E C O N O M I C S B U L L E T I N

Are Unemployment Rates Nonstationary or Nonlinear? Evidence from 19 OECD Countries

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Abstract

This study investigates the stationarity and linearity properties of unemployment rates in 17 OECD countries. We use a new unit root test developed by Kapetanios, Shin and Snell (2003) (KSS) which tests the joint null hypothesis of linearity and a unit root against a nonlinear stationary process. We reject the null hypothesis of a linear unit root so find evidence in support of the natural rate of unemployment for Belgium, Korea, Switzerland, USA, Netherlands and Poland and we unable to reject the null hypothesis of hysteresis for Australia, Austria, Canada, Finland, Germany, Japan, Luxembourg, Norway, Slovak Republic and Turkey according to the KSS test results.

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1. Introduction

Unemployment is a major problem almost in all countries over the world and the rise in its levels after the first oil shock has made it one of the popular preoccupations for macro economists. There have been several studies try to understand the behavior of unemployment rates based on especially two different theories.

The first theory is "natural rate of unemployment" pioneered by Friedman (1968) and Phelps (1967, 1968). They state one time shocks have only transitory effects on unemployment rates, that is, the rates fluctuate around a natural rate. Latter is "hysteresis hypothesis" proposed by Blanchard and Summers (1986). They emphasize even transitory shocks can have permanent effects on the rates. Thus, unemployment rates do not revert to its long run equilibrium. They argue the bargaining power of the insiders in wage determination is the main reason for the hysteresis. There are also some other explanations for hysteresis hypothesis; the stigma effect theory of Sessions (1994), technological change, interest rates, human capital changes among the unemployed, fluctuations in macroeconomic variables, etc.

We discriminate between these competing theories directly by using unit root tests. The approval of the null of unit root implies hysteresis hypothesis is supported and the disapproval of it shows natural rate of unemployment is valid.

Most of the previous studies examine the unemployment behavior only within a linear framework. The real world is too complex to explain with linear functions; therefore, we use a unit root test which considers possible nonlinearity, to analyze the behavior of unemployment rates in OECD countries.

The remainder of the paper organized as follows. Section 2 describes the econometric methodology. Section 3 presents the data and empirical results and section 4 concludes.

2. Econometric Methodology

In this study, we use nonlinear test introduced by Kapetanios et al. (2003) (KSS hereafter). KSS extend the standard ADF test and introduce a new unit root test to test for a linear unit root against an alternative of non-linear stationary exponential smooth transition autoregressive process. They investigate the following nonlinear regression:

$$\Delta y_t = \gamma y_{t-1}[1-\exp\left(-\theta y_{t-d}^2\right)]+\varepsilon_t \qquad (1)$$

Here $[1-\exp\left(-\theta y_{t-d}^2\right)]$ is the exponential transition function. We focus on the θ parameter which is zero under the null and positive under the alternative. Since γ is not identified under the joint null hypothesis of linearity and a unit root, testing the null hypothesis of $H_0:\theta=0$, against the alternative hypothesis of $H_1:\theta>0$ is not feasible. Thus KSS reparametrize Eq. 1 by using Taylor series approximation to obtain:

$$\Delta y_t = \delta y_{t-1}^3 + e_t \tag{2}$$

or

$$\Delta y_t = \sum_{j=1}^{p} \rho_j \Delta y_{t-j} + \delta y_{t-1}^3 + e_t \tag{3}$$

where y_t is demeaned or detrended series of interest and *p* is the maximum autoregressive lag order to eliminate for serially correlated errors.

Equation 2 and 3 are analogous to the Dickey Fuller and the Augmented Dickey Fuller regressions respectively, the only difference is the lagged level of *Y* is raised to power three rather than power one.

In both Eq. 2 and Eq. 3 the null of $H_0 : \delta = 0$ is tested against the alternative of $H_1 : \delta > 0$ by using familiar *t* ratio obtained for δ [1]. However, since asymptotic distribution of *t* is not standard normal, KSS tabulated critical values via simulations.

3. Data and Empirical Results

We obtained monthly data on unemployment rates for 17 OECD countries, namely Australia, Austria, Belgium, Canada, Czech Republic, Finland, Germany, Japan, Korea, Luxembourg, Netherlands, Norway, Poland, Slovak Republic, Switzerland, Turkey and USA from the IFS database.

