International Journal of Economics and Financial Issues
Vol. 3, No. 3, 2013, pp.694-700
ISSN: 2146-4138
www.econjournals.com

Testing Unemployment Persistence in Central and Eastern European Countries

Giray Gozgor
Department of International Trade and Business,
Dogus University, Turkey.
Email: ggozgor@dogus.edu.tr

ABSTRACT: This study investigates whether stochastic properties of the unemployment rate in ten Central and Eastern European Countries (CEE) countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia can be explained by the non-accelerating inflation rate of unemployment or the hysteresis hypotheses. We primarily show the cross-sectional dependence in unemployment rates, and then apply panel-based unit root tests that take cross-section dependence into account. The empirical findings indicate that there is no mean-reverting process in unemployment rates for ten CEE countries. Thus the results provide evidences for validity of the hysteresis hypothesis—unemployment persistence—in related CEE countries.

Keywords: Unemployment persistence; Panel-based unit root tests; Cross-section dependence
JEL Classification: C23; J64

1. Introduction

Involuntary unemployment was not an economic problem in the planned economies of Central and Eastern Europe (henceforth CEE) countries. In the early 1990s, when the transition process started, it was commonly suggested that unemployment rates in CEE countries would spike in short term but they should rapidly return to the "natural" marginal levels. However, events showed that transition shocks would have permanent effects on the unemployment rates (Cuestas et al., 2011).

Dynamics of unemployment are basically described by two theoretical views: the non-accelerating inflation rate of unemployment (NAIRU) hypothesis and the hysteresis hypothesis (Romer, 2011: ch.10). The first states that fluctuations in unemployment rates are "cyclical deviations" from the "natural-rate", or the NAIRU. Phelps (1968) and Friedman (1968), who firstly proposed the NAIRU hypothesis, indicated that unemployment rates should follow a stationary process. However, against this proposition of the NAIRU—mainly due to the persistent characteristics of unemployment rates in 1970s and early 1980s—Blanchard and Summers (1986), who firstly proposed the hysteresis hypothesis, defined unemployment rates as a unit root process. They suggested that shocks on unemployment rate would not have temporary effects, thus the cyclical fluctuations lead to long term persistence in labour markets. In short, according to the hysteresis hypothesis, "equilibrium rate of unemployment" shifts from one level to another by an exogenous shock.

In fact, these two opposite views are widely tested by the "individual" unit root tests, such as that proposed by Dickey and Fuller (1979), Kwiatkowski et al. (1992), Zivot and Andrews (1992), Elliott et al. (1996), Perron (1989, 1997) and Ng and Perron (2001). These unit root tests are applied into developing countries or developed economies, particularly into the Organization for Economic Co-operation and Development (OECD) countries. Following the seminal paper of Blanchard and Summers (1986); Brunello (1990), Mitchell (1993), Jaeger and Parkinson (1994), Roed (1996), Papell et al. (2000), Feve et al. (2003), Camarero and Tamarit (2004), Chang et al. (2005), Camarero et al. (2006), and Lee and Chang (2008) focused on developed or the OECD countries and they have reached mixed empirical results. However, mostly, they have obtained the evidences with validity of the hysteresis hypothesis. Some of these papers have used panel-based unit root (henceforth PUR) tests; while some of them have considered "individual" unit root tests.

However, similar literature is that to test the hysteresis hypothesis or the NAIRU hypothesis within an empirical regularity for unemployment rates in transition economies is limited. For instance, Leon-

