Common smooth transition trend-stationarity in European unemployment

Massimo Franchi

University of Rome

Javier Ordóñez*

Jaume I University

22nd June 2007

Abstract

This paper analyzes the hypothesis of hysteresis among European unemployment rates using unit root tests that allow under the alternative hypothesis for stationarity around a smooth transition in linear trend. The results are favorable to smooth transition trend-stationarity in European unemployment rates and suggest the existence of a common force that generates the nonlinear behavior.

Classification J.E.L.: C32, E24.

Key words: unemployment, European Union, unit root, smooth transition, linear trend.

*Corresponding author: Department of Economics, Jaume I University. Campus de Riu Sec. E-12080 Castellón (Spain). e-mail: jmonfort@eco.uji.es. Javier Ordóñez gratefully acknowledges the financial support from the CICYT and FEDER project SEJ2005-01163, the Bancaja project P1.1B2005-03 and the Generalitat Valenciana project GV-2007-111. Massimo Franchi gratefully acknowledges the financial support from University Jaume I mobility programme. Javier Ordóñez is member of the INTECO research group. The usual disclaimer applies.

1 Introduction

The high and persistent European unemployment rates over the past decades cast doubts on the existence of a unique (natural) equilibrium rate of unemployment and suggest a situation in which shocks to unemployment might have permanent effects, the so called phenomenon of unemployment hysteresis. Blanchard and Summers (1986) suggested that the bargaining power of strong unions and worker protection schemes may be able to explain this persistence. Moreover, the effects of human capital depreciation and reduced social stigma (see Phelps, 1972, Akerlof, 1980, Pissarides, 1992, and Clark, 2003, among others) could also play an important role in explaining this phenomenon and the fact that it appears to be more relevant in Europe rather than in the United States. In contrast to the hysteresis hypothesis, structuralist theories of unemployment argue that the natural rate of unemployment can be endogenous and affected by structural factors in the economy: since the equilibrium rate of unemployment fluctuates around the natural rate and the latter depends on macroeconomic and institutional factors, it then follows that also the former is is affected by changes in those variables (Layard, Nickell and Jackman, 1991).

From the econometric point of view, testing for hysteresis has traditionally involved using unit root tests, since " [...] unemployment exhibits hysteresis when current unemployment depends on past values with coefficients summing to 1" (Blanchard and Summers, 1986, p. 17). On the other hand, the structuralist view implies that most shocks cause temporary movements of unemployment around the natural rate, but occasional shocks might cause permanent changes in the natural rate itself. Thus, unemployment would be

stationary around a process that is subject to structural breaks (Papell, et al. 2000).

In early works, the results obtained applying Dickey-Fuller type tests normally pointed to hysteresis in European unemployment. However, standard unit root tests are not able to reject the I(1) hypothesis in the presence of breaking deterministic linear trends (Perron, 1989, 1990). More recent studies (Banerjee, Lumsdaine, and Stock, 1992, Camarero, Carrion-i-Silvestre and Tamarit, 2006, Gustavsson and Österholm, 2006, and Lumsdaine and Papell, 1997) have considered the existence of one or multiple structural changes in the individual series of unemployment rate and obtained more frequent rejections of the hysteresis hypothesis.

The above studies, however, assume that the deterministic structural change occurs instantaneously, implying that economic agents will react simultaneously to a given economic shock. In labor markets, individual workers behavior needs not to be the same: depreciation of skills, search effectiveness and stigma effects might be different among labor force causing workers to react with different time lags. Similarly, firm´s expected profitability of maintaining the current workforce or the different degree of their own human capital depreciation might explain also non simultaneous behavior. As a consequence, the aggregate behavior of economic agents in labor markets would be better captured by a model whose deterministic components allow for a gradual rather than instantaneous adjustment[1].

[1]See Leybourne, et. al., 1996, for a discussion about changes in economic aggregates as a consequence of the aggregation of a very large number of agents behavior's.

