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An empirical note on testing hysteresis in unemployment for ten European countries: panel SURADF approach

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The hysteresis hypothesis in unemployment for ten European countries are tested using newly developed Panel SURADF tests of Breuer *et al.* (2001) for the 1961–1999 period. While the other Panel-based unit root tests are joint tests of a unit root for all members of the panel and are incapable of determining the mix of $I(0)$ and $I(1)$ series in the panel setting, the Panel SURADF tests a separate unit-root null hypothesis for each individual panel member and, therefore identifies how many and which series in the panel are stationary processes. The hysteresis hypothesis is confirmed for all the European countries except Belgium and the Netherlands when Breuer *et al.*'s Panel SURADF tests are conducted.

I. Introduction

The issue of unemployment clearly becomes the most pressing problem for most of the countries over recent decades. In the case of European countries, the unemployment rate increased from under 4% in the 1960s to over 10% in the 1990s. The dominant feature of unemployment is its high persistence even in times of relative booms. What causes this higher persistence in unemployment has attracted a lot of both theoretical and empirical studies devoted to investigating whether the hypothesis of hysteresis in unemployment holds true for those countries with higher unemployment rates. These studies are critical not only for empirical researcher but also for policymakers.

Considering the assumptions inherent in the hysteresis hypothesis in unemployment, if unemployment is the $I(1)$ process, then the shocks affecting the series will have permanent effects, thus shifting the unemployment equilibrium from one level to another.[1] Should this be the case, from the policy perspective, policy action is, indeed, required to return unemployment to its original level. On the

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[1] Dixon and Shepherd (2001) point out that while it may be true that the unemployment series are stationary in the probability limit (here) one is dealing not only with a finite realization of the process, but also a sample period that is 'very short'. In these circumstances, it is quite possible that the series may wander significantly within the interval, exhibiting characteristics that are, for all practical purposes, indistinguishable from an unrestricted random walk (see Smyth, 2003). Thus, the extant literature is followed and the issue of boundness is ignored in the present study.

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other hand, if unemployment is the $I(0)$ process, the effects of the shock will merely be transitory, making the need for policy action less mandatory since unemployment will eventually return to its equilibrium level. The $I(0)$ process has commonly been referred to as the natural rate of unemployment hypothesis (NAIRU) for it characterizes unemployment dynamics as a mean reversion process.

Because hysteresis is associated with non-stationary unemployment rates, unit root tests have widely been used to investigate its validity. Using 1853–1984 data for France, Germany, the United Kingdom and the USA, Blanchard and Summers (1986) laid the groundwork by employing conventional unit root tests to investigate the effects of hysteresis on unemployment, and they were unable to reject the non-stationarity of unemployment rates, except for the USA where they did find evidence of stationarity. A little later, Brunello (1990), using 1955–1987 Japanese unemployment data, was also unable to reject the null hypothesis of a unit root. Mitchell (1993) later adopted Perron's (1989) unit root test, which assumes one exogenously given structural break, and this similarly provided support for hysteresis in several OECD countries. Likewise, Jaeger and Parkinson (1994) reported that unemployment hysteresis exists in Germany, the United Kingdom and Canada, but not in the USA. Using 1970–1994 data, Roed (1996) reported on unemployment hysteresis in 16 OECD countries and the strong likelihood of it in Australia, Canada, Japan and several European countries, but like other researchers rejected it in the USA. Other studies on this issue using different econometric techniques see Koustas and Veloce (1996) for Canada and Smyth and Easaw (2001) for the USA.

While these findings generally supported a unit root in unemployment and, therefore hysteresis, critics have claimed that the drawing of such conclusions may be attributed to the lower power of the conventional unit root tests employed. More recently, in fact, it has been reported that conventional unit root tests not only fail to consider information across regions, thereby leading to less efficient estimations, but also have low power against near-unit-root but stationary alternatives. It is not surprising that these factors should expectedly have cast considerable doubt on many of the earlier findings of a unit root in unemployment rates.