Ledesma and McAdam (2004) used monthly data for 12 CEE countries, and 15 European Union (EU) countries from January 1991 to May 2001. Their analysis included individual unit root tests, PUR tests, and unit root tests allowing for structural breaks. As a result, they obtained the evidences against the hysteresis hypothesis. Camarero et al. (2005) used monthly data for eight CEE countries as well as Malta for the period from January 1991 to November 2003. For all countries, the hysteresis hypothesis was rejected by individual and structural breaks allowing unit root tests. Camarero et al. (2008) then employed "first generation" PUR tests and PUR tests allowing for structural breaks within the same sample in Camarero et al. (2005). They reached almost similar findings with Leon-Ledesma and McAdam (2004) and Camarero et al. (2005). In other words, accounting for exogenous shocks gave evidences to the validity of the natural-rate hypothesis. Cuestas and Ordonez (2011) used monthly data for eight CEE countries over the period January 1998-December 2007, and found that the unemployment rates in most countries are stationary process around a non-linear trend but there are common factors for five CEE countries. Their findings showed that CEE countries shared a common non-linear component which accounts for the observed co-movement within them. Cuestas et al. (2011) employed some recent unit root tests, accounting also for unit root tests allowing for structural breaks, within the same sample in Cuestas and Ordonez (2011). Their findings are similar with Cuestas and Ordonez (2011) but they indicated that significant degree of persistence in unemployment is appeared in CEE countries.

As seen, the recent papers of Cuestas and Ordonez (2011) and Cuestas et al. (2011) refer common factors and significant degree of persistence in the unemployment rates in CEE countries. Indeed, there are several reasons to think that there is interdependence or common factors in CEE countries that may cause their unemployment rates persist over time. First, the recent empirical evidence supports the common factors and interdependence in unemployment rate in CEE countries (Cuestas et al., 2011). Second, simultaneous increase in unemployment rate during the period of the global recession both at the global level and across countries in CEE may produce empirical evidence in favor of strong cross-sectional dependence among CEE countries. Third, the issue can be a result of the local spillover effects among countries in the region (Banerjee et al., 2010). Fourth, cross-sectional dependence is the prominent feature of the panel data analysis. The interdependence among panel units can be confirmed by robust and efficient panel-based tests, and this refers common (global) shocks that heterogeneously impact across countries, such as those observed in the energy crises in 1970s and the great global recession of 2008-09 (Bakas and Papapetrou, 2012). In this context, the results of the cross-sectional independence test of Pesaran (2004) suggest that panel unit root tests that do not take cross-sectional dependence into account would report statistically spurious results. Inherently, if the hysteresis hypothesis presents in the unemployment rates, the conclusion that is should be robust to the presence of cross-sectional dependence (Camarero et al., 2006).

In this paper we aim to investigate whether the stochastic properties of the unemployment rate in Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia can possibly be explained by the NAIRU hypothesis or the hysteresis hypothesis. This paper aims to contribute into the related literature in two ways: First, to the best of our knowledge, this paper is the first that to use "second generation" PUR tests that assuming cross-section dependence, in order to examine unemployment characteristics in the CEE countries. We suggest that the issue of cross-sectional dependence may be also important, due to the literature recently concluded that there is a common component and a significant degree of persistence in the unemployment rate in CEE countries. Indeed, heterogeneous or homogenous PUR tests that assuming cross-sectional independence are widely applied in the literature. However, to the best of our knowledge, there is still no empirical result that obtained from the "heterogeneous second generation" PUR tests. Given that the individual unit root tests are also characterized with power problems, this paper mainly contributes into the related literature for applying "more powerful" second generation PUR tests to stochastic properties of the unemployment rate in CEE countries. Second, this study analyses the stochastic features of unemployment rates over the period from 1998 to early 2012, namely we focus on a period in which the main transition shocks had clearly disappeared, and CEE countries provided strong economic growth and institutional transformation. Furthermore, our sample and methodology allow analyzing whether economic growth trend and labour market conditions of CEE countries have been shifted by the great global recession of 2008-09 or not.

The remainder of this paper is organized as follows. In Section 2 we explain the data and the econometric methodology. Section 3 discusses the empirical results, and Section 4 presents our concluding remarks.

2. Data and Econometric Methodology

2.1. Data

This paper focuses on the period from January 1998 to January 2012, and the frequency of data is monthly. We investigate the stochastic properties of unemployment rate in Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. We select this sample, mainly because "clear data" for a balanced panel are available over related period. Second, our data cover the period that CEE countries prepared for and gained membership of the EU by including their substantial structural reforms for labour markets. Third, some part of the related period was commonly characterized by "high-trend" economic growth in CEE countries (Cuestas et al., 2011). Fourth, this period included shocks—i.e. the Russian crisis in 1998 or the great global recession of 2008-09—that possibly affect on unemployment rates in CEE countries.

