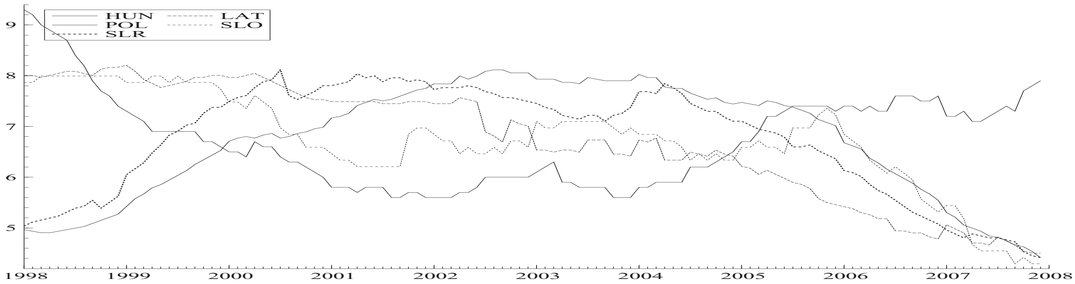


(d) Slovenia



(e) Slovak Republic

Figure 2: Unemployment rates for Hungary, Latvia, Poland, Slovenia and Slovak Republic



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