In this paper we attempt to capture gradual deterministic structural changes in European unemployment time series by means of smooth transition models and show that the common behavior of the unemployment rates can be explained by the existence of a common nonlinear component. The European economic integration process, the fact that the countries are partly ruled by common governmental institutions, the existence of adverse shocks that may have caused a productivity slowdown in Europe and the institutional framework of the labor market are all possible explanations of this feature of the data.

2 Methodology and empirical results

Leybourne, et. al. (1996), proposed a unit root test against smooth transition stationarity. The null hypothesis

$$H_0 : u_t = u_{t-1} + \varepsilon_t, u_0 \text{ fixed}$$

where u_t is the unemployment rate and ε_t is i.i.d. is tested against the alternative

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

where S_t is the logistic function $S_t(\gamma, \tau) = [1 + exp\{-\gamma(t - \tau \, T)\}]^{-1}$ and ν_t is i.i.d.

The corresponding t statistic for the null of unit root is calculated via a two-step procedure. The first step consists of the estimation by nonlinear least squares of the deterministic components of the model under the alternative. Second, the estimated residuals are tested for a unit root using an ADF unit root test. Critical values are approximated using Monte Carlo simulation.

In what follows we firstly analyze whether the unemployment rates for France, Germany, Italy, Spain and the United Kingdom are stationary around a smooth transition trend. The data corresponds to annual observations for the period 1956-2005 and has been taken from the OECD Main Economic Indicators Database. The standardized[2] series of unemployment rates are plotted in Figure 1.

Table 1 presents the estimation of the models under the alternative. For all five unemployment rates a smooth transition trend appears to be statistically significant. As pointed out by Papell, et al. (2000), while a nonzero trend for unemployment does not make sense asymptotically, a slowly increasing natural rate could be represented by a trend stationary process in small samples. The smooth trend stationarity specification in Table 1 is additionally capturing unemployment long transition between shifting natural rates. Figure 2 displays each of the unemployment rates against the smooth transition trend. As it can be seen, the smooth trend captures the main features of the series. ADF unit root test are reported in Table 2. The lag length k for the ADF statistic has been chosen as the highest k with a significant last coefficient. According to these results, for all unemployment rates we reject the null of unit root, so that the series appear to be well described by a smooth trend stationary process. These results are compatible with the structuralist theories as described by Phelps (1994).

From Figure 1 it is evident that the European unemployment rates move

[2]The variables have been standardized between 0 and 1 by applying the transformation $f(z_t) = \frac{z_t - min(z_t)}{max(z_t) - min(z_t)}$

together over time, so that they seem to share a common driving force. In order to address this issue we test for common LSTAR nonlinearities following the methodology proposed by Anderson and Vahid (1998), which consists in the following. Let

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

be the multivariate version of the H_1 model, where y_t is the 5×1 vector of unemployment rates, $\pi_i(L)$ is a matrix polynomial of degree p in the lag operator, ϵ_t is i.i.d., and $F(z_t)$ is a diagonal matrix containing the transition functions S_t 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 $\chi^2_{(3p-1)5s+s^2}$; rejection of the null hypothesis provides evidence of the presence of at most s common nonlinearities.

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, but fails to reject the null that there is only one such factor at the 5% significance level. Thus, the tests seem to provide evidence that a common force generates nonlinear behavior in each of the unemployment rates.

3 Conclusions

In this paper we provide new evidence against the hysteresis hypothesis. Once a smooth transition trend is accounted for, European unemployment rates appears to be stationary around it. In addition, we find that European unemployment share a common nonlinear component.

References

Akerlof, G. (1980): "A theory of social custom, of which unemployment may be one consequence", *Quarterly Journal of Economics*, vol. 94, pp. 749–775.

Anderson, H. M. and F. Vahid (1998): "Testing multiple equation systems for common nonlinear components", *Journal of Econometrics*, vol. 84, pp. 1–36.

Banerjee, A., R. L. Lumsdaine and J. H. Stock (1992): "Recursive and sequential tests of the unit-root and trend-break hypotheses: Theory and international evidence", *Journal of Business & Economic Statistics*, vol. 13, no. 3, pp. 271–287.