One proposed approach to increasing power in testing for a unit root involves the use of panel data. Levin and Lin (1992) and Im *et al.*, (1997) developed the asymptotic theory and the finite-sample properties of ADF tests of panel data, and both have demonstrated that even relatively small panels yield large improvements with respect to power. These panel-based unit root tests are now being extensively used in empirical testing – particularly as found in the literature for purchasing power parity; for example, see MacDonald (1996), Oh (1996), Wu (1996), Papell (1997), Papell and Theodoridis (2001), and Wu and Wu (2001). As for unemployment, on testing the hysteresis hypothesis in unemployment for 48 contiguous US states and 16 OECD countries by simultaneously using the univariate and the panel-based unit root tests of Levin and Lin (1992), respectively, Song and Wu (1997, 1998) observed that with the application of the standard ADF and P-P tests to individual unemployment series, the unit root null is never rejected. By sharp contrast, with data pooled for the panel-based unit root test, the unit root null can generally be rejected. Simply put, they found no support whatsoever for the hysteresis hypothesis. However, from their application of Im *et al.*'s (1997) panel-based unit root test for hysteresis in unemployment, what Leon-Ledesam (2002) concluded is that hysteresis for the EU and the natural-rate for the USA are the most plausible hypotheses.

Taylor and Sarno (1998) and Breuer *et al.*, (2001) showed the recent methodological refinements of the Levin and Lin test fail to fully address the 'all-or-nothing' nature of the test. It is true that Im *et al.* (1997), Maddala and Wu (1997) and Taylor and Sarno (1998) developed tests that permit the autoregressive parameters to differ across panel members under the stationary alternative, but because they are joint tests of the null hypothesis, they are not informative about the number of series that are stationary processes when the null hypothesis is rejected. Breuer *et al.* (2001) further claimed that, by analogy to simple regression, when an F-statistic rejects the null that a vector of coefficients is equal to zero, it does not follow that each coefficient is nonzero. Similarly, when the unit-root null hypothesis is rejected, it may be erroneous to conclude that all series in the panel are stationary.

This empirical note contributes to this line of research by determining whether hysteresis in unemployment is characteristic of the European labor market. The hysteresis hypothesis in unemployment is tested for ten European country data sets using the Breuer *et al.* (2001) Panel SURADF unit root tests.

The remainder of this empirical note is organized as follows. Section II presents the data used, and Section III describes the methodology, the empirical findings and policy implications. Finally, Section IV presents some concluding remarks.

Table 1. Summary statistics of unemployment data sets

Country name	Mean	Std	Maximum	Minimum	Skewness	Kurtosis	J-B
1. Belgium	5.993	3.427	10.811	1.336	−0.097	1.436	4.035
2. Denmark	4.789	3.082	10.486	0.589	−0.082	1.579	3.322
3. France	6.406	3.967	12.399	1.163	0.074	1.438	4.002
4. Ireland	9.915	4.237	16.809	4.978	0.335	1.557	4.116
5. Italy	7.429	2.517	11.837	3.536	0.368	1.899	2.851
6. Netherlands	4.678	3.001	11.693	0.444	0.038	2.025	1.554
7. Portugal	5.022	2.329	8.709	1.619	−0.017	1.448	3.917
8. UK	5.816	3.572	11.396	1.081	0.127	1.516	3.685
9. Norway	2.775	1.491	5.959	1.295	0.899	2.369	5.895*
10. Finland	5.892	4.731	17.031	1.197	1.137	3.092	8.422**

Notes: Std denotes standard deviation and J-B denotes the Jarque-Bera Test for Normality. *, and ** indicate significance at the 0.10 and 0.05 levels, respectively.

II. Data

This empirical note employs the 1961–1999 unemployment rates for ten European countries, namely Belgium, Denmark, France, Ireland, Italy, the Netherlands, Portugal, the UK, Norway and Finland.[2] All the data are from the AREMOS database of the Ministry of Education of Taiwan, and summary statistics are given in Table 1. The unemployment data indicate that Ireland and Norway have the highest and lowest average unemployment rates, respectively. The Jarque-Bera test results meanwhile indicate that, except for Norway and Finland, all the unemployment data sets are approximately normal.

