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Unemployment hysteresis in G20 countries: Evidence from non-linear panel unit-root tests

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In this study, we apply non-linear panel unit-root test to assess the hysteresis hypothesis in unemployment for G20 countries. We find that non-linear panel unit-root test has higher power than linear method suggested by Breuer et al. (2001), if the true data generating process of unemployment rate is in fact a stationary non-linear process. We investigated the rate of unemployment from the panel non-linear point of view and provide robust evidence which clearly indicated that hysteresis hypothesis is not supported in nine countries when non-linear panel unit-root test are conducted.

Key words: Hysteresis, non-linear panel unit-root test.

INTRODUCTION

Unemployment is a major source of concern among policymakers and society as a whole. The issue of unemployment has become the most pressing problem for most of the countries, particular in times of recession. From theoretical viewpoints, the relationship between the business cycle and unemployment suggests two major hypotheses. The first is so-called natural rate of unemployment (NAIRU) hypothesis, characterizing unemployment dynamics as a mean reverting process, in the long run, the unemployment rate will revert to its equilibrium level. The other hypothesis is the unemployment hysteresis proposed by Blanchard and Summers (1986), which states that cyclical fluctuations will have permanent effects on the level of unemployment due to labor market rigidities. The unemployment hysteresis hypothesis has important policy implications because it suggests that high unemployment may continue to be a serious problem in the long run in the absence of government intervention to address the problem. The existence of hysteresis in unemployment implies that the economic effects of recessions are more costly than the nature rate hypothesis would indicate. Thus, if the hysteresis hypothesis of unemployment is correct, it will be useful for government policies to fight unemployment.

However, the usual procedure to measure the hysteresis hypothesis has been to test for a unit root in the unemployment rate. In general, previous studies cannot reject the null of a unit root for most of the European countries but for the US, mixed results are obtained. The traditional measurements of unemployment rate are nonstationary by using rather univariate unit root statistics (Blanchard and Summers, 1986; Brunello, 1990; Mitchell, 1993; Roed, 1996) or panel unit root tests (Smyth, 2003) along the lines of the Augmented Dickey-Fuller (ADF) statistics. The key feature of all these tests is that they work upon the hypothesis that a symmetric adjustment process exists. The linear framework is restrictive in the sense that it may be argued that hysteresis is intrinsically a non-linear phenomenon (Amable et al., 1995). Bodman (2002) has provided solid empirical evidence for non-linear dynamics for labor market and unit root testing procedures. Taylor (2001) indicates that the power of the conventional Augmented Dickey-Fuller (ADF) test is poor if the series follow a non-linear threshold process. To do that, the non-linear unit root test based on an exponential smooth transition autoregressive (ESTAR) proposed by Kapetanois et al. (2003) and it shows that the power of their test is higher than that of the ADF test. Important to note, nevertheless, is that under no circumstance does the finding of nonlinear adjustment necessarily signify the existence of nonlinear mean-reversion or stationarity. Thus, it is
essential that stationary tests based on a nonlinear framework be applied.

While numerous studies support a unit root in unemployment rate, 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, 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 lower power when compared with near-unit-root but stationary alternatives. It is not surprising that these factors have cast considerable doubt on many of the earlier findings that have been based on a unit root in unemployment rate. In order to increase the power in testing for a unit root, many researchers have employed panel data (Taylor and Sarno, 1998; Maddala and Wu, 1999; Levin et al., 2002; Im et al., 2003; Pesaran, 2007). Song and Wu (1997; 1998) were first to apply panel data unit test to examine hysteresis in unemployment and find hysteresis does not characterize unemployment dynamics for either US states or OECD countries. Leon-Ledesma (2002) also applies panel methods and finds hysteresis characteristics unemployment in the European Union. These tests have been successful in finding evidence of stationarity that cannot be found by univariate methods. The major advantage for adopting panel unit-root tests is their high power by exploiting cross-section dependence.