As a benchmark, we employ the ADF test for our study. Table 1 presents results of two statistics, ADF_c is the ADF test statistic for the null of unit root of the variable with a constant, KSS_m is the KSS test statistic for the demeaned data. We use significance testing procedure for selecting optimal lag length for both ADF and KSS tests by considering a maximum lag order of 12. We consider only the mean versions of the tests, since results of the tests for both mean and trend cases are identical.

[1] $t_{NL} = \hat{\delta} / se\left(\hat{\delta}\right)$

Table I. Unit Root Tests Results

Countries	Sample	ADF_c	KSS_m
Australia	1982:07-2007:12	-2.441(12)	-2.389(12)
Austria	1993:01-2008:03	-3.005(12)*	-1.777(12)
Belgium	1993:01-2008:02	-3.329(3)*	-4.352(3)*
Canada	2000:06-2008:01	0.067(12)	-0.019(12)
Czech Republic	1998:01-2007:11	-1.498(11)	-4.848(9)*
Finland	1993:01-2007:12	-1.251(12)	-2.018(12)
Germany	1993:01-2008:03	-2.551(12)	-2.033(12)
Japan	1993:01-2007:12	-1.660(12)	-1.539(12)
Korea	1993:01-2007:06	-3.643(12)*	-5.404(12)*
Luxembourg	1993:01-2008:03	-1.812(12)	-1.616(12)
Netherlands	1992:01-2008:01	-2.388(12)	-3.218(12)*
Norway	2000:10-2007:12	-2.150(12)	-1.697(12)
Poland	1993:01-2008:01	-1.895(12)	-7.398(12)*
Slovak Republic	1997:01-2007:09	-1.317(12)	-1.684(12)
Switzerland	1993:01-2008:01	-4.595(12)*	-4.166(12)*
Turkey	2005:01-2008:03	-2.625(12)	-2.221(12)
USA	1970:01-2008:04	-4.135(12)*	-3.475(12)*

Note: The numbers in parenthesis are number of augmented lags.
5% critical values for the ADF_c , KSS_m tests are -2.87, -2.93 respectively.
* denotes significance at the 5% level.

We find that the ADF test fails to reject the null of unit root so accepts the hysteresis hypothesis for 12 countries. These are; Australia, Canada, Czech Republic, Finland, Germany, Japan, Luxembourg, Netherlands, Norway, Poland, Slovak Republic and Turkey. We accept the natural rate of unemployment hypothesis for Austria, Belgium, Korea, Switzerland and USA according to the ADF test results, since we find the unemployment rates as stationary.

When the underlying process is ESTAR, ADF test may lack power. Therefore, we also use the KSS test for analyzing the unemployment rates. We reject the null hypothesis of unit root for Belgium, Czech Republic, Korea, Netherlands, Poland, Switzerland and USA. The natural rate hypothesis is supported for these countries. On the other hand, we cannot reject the unit root hypothesis namely hysteresis for Australia, Austria, Canada, Finland, Germany, Japan, Luxembourg, Norway, Slovak Republic and Turkey.

We summarize our findings in Table 2. We find that the natural rate hypothesis is supported for Belgium, Korea, Switzerland and USA by using either test. If we consider possible nonlinearity in the series, we also find the unemployment rates of Netherlands, Czech Republic and Poland as stationary. Therefore, in total, we find evidence in favor of the natural rate hypothesis for 8 countries, whereas we find no evidence against hysteresis for the remaining 9 countries.

Table II. Summary of the Test Results

(i)	Austria, Belgium, Korea, Switzerland and USA
(ii)	Belgium, Czech Republic, Korea, Netherlands, Poland, Switzerland and USA

Note: (i) denotes rejections of hysteresis according to the ADF test.
(ii) denotes rejections of hysteresis according to the KSS test.

4. Conclusion

In this study our main goal was to find whether the unemployment rates of the 17 OECD countries are stationary or not. We investigated this issue by employing the standard ADF test and nonlinear KSS test. The results of the ADF unit root test provide evidence in support of the natural rate of unemployment in 5 countries, while the KSS test results suggest that in 7 countries null of unit root can be rejected. Thus, our results show when the underlying process is nonlinear, the power of the ADF test becomes poor. We conclude hysteresis hypothesis is supported for Australia, Canada, Finland, Germany, Japan, Luxembourg, Norway, Slovak Republic and Turkey.

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