III. Panel Unit Root Methodology and Empirical Results

Breuer et al.*'s seemingly unrelated regressions augmented Dickey-Fuller test (SURADF)*

Breuer *et al*. (2001) claimed that, by analogy to simple regression, when an *F*-statistic rejects the null that a vector of coefficients is equal to zero, it does not follow that each coefficient is nonzero. Similarly, when the unit-root null hypothesis is rejected, it may be erroneous to conclude that all series in the panel are stationary. To avoid the problem, Breuer *et al*. (2001) introduced the 'seemingly unrelated regressions augmented Dickey-Fuller' (SURADF) test, which is an augmented Dickey-Fuller test based on the panel estimation method of seemingly unrelated regression (SUR). In contrast to the MADF test of Taylor and Sarno (1998), separate null and alternative hypotheses are tested for each panel within a SUR framework. However, this test is similar to the MADF test, this test also has non-standard distributions and the critical values must be obtained by simulation. The system of the ADF equations estimated here are:

$$\begin{aligned}
\Delta X_{1,t} &= \alpha_1 + \beta_1 X_{1,t-1} + \gamma t + \sum_{j=1}^{k1} \theta_{1,j} \Delta X_{1,t-j} + \varepsilon_{1,t} \\
&\qquad t = 1, 2, \ldots, T \\
\Delta X_{2,t} &= \alpha_2 + \beta_2 X_{2,t-1} + \gamma t + \sum_{j=1}^{k2} \theta_{2,j} \Delta X_{2,t-j} + \varepsilon_{2,t} \\
&\qquad t = 1, 2, \ldots, T \\
&\quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
&\quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
\Delta X_{N,t} &= \alpha_N + \beta_N X_{N,t-1} + \gamma t + \sum_{j=1}^{kN} \theta_{N,j} \Delta X_{N,t-j} + \varepsilon_{N,t} \\
&\qquad t = 1, 2, \ldots, T \qquad (1)
\end{aligned}$$

The N null and alternative hypotheses are tested individually:

$$\begin{aligned}
H_0^1 &: \beta_1 = 0; \; H_A^1 : \beta_1 < 0 \\
H_0^2 &: \beta_2 = 0; \; H_A^2 : \beta_2 < 0 \\
&\cdot \quad \cdot \\
&\cdot \quad \cdot \\
H_0^N &: \beta_N = 0; \; H_A^N : \beta_N < 0
\end{aligned}$$

with test statistics computed from the SUR estimates of system 1. As Breuer *et al*. (2001) showed

[2] Due to data availability from the data source, only these ten countries are include in the present study. Germany was omitted as one of the countries tested because of the problem caused by reunification.

the imposition of an identical lag structure across panel members could bias test statistics, we select the lag structures for each equation based on Perron's (1989) method.

The major difference between the SURADF and other panel unit tests such as the MADF test of Taylor and Sarno (1998) derives from the formulation of the null hypothesis. While the others are joint tests of a unit root for all members of the panel, the SURADF tests a separate unit-root null hypothesis for each individual panel member and, therefore, identifies how many and which series in the panel are stationary processes.

Empirical results

For comparison, first, several conventional unit root tests are applied to examine the null of a unit root in the unemployment rate of each country. The lag order of the test is selected on the basis of the recursive *t*-statistic, as suggested by Perron (1989). The results in Table 2 clearly indicate that the ADF, DF-GLS (of Elliott *et al*., 1996), the P-P and NP (of Ng and Perron, 2001) tests all fail to reject the null of non-stationary unemployment for all ten countries. The KPSS test also yields the same results. Since the single-equation ADF test has low power with short time spans, as pointed out by Shiller and Perron (1985), here there are only annual observations spanning a 39-year period, perhaps indicating that the failure of the ADF test to have previously rejected the unit root null was due to the time span of the data. This possibility is investigated by exploiting the cross-section variability among regions by applying the Breuer *et al*. (2001) panel-based unit root tests and examine the stationarity of unemployment. Table 3 presents Breuer *et al*.'s (2001) Panel SURADF test results, which indicates the hysteresis hypothesis holds true for all the European countries studied here with the exception of Belgium and