We use the Labour Force Survey (LFS) based seasonally adjusted unemployment rates of the EU, and obtain the data from the database of the European Central Bank. We report summary of the descriptive statistics in Table 1 as follows:

Table 1. Summary of Descriptive Statistics of the Unemployment Rates

Statistics	Bulgaria	The Czech Republic	Estonia	Hungary	Latvia
Mean	12.04	8.26	10.38	7.67	9.02
Median	11.5	8.6	10.4	7.3	8.6
Maximum	19.2	10.9	18.8	11.3	17.3
Minimum	5.8	5.0	3.9	5.6	4.8
Standard Deviation	3.92	1.37	3.53	1.83	2.82
Observation	169	169	169	169	169
Statistics	Lithuania	Poland	Romania	Slovakia	Slovenia
Mean	12.01	14.4	7.41	13.58	6.45
Median	12.9	13.7	7.1	13.2	6.5
Maximum	18.4	20.7	13.2	19.8	8.7
Minimum	4.2	8.8	3.7	7.4	4.2
Standard Deviation	4.27	3.44	2.46	3.51	1.02
Observation	169	169	169	169	169

2.2. Econometric Methodology

Individual unit root tests are subject to the intensive criticism, because of the low-power in small samples. Therefore, "first generation" PUR tests, such as that proposed by Harris and Tzavalis (1999), Breitung (2000), Hadri (2000), Choi (2001), Levin et al. (2002), Im et al. (2003) have begun to be employed in the literature. These PUR tests can be arranged in subgroups by considering cross-section dependence or independence, as well as heterogeneous or homogenous unit roots. However, the literature also suggests that we should reconsider the reliability and robustness of the results from "first generation" PUR tests. Homogenous PUR tests can report the bias findings, and relative low-power of these tests can be strong. On the other hand, the effects of cross-sectional dependence on unemployment rates can be significant in related CEE countries. Therefore, we firstly perform a formal test of Pesaran (2004) for cross-section dependence. Our result shows the presence of cross-section dependence, and therefore "first-generation" PUR tests that assuming cross-section independence should be replaced in favour of "second-generation" PUR tests (Gozgor, 2012). There are now a number of efficient "second-generation" PUR tests, such as that proposed by Bai and Ng (2002, 2004), Chang (2002, 2004), Choi (2005), Moon and Perron (2004), Phillips and Sul (2003), and Pesaran (2007) but given the relatively small sample and possible structural breaks in the covering period, the PUR test of Pesaran (2007) would be a good choice (Sarafidis et al., 2009).

Pesaran (2007) proposed the PUR test for balanced panel with *N* cross-section and *T* time series data. He firstly defined a heterogonous and linear model as follows:

$$Y_{it} = (1-\rho_i)u_i + \rho_i Y_{it-1} + u_{it} \quad (1)$$

In this model, u_{it} is an error term, and it has common factor structure, and we can separately write it as follows:

$$u_{it} = \gamma_i f_t + e_{it} \quad (2)$$

In Equation (2), f_t is the unobserved common factor, γ_i is the loading of corresponding factor, e_{it} is independent from the common factor, and it is an idiosyncratic error term independent across i. We can now rewrite a simple heterogonous and linear model as follows:

$$\Delta Y_{it} = \alpha_{0i} + \alpha_{1i} Y_{it-1} + \gamma_i f_t + e_{it} \quad (3)$$

In this model, $\alpha_{0i} = (1-\rho_i)u_i$ and $\alpha_{1i} = (\rho_i - 1)$. At this point, Pesaran (2007) suggested the Cross-sectionally Augment (CADF) test equation as the cross-sectional averages of the first differences and the lagged levels of variable. Thus he accounted for the cross-sectional dependence in the common factor. Then, the CADF equation is simply given by as follows:

$$\Delta Y_{it} = \alpha_i + b_i Y_{it-1} + c_i \overline{Y}_{t-1} + d_i \Delta \overline{Y}_t + \varepsilon_{it} \quad (4)$$