Blanchard, O. J. and L.H. Summers (1986): "Hysteresis and the European unemployment problem", in *NBER Macroeconomic Annual*, edited by S. Fischer, Cambridge, MIT Press.

Camarero, M. A., C. Tamarit and J.L. Carrion-i-Silvestre (2006): "Testing for hysteresis in unemployment in OECD countries. New evidence using stationary panel tests with breaks", *Oxford Bulletin of Economic and Statistics, forthcoming.*

Clark, A. (2003): "Unemployment as a social norm: psychological evidence from panel data", *Journal of Labor Economics*, vol. 21, pp. 323–351.

Gustavsson, M. and P. Österholm (2006): "Hysteresis and non-linearities in unemployment rates", *Applied Economics Letters*, vol. 13, pp. 545–548.

Layard, R., S. Nickell and R. Jackman (1991): *Unemployment. Macroeconomic Performance and the Labor Market*, Oxford Univesity Press, Oxford.

Leybourne, S., P. Newbold and D. Vougas (1996): "Unit roots and smooth transitions", *Journal of Time Series Analysis*, vol. 19, pp. 83–97.

Lumsdaine, R. L. and D. H. Papell (1997): "Multiple trend breaks and the unit root hypothesis", *Review of Economics and Statistics*, vol. 79, pp. 212–218.

Papell, D. H., C.J. Murray and H. Ghiblawi (2000): "The structure of unemployment", *The Review of Economics and Statistics*, vol. 82, pp. 309–315.

Perron, P. (1989): "The great crash, the oil price shock, and the unit root hypothesis", *Econometrica*, vol. 57, pp. 1361–1402.

Perron, P. (1990): "Testing for a unit root in a time series with a changing mean", *Journal of Business and Economic Statistics*, vol. 8, pp. 153–162.

Phelps, E. S. (1972): *Inflation Policy and Unemployment Theory: The Cost-Benefit Approach to Monetary Planning*, Norton, New York.

Phelps, E. S. (1994): *Strucutral Slumps. The Modern Theory of Unemployment, Interest and Assets*, Harvard University Press, Cambridge, MA.

Pissarides, C. (1992): "Loss of skill during unemployment and the persistence of employment shocks", *Journal of Economics*, vol. 107, pp. 1371–1391.

Table 1: Estimated models

France

$$u_t = \underset{[0.31]}{3.01}\, S_t(\underset{[0.04]}{0.25}, \underset{[0.02]}{0.45}) + \underset{[0.01]}{0.03}\, t - \underset{[0.01]}{0.04}\, t\, S_t(\underset{[0.04]}{0.25}, \underset{[0.02]}{0.45}) + \nu_t$$

Germany

$$u_t = \underset{[0.22]}{1.36} - \underset{[0.06]}{0.21}\, t + \underset{[0.05]}{0.22}\, t\, S_t(\underset{[0.10]}{0.34}, \underset{[0.02]}{0.33}) + \nu_t$$

Italy

$$u_t = \underset{[0.53]}{1.65}\, S_t(\underset{[0.01]}{0.08}, \underset{[0.02]}{0.29}) - \underset{[0.03]}{0.39}\, t + \underset{[0.02]}{0.24}\, t\, S_t(\underset{[0.01]}{0.08}, \underset{[0.02]}{0.29}) + \nu_t$$

Spain

$$u_t = -\underset{[0.07]}{0.31} + \underset{[0.52]}{5.56}\, S_t(\underset{[0.04]}{0.25}, \underset{[0.01]}{0.49}) + \underset{[0.01]}{0.04}\, t - \underset{[0.01]}{0.10}\, t\, S_t(\underset{[0.04]}{0.25}, \underset{[0.01]}{0.49}) + \nu_t$$

United Kingdom

$$u_t = \underset{[0.25]}{3.77}\, S_t(\underset{[0.11]}{0.40}, \underset{[0.01]}{0.48}) + \underset{[0.01]}{0.04}\, t - \underset{[0.01]}{0.08}\, t\, S_t(\underset{[0.11]}{0.40}, \underset{[0.01]}{0.48}) + \nu_t$$

Note: t values in brackets. $S_t(\gamma, \tau) = [1 + exp\{-\gamma(t - \tau\, T)\}]^{-1}$ for $\gamma > 0$.