Table 2. Univariate unit root tests (ADF, DF-GLS, P-P, KPSS and NP)

Country name	ADF	DF-GLS	P-P	KPSS	NP
1. Belgium	−1.586(1)	−1.243(1)	−1.061[1]	0.617[5]**	−2.521
2. Denmark	−1.218(0)	−0.907(0)	−1.308[3]	0.573[5]**	−1.455
3. France	−1.693(0)	0.097(1)	−1.878[5]	0.725[5]**	0.478
4. Ireland	−1.485(1)	−1.291(1)	−1.299[2]	0.554[5]**	−3.487
5. Italy	−0.398(0)	−0.009(0)	0.389[3]	0.747[5]***	0.252
6. Netherlands	−2.227(1)	−1.115(1)	−2.135[4]	0.562[5]**	−1.455
7. Portugal	−1.665(0)	−1.077(0)	−1.709[1]	0.513[5]**	−1.836
8. UK	−1.301(2)	−0.369(2)	−1.881[9]	0.636[5]**	−0.428
9. Norway	−1.304(0)	−1.071(0)	−1.204[5]	0.621[5]**	−2.343
10. Finland	−1.963(1)	−0.373(2)	−1.256[7]	0.685[5]**	−0.659

Notes: **, and *** indicate significance at the 0.05 and 0.01 levels, respectively. The number in brackets indicates the lag truncation for the Bartlett Kernel, as suggested by the Newey-West test (1987). The number in parentheses indicates the lag order selected based on the recursive *t*-statistic, as suggested by Perron (1989). The NP test was based on the MZa statistic.

Table 3. SURADF tests and critical values

	Critical values			
Country panel label	SURADF	0.01	0.05	0.10
1. Belgium	−4.312**	−4.465	−4.265	−4.079
2. Denmark	−1.359	−3.346	−2.727	−2.688
3. France	−3.114	−3.367	−3.250	−3.129
4. Ireland	−2.571	−3.209	−2.949	−2.865
5. Italy	−1.814	−4.031	−3.234	−2.812
6. Netherlands	−4.738***	−3.171	−3.067	−3.027
7. Portugal	−2.911	−4.378	−3.399	−3.179
8. UK	−2.112	−3.926	−3.316	−3.192
9. Norway	−1.474	−2.626	−2.496	−2.122
10. Finland	−2.821	−3.664	−3.179	−3.041

Notes: **, and *** indicate significance at the 0.05 and 0.01 levels, respectively. Critical values are calculated by Monte Carlo simulation with 10 000 draws, tailored to the present sample size. (For details of this simulation, see Breuer *et al*., 2001.)

the Netherlands. The estimated 1%, 5% and 10% critical values, obtained from simulations based on 39 observations for each series and 10 000 replications using the lag and covariance structure from the panel of unemployment series, for each of the ten panel members are also reported in Table 3.

Worth noting is that the results here are not consistent with those of Song and Wu (1997, 1998) which, based on the unemployment rate data for 48 US states and 16 OECD countries, support the weak version of the natural-rate hypothesis. The results, nevertheless, are consistent with those of Leon-Ledesma (2002), which support the notion of hysteresis in unemployment for the European countries.

A major policy implication of the study is that a stabilization policy may have some permanent effects on the unemployment rates of the European countries under study. What, however, are the most effective policies to fight this continuously climbing unemployment? To answer this, the underlying reasons for unemployment must first be identified, but as this is beyond the scope of this article, it will be investigated in a future study.

IV. Conclusions

This empirical note employs the Breuer *et al*. (2001) Panel SURADF unit tests to assess the hysteresis hypothesis in unemployment using data from selected European countries. Breuer *et al*.'s (2001) Panel SURADF test indicates the hysteresis hypothesis is supported for all the European countries except for Belgium and the Netherlands.

Finally, as concerns major policy, the study implies that a fiscal stabilization policy would possibly have permanent effects on the unemployment rates of these European countries.

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