In the CADF equation, $\overline{Y}_{t-1} = \sum_{i=1}^{N} Y_{it-1}$ and $\Delta \overline{Y}_t = \sum_{i=1}^{N} \Delta Y_{it}$. ε_{it} is the error term. Null hypothesis of the Pesaran's PUR test is, $\rho_i = 1$ for all i against and the heterogeneous alternative hypothesis is $\rho_i < 1$ for some i is given by the cross-sectional average of the $CADF_i$. This is calculated as such that,

$$\overline{CADF} = N^{-1} \sum_{i=1}^{N} CADF_i \quad (5)$$

3. Empirical Results

We now apply the CD test procedure into the unemployment rates in ten CEE countries and report the findings in Table 2. We also report the results of the MW of Maddala and Wu (1999) and the Cross-sectionally Augmented PUR (CIPS) tests of Pesaran (2007) in Table 3.

Table 2. Results of the CD test of Pesaran (2004) for Unemployment Rates in ten CEE Countries

The CD-stat in Pesaran (2004)	6.995 (0.000)
Average absolute value of the off-diagonal elements	0.254

Notes: The CD test of Pesaran (2004) is defined under the null hypothesis of cross-sectional independence in the unemployment rates in ten CEE countries. The p-value is in parenthesis.

Table 3. Results of the Cross-sectional Dependence PUR tests

Heterogeneous Unit Root Maddala and Wu (1999) MW	Constant	Constant and Trend
ADF-Fisher Inverse Chi-squared	14.653 (0.795)	14.641 (0.796)
ADF-Fisher Inverse Normal	0.737 (0.769)	2.041 (0.979)
ADF-Fisher Inverse Logit	0.650 (0.741)	2.127 (0.981)
ADF-Fisher Modified Inverse Chi-squared	-0.845 (0.801)	-0.847 (0.801)
PP-Fisher Inverse Chi-squared	16.636 (0.676)	16.643 (0.676)
PP-Fisher Inverse Normal	-0.246 (0.402)	0.811 (0.791)
PP-Fisher Inverse Logit	-0.221 (0.413)	0.796 (0.785)
PP-Fisher Modified Inverse Chi-squared	-0.531 (0.702)	-0.530 (0.702)
Heterogeneous Unit Root Pesaran (2007) CIPS	Constant	Constant and Trend
Zt-bar Statistic	1.249 (0.894)	0.479 (0.684)

Notes: The MW and the CIPS tests are defined under the null hypothesis of non-stationary unemployment rates in ten CEE countries. The CIPS test assumes cross-section dependence in form of a single unobserved common factor. The optimal number of lag is chosen by the Akaike Information Criterion (AIC). Probabilities for Fisher tests are computed by using related distribution. The p-values are in parentheses.

As seen in Table 2, the CD test of Pesaran (2004) strongly rejects the null hypothesis of no cross-sectional independence. Thus following results of the CD test of Pesaran (2004), we apply the cross-sectional dependence PUR tests, such as that proposed by Maddala and Wu (1999) and Pesaran (2007). Maddala and Wu (1999) proposed an alternative approach to PUR tests by using Fisher's results to derive tests that combine the p-values from individual unit root tests. In this paper we use bootstrap versions for the PUR test of Maddala and Wu (1999), due to the proposed methodology to way out the cross-sectional independence problem by using bootstrap methods. Although they do not fully eliminate the size distortions in the cross-sectional correlations, their bootstrap methods result in a decrease in them (Sarafidis et al., 2009). In short, the bootstrap versions of this first generation PUR test perform much better.

As seen in Table 3, the PUR tests of Maddala and Wu (1999) and Pesaran (2007) cannot reject the null hypothesis of the unit root hypothesis is valid. The results from PUR tests suggest that there is no mean-reversion in unemployment rates in ten CEE countries. Thus empirical findings strongly provide significant support for the existence of the hysteresis hypothesis in unemployment rates in ten CEE countries.