Furthermore, Breuer et al. (2001), Taylor (2001) showed that the methodological refinements of Levin et al. (2002) test fail to fully address the ‘all-or-nothing’ nature of the tests. Because they are joint tests of the null hypothesis, they are not informative with regard to the number of series that are stationary processes when the null hypothesis is rejected. In this regards, Breuer et al. (2001) claim that, by analogy to a simple regression, when an F-statistic rejects the null that a vector of coefficients is equal to zero, it is not necessarily true that each coefficient is non zero. Likewise, when the unit-root null hypothesis is rejected, it may be erroneous to conclude that all series in the panel are stationary. Breuer et al. (2001) propose a series-specific unit-root test that allows researchers to distinguish I (0) and I (1) series in the panel.

The dominant feature of unemployment is its high persistence. 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. This study contributes significantly to the literature on the hypothesis of hysteresis in unemployment versus the nature rate in several respects: Firstly, we apply seemingly unrelated regression (SUR) methods that have better power properties than univariate linear and nonlinear tests. Secondly, we will propose a series-specific non-linear panel unit-root test that exploits the cross-section information and to test the unit-root hypothesis for each series in the panel by Wu and Lee (2009). According to their results, the nonlinear panel unit-root test is superior in power to the BMW test (the Breuer-McNown-Wallace test) when the data generating process is highly nonlinear and it can handle the issues of contemporaneous correlation and heterogeneous serial correlation. Finally, the non-linear panel unit-root test to cluster G20 countries in two groups: those who fulfill the nature rate hypothesis and those that present in their labor market.

The reminder of this empirical study is organized as follows. Section II describes the methodology of the non-linear series-specific unit-root tests. Section III presents the data used and discusses the empirical findings. Section IV concludes.

**METHODODOLOGY**

Kapetanios et al. (2003) propose a testing procedure to detect the presence of non-stationarity against non-linear but globally stationary ESTAR process. They first consider the following auxiliary equation based on Taylor series approximation and construct the t-statistic of the least square estimators of the coefficients in this equation,

\[ \Delta U_t = \delta U_{t-1} + \sum_{j=1}^{i} \beta_j \Delta U_{t-j} + \epsilon_t \]

(1)

where \( U_t \) is the unemployment rate. In this framework, the null hypothesis and alternative hypothesis are expressed as \( \delta = 0 \) (nonstationary) against \( \delta < 0 \) (nonlinear ESTAR stationary). Kapetanios et al. (2003) showed that t-statistic of the parameter of interest, that is, \( \delta \) does not have an asymptotic normal distribution and thus one must resort to simulations for asymptotic critical values.

As stated earlier, Breuer et al. (2001) have made the claim that, by analogy to a 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 non zero. Similarly, when the unit-root null hypothesis is rejected, it may be erroneous to assume that all series in the panel are stationary. To avoid this problem, Breuer et al. (2001) has introduced the “Seemingly Unrelated Regressions Augmented Dickey-Fuller” (SURADF) tests, which are Augmented Dickey-Fuller tests based on the panel estimation method of SUR. The system of the ADF equations that we estimate here is:

\[ \Delta U_{1,t} = \alpha_1 + \beta_1 U_{1,t-1} + \sum_{j=1}^{11} \theta_{1,j} \Delta U_{1,t-j} + \epsilon_{1,t} \quad t = 1,2,\ldots,T \]

\[ \Delta U_{2,t} = \alpha_2 + \beta_2 U_{2,t-1} + \sum_{j=1}^{11} \theta_{2,j} \Delta U_{2,t-j} + \epsilon_{2,t} \quad t = 1,2,\ldots,T \]

\[ \Delta U_{N,t} = \alpha_N + \beta_N U_{N,t-1} + \sum_{j=1}^{11} \theta_{N,j} \Delta U_{N,t-j} + \epsilon_{N,t} \quad t = 1,2,\ldots,T \]

(2)
We test the N null and alternative hypotheses individually:

\[ H_0^1: \beta_1 = 0; H_{10}^1: \beta_1 < 0 \]

\[ H_0^2: \beta_2 = 0; H_{10}^2: \beta_2 < 0 \]

\[ H_0^N: \beta_N = 0; H_{10}^N: \beta_N < 0 \]

Where, we compute the test statistics from the SUR estimates of Equation (2).