Table 2: ADF unit root tests

Estimated t-statistics for the null of unit root

	France	**Germany**	**Italy**	**Spain**	**U.K.**
k	4	4	1	4	5
t-stat	-5.02**	-6.60**	-4.45*	-4.14*	-4.96**

Note: Simulated critical values for T=50: k=1, 10%=-4.37, 5%=-4.75, 1%=-5.48; k=4, 10%=-3.95, 5%=-4.29, 1%=-5.02;k=5, 10%=-3.89, 5%=-4.23, 1%=-4.90. Rejects the null at the **5 per cent and *10 per cent 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	0.025
Unemployment rates have at most 1 common LSTAR nonlinearity	Unemployment rates have at least 2 of these LSTAR nonlinearities	0.237
Unemployment rates have at most 2 common LSTAR nonlinearity	Unemployment rates have at least 3 of these LSTAR nonlinearities	0.475
Unemployment rates have at most 3 common LSTAR nonlinearity	Unemployment rates have at least 4 of these LSTAR nonlinearities	0.588
Unemployment rates have at most 4 common LSTAR nonlinearity	Unemployment rates have at least 5 of these LSTAR nonlinearities	0.593

Figure 1: Unemployment rates.

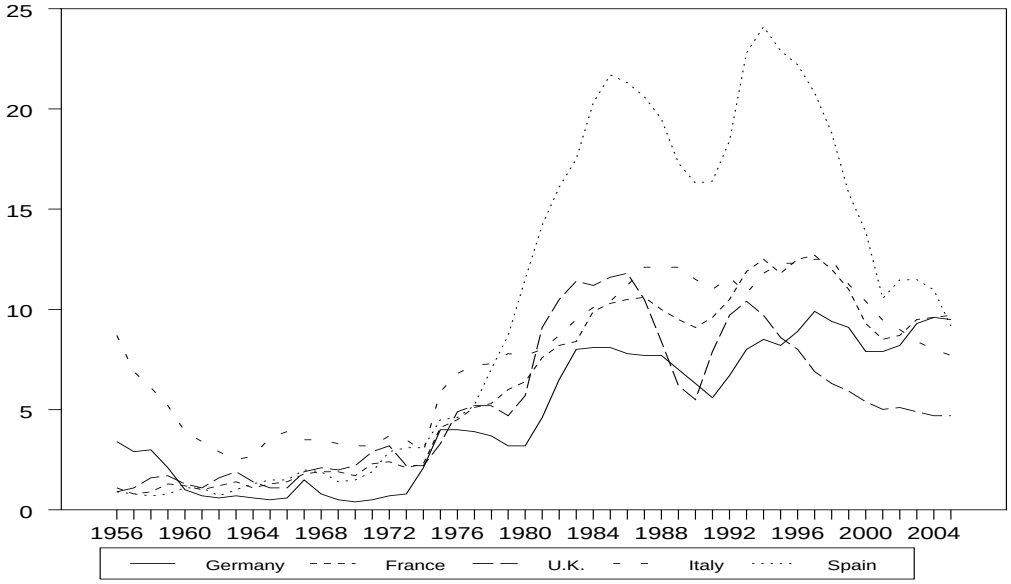
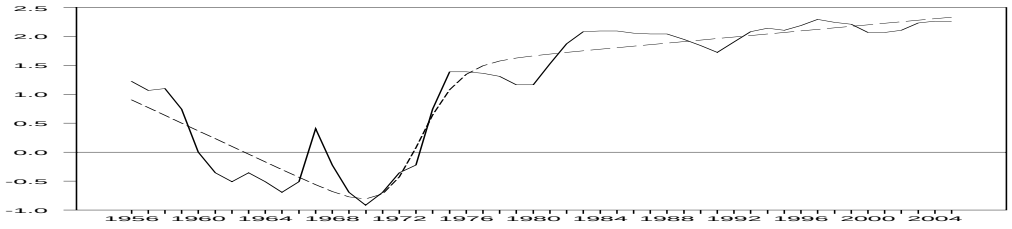
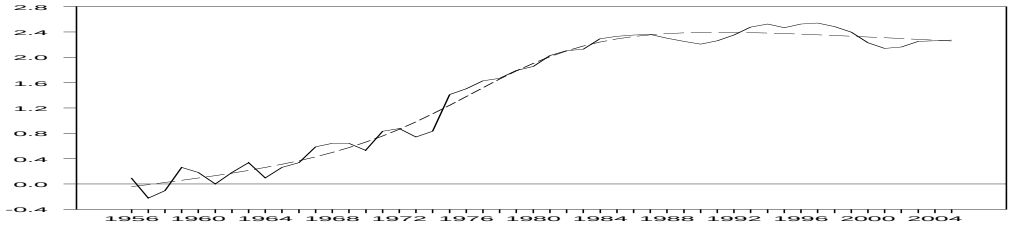