4. Concluding Remarks

This paper investigates whether the stochastic properties of the unemployment rate in Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia can possibly be explained by the NAIRU hypothesis or the hysteresis hypothesis for the period from January 1998 to January 2012 within monthly data set. We primarily test that the cross-sectional dependence in unemployment rates in ten CEE countries by using the CD test of Pesaran (2004). We then apply PUR tests that can be arranged in groups by cross-section dependence, such that proposed by Maddala and Wu (1999) and Pesaran (2007). The results from these PUR tests suggest that there is no mean-reversion in unemployment rates in ten CEE countries. In other words, the empirical findings provide significant support for the existence of persistence in unemployment rates, and the hysteresis hypothesis is empirically valid in related CEE countries. We also suggest that the covering period in this paper was not only characterized by the high-trend economic growth in CEE countries, but also included a number of shocks—the Russian crisis in 1998 and the great global recession of 2008-09—that possibly affected on unemployment rates in CEE countries. We find the persistent effects upon unemployment rates.

The main policy implication may be deduced from this study is that monetary and fiscal policy frameworks would cause long-lasting impacts on the unemployment rates in CEE countries. Noteworthy implication of the empirical findings is that global or domestic shocks upon the labour markets in CEE countries would not have provisional effects. Therefore, the demand-stimulation policy frameworks can be effective in order to reduce the equilibrium rates of unemployment in the long-run. Furthermore, the main conclusion in this study is in the line with the recent findings of Cuestas et al. (2011).

In addition, we suggest that the presence of persistence in unemployment rates for related CEE countries still deserves a further investigation, particularly using a longer-span data and some other recent cross-sectionally dependent PUR test methods. We would like to stand out that a better alternative may be that of relying on a nonlinear PUR test based on a smooth transition model, such as that proposed by Chang (2002, 2004) and Cerrato et al. (2011).

Acknowledgments

The author would like to thank the editor and two anonymous referees for their valuable comments on the paper.

References

Bai, J., Ng, S. (2002), *Determining the Number of Factors in Approximate Factor Models*. Econometrica, 70(1), 191-221.

Bai, J., Ng, S. (2004), *A PANIC Attack on Unit Roots and Cointegration*. Econometrica, 72(4), 1127-1178.

Bakas, D., Papapetrou, E. (2012), *Unemployment in Greece: Evidence from Greek Regions*, Bank of Greece Working Paper, 146.

Banerjee, A., Eberhardt, M., Reade, J.J. (2010), *Panel Estimation for Worriers*, University of Oxford, Department of Economics Discussion Paper Series, 514.

Blanchard, O.J., Summers, L.H. (1986), *Hysteresis and the European Unemployment Problem*. NBER Macroeconomics Annual, Vol. 1, MIT Press, 15-90.

Breitung, J. (2000), The local power of some unit root tests for panel data, in: B.H. Baltagi, T.B. Fomby, R.C. Hill (Ed.), Nonstationary Panels, Panel Cointegration, and Dynamic Panels. Advances in Econometrics, Vol. 15, JAI Press, 161-178.

Brunello, G. (1990), *Hysteresis and the Japanese Unemployment Problem: A Preliminary Investigation*. Oxford Economic Papers, 42(3), 483-500.

Camarero, M., Carrion-i-Silvestre, J.L., Tamarit, C. (2005), *Unemployment Dynamics and NAIRU Estimates for Accession Countries: A Univariate Approach*. Journal of Comparative Economics, 33(3), 584-603.

Camarero, M., Carrion-i-Silvestre, J.L., Tamarit, C. (2006), *Testing for Hysteresis in Unemployment in OECD Countries: New Evidence using Stationarity Panel Tests with Breaks*. Oxford Bulletin of Economics and Statistics, 68(2), 167-182.

Camarero, M., Carrion-i-Silvestre, J.L., Tamarit, C. (2008), *Unemployment Hysteresis in Transition Countries: Evidence Using Stationarity Panel Tests with Breaks*. Review of Development Economics, 12(3), 620-635.

Camarero, M., Tamarit, C. (2004), *Hysteresis vs. Natural Rate of Unemployment: New Evidence for OECD Countries*. Economic Letters, 84(3), 413-417.