To generalize the non-linear unit-root test of Kapetanos et al. to a panel framework and allow for testing stationarity for each series in a panel, we use the following system equations:

\[
\Delta U_{N,t} = \delta_N U_{N,t-1} + \sum_{i=1}^{k_N} \phi_{N,i} \Delta U_{N,t-i} + \varepsilon_{N,t} \tag{3}
\]

After estimating the equation (3) with SUR, the \( t \)-statistic for the hypothesis of \( \delta_N = 0 \) is constructed to test for the stationarity of the series, \( \Delta U_{N,t} \). However, this test has non-standard distributions and the critical values must be obtained by simulation.

RESULTS AND DISCUSSION

This empirical study based on unemployment rate data for G20 countries for the period 1980 to 2008. The source of the data is the world economic outlook database. For comparison, first, we apply conventional ADF statistic to examine the null of a unit root in the unemployment of each country. The results in Table 1 clearly indicate that ADF tests fail to reject the null of non-stationary unemployment rate for almost all countries except Germany. This finding is consistent with the un-employment literature and is due to the low power of the ADF test when the unemployment is highly persistent and the processes are likely to be non-linear. Furthermore, we apply the non-linear unit-root test of Kapetanos et al. (2003) to re-investigate the mean reversion behavior of unemployment adjustment. However, results from the third column of Table 1 indicate that the unit-root hypothesis is also not rejected for all countries.

The reason of failure of rejecting the unit-root hypothesis given linear and non-linear unit-root tests is the power of a single equation is low. One proposed approach to increasing power in testing for a unit root involves the use of panel data. Therefore, we apply panel unit-root tests to re-examine the null of hysteresis hypothesis. Next, we first apply the panel SURADF test by Breuer et al. (2001) to examine the stationarity of unemployment rate based on the panel of G20 countries. The SURADF results are reported in the fourth column of Table 1. To avoid the small-sample size bias, we estimate the one, five and ten percent critical values are reported.

| Country    | ADF  | \( t_{KSS} \) | SURADF | 1%    | 5%    | 10%   | \( SUR_{KSS} \) | 1%    | 5%    | 10%   |
|------------|------|---------------|--------|-------|-------|-------|----------------|-------|-------|-------|
| Australia  | -0.971 | -1.229 | -1.319 | -3.891 | -3.176 | -2.834 | -1.516 | -4.877 | -3.874 | -3.526 |
| Austria    | -1.735 | -1.754 | -1.599 | -4.203 | -3.363 | -2.954 | -2.606 | -3.952 | -3.347 | -3.015 |
| Belgium    | -2.338 | -1.76  | -2.639 | -4.064 | -3.446 | -3.127 | -3.501** | -4.032 | -3.370 | -3.012 |
| Canada     | -2.409 | -1.218 | -2.826 | -4.045 | -3.403 | -3.022 | -4.443** | -4.654 | -4.020 | -3.649 |
| Denmark    | -1.922 | -1.523 | -0.551 | -4.010 | -3.318 | -2.972 | -3.449** | -4.109 | -3.415 | -3.061 |
| Finland    | -2.730* | -1.612 | -2.881 | -3.819 | -3.204 | -2.874 | -3.812** | -4.092 | -3.487 | -3.119 |
| France     | -2.282 | -0.861 | -0.348 | -4.208 | -3.342 | -2.977 | -4.326** | -4.635 | -3.958 | -3.583 |
| Germany    | -4.190*** | -1.748 | -3.145* | -4.149 | -3.501 | -3.136 | -3.934*** | -3.752 | -3.133 | -2.799 |
| Greece     | -1.525 | -1.440 | -1.379 | -4.090 | -3.362 | -3.049 | -1.933 | -3.764 | -3.171 | -2.871 |
| Ireland    | -1.061 | -1.21  | -3.170* | -3.952 | -3.239 | -2.912 | -2.459 | -4.127 | -3.498 | -3.137 |
| Italy      | -1.595 | -1.529 | 3.064 | -4.079 | -3.418 | -3.096 | -1.497 | -3.936 | -3.269 | -2.933 |
| Japan      | -1.426 | -1.735 | -1.461 | -3.604 | -3.032 | -2.27  | -1.043 | -3.495 | -2.947 | -2.627 |
| Netherlands| -1.380 | -1.436 | -1.530 | -4.161 | -3.481 | -3.149 | -0.861 | -3.914 | -3.313 | -2.981 |
| New Zealand| -2.281 | -1.249 | -3.472** | -4.014 | -3.343 | -2.997 | -3.875** | -3.981 | -3.337 | -2.985 |
| Norway     | -1.845 | -1.603 | -4.240** | -3.871 | -3.267 | -2.937 | -4.723*** | -3.991 | -3.309 | -2.947 |
| Portugal   | -1.701 | -1.609 | -3.179** | -3.609 | -3.027 | -2.694 | -3.714** | -3.770 | -3.120 | -2.767 |
| Spain      | -1.501 | -1.379 | -0.632 | -4.398 | -3.643 | -3.245 | -1.162 | -4.390 | -3.655 | -3.295 |
| Sweden     | -2.254 | -1.893 | -1.941 | -4.251 | -3.485 | -3.064 | -1.815 | -4.344 | -3.699 | -3.329 |
| Switzerland| -2.080 | -1.700 | -2.341 | -4.161 | -3.457 | -3.068 | -1.959 | -4.184 | -3.511 | -3.131 |
| United Kingdom | -1.225 | -1.275 | -2.067 | -3.969 | -3.309 | -2.927 | -2.784 | -3.898 | -3.249 | -2.919 |