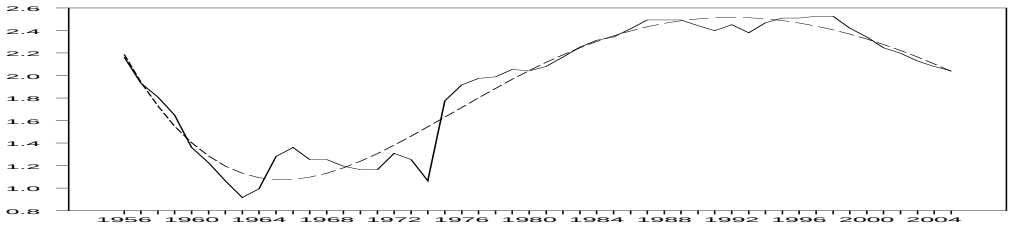
Figure 2: Unemployment rates (in logs) and the smooth transition trend.



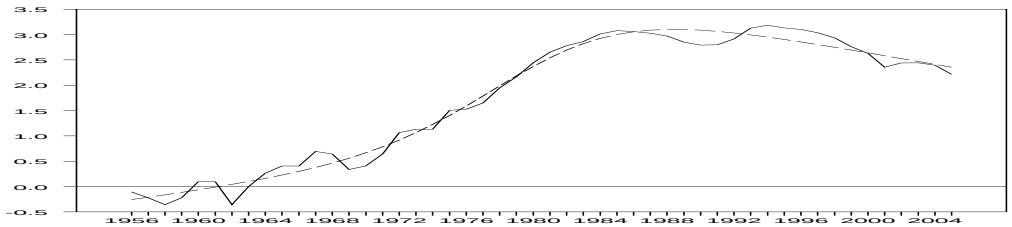
(a) Germany



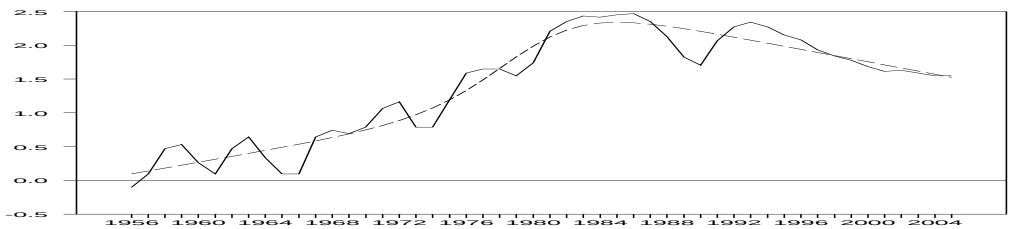
(b) France



(c) Italy



(d) Spain



(e) United Kingdom