NOTES: ***,**, and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively. Critical values are calculated by Monte Carlo simulation with 10,000 draws, tailored to the present sample size.
in columns 5-7 respectively, obtained from simulations based on observations for each series and 10,000 replications using the lag and covariance structure from the panel of unemployment data series for each of the 20 panel members. Findings from columns five to twenty indicate that unemployment rate is non-stationary for 15 countries. Finally, we apply panel framework of non-linear unit-root test to test stationarity for each series in the eighth column of Table 1. It is interesting that the results indicate the stationarity in unemployment rate holds in these countries (Belgium, Canada, Denmark, Finland, France, Germany, New Zealand, Norway and Portugal).

Results from Table 1 conclude that failing to control the non-linearity of data leads the SURADF test to be a conservative test relative to the $SUR_{KS}$ test. Our evidence points that the hysteresis hypothesis holds true for 11 countries studied here. The government’s monetary policies should be nature for other 9 countries in the long term if they only affect nominal variables and have a transient effect on the unemployment rate which converges sooner or later to its nature level. Whenever evidence of hysteresis is found, there exists room to decrease the unemployment rate without changing any structure in the organization of the labor market. It has important implications for government fiscal and/or monetary stabilization policy. This suggests that there is a role for greater government intervention to address unemployment issues, particularly which are designed to re-enfranchise the long-term unemployed.

A major policy implication of our study is that a stabilization policy may have some permanent effect on the unemployment rates for the G-20 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 paper, it will be investigated in a future study.

**CONCLUSION**

This study employs the non-linear and panel unit root by Wu and Lee (2009) to assess the hysteresis hypothesis in unemployment from G20 countries. Standard linear ADF, Kapetanios et al. (2003) and Breuer et al. (2001) statistics show that the data are basically non-stationary for almost these countries. In contrast, when we adopt a non-linear panel unit-root model which has higher power than a standard univariate, non-linear and panel unit root statistic to reject a false null hypothesis of unit root behavior, the empirical evidence suggests that hysteresis hypothesis is not supported for Belgium, Canada, Denmark, Finland, France, Germany, New Zealand, Norway and Portugal. This might offer an alternative explanation for the difficulty researchers have encountered in rejecting the hysteresis hypothesis for unemployment. In addition, the results point to the importance of considering some degree of nonlinearity and heterogeneity associated in the G20 case with institutional difference in their labor markets.

These results have important implications for labor market reforms, as well as macro stabilization policy in the G20. Standard progressive macroeconomic stabilization policies do not appear to have a long lasting impact on unemployment, at least not longer than what the G20 experience reveals. However, deeper reforms of both labor and goods markets which might constitute “large” shocks that are likely to continue in the G20, should take into account the possibility of having a long lasting impact on the equilibrium level of unemployment.

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