Cerrato, M., de Peretti, C., Larsson, R., Sarantis, N. (2011), *A Nonlinear Panel Unit Root Test under Cross section Dependence*. University of Glasgow Business School-Economics Working Papers, 2011/08.

Chang, T., Lee, K.C., Nieh, C.C., Wei, C.C. (2005), *An Empirical Note on Testing Hysteresis in Unemployment for ten European Countries: Panel SURADF Approach*. Applied Economics Letters, 12(14), 881-886.

Chang, Y. (2002), *Nonlinear IV Unit Root Tests in Panels with Cross-sectional Dependency*. Journal of Econometrics, 110(2), 261-292.

Chang, Y. (2004), *Bootstrap Unit Root Tests in Panels with Cross-sectional Dependency*. Journal of Econometrics, 120(2), 263-293.

Choi, I. (2001), *Unit Root Tests for Panel Data*. Journal of International Money and Finance, 20(2), 249-272.

Choi, I. (2005), Combination unit root tests for cross-sectionally correlated panels, in: P.D. Corbae, S.N. Durlauf, B.E. Hansen (Ed.) Econometric Theory and Practice: Frontiers of Analysis and Applied Research: Essays in Honor of Peter C.B.Phillips, chapter 12, Cambridge University Press.

Cuestas, J.C., Ordonez, J. (2011), *Unemployment and Common Smooth Transition Trends in Central and Eastern European Countries*. Economic Issues, 16(2), 39-52.

Cuestas, J.C., Gil-Alana, L.A., Staehr, K. (2011), *A Further Investigation of the Unemployment Persistence in European Transition Economies.* Journal of Comparative Economics, 39(4), 514-532.

Dickey, D.A., Fuller, W.A. (1979), *Distribution of the Estimators for Autoregressive Time Series with a Unit Root*. Journal of the American Statistical Association, 74(366), 427-431.

Elliott, G., Rothenberg, T.J., Stock, J.H. (1996), *Efficient Tests for an Autoregressive Unit Root*. Econometrica, 64(4), 813-836.

Feve, P., Henin, P.Y., Jolivaldt, P. (2003), *Testing for Hysteresis: Unemployment Persistence and Wage Adjustment*. Empirical Economics, 28(3), 535-552.

Friedman, M. (1968), *The Role of Monetary Policy*. American Economic Review, 58(1), 1-17.

Gozgor, G. (2012), *Hysteresis in Regional Unemployment Rates in Turkey*. International Journal of Economics and Finance, 4(9), 175-181.

Hadri, K. (2000), *Testing for Stationarity in Heterogeneous Panel Data*. Econometrics Journal, 3(2), 148-161.

Harris, R.D.F., Tzavalis, E. (1999), *Inference for Unit Roots in Dynamic Panels where the Time Dimension is Fixed*. Journal of Econometrics, 91(2), 201-226.

Im, K.S., Pesaran, M.H., Shin, Y. (2003), *Testing for Unit Roots in Heterogeneous Panels*. Journal of Econometrics, 115(1), 53-74.

Jaeger, A., Parkinson, M. (1994), *Some Evidence on Hysteresis in Unemployment Rates*. European Economic Review, 38(2), 329-342.

Kwiatkowski, D., Phillips, P.C.B., Schmidt, P., Shin, Y. (1992), *Testing the Null Hypothesis of Stationary against the Alternative of a Unit Root: How Sure are we that Economic Time Series Have a Unit Root?*. Journal of Econometrics, 54(1-3), 159-178.

Lee, C.C., Chang, C.P. (2008), *Unemployment Hysteresis in OECD Countries: Centurial Time Series Evidence with Structural Breaks*. Economic Modelling, 25(2), 312-325.

Leon-Ledesma, M.A., McAdam, P. (2004), *Unemployment, Hysteresis and Transition*. Scottish Journal of Political Economy, 51(3), 377-401.

Levin, A., Lin, C.F., Chu, C. (2002), *Unit Root Tests in Panel Data: Asymptotic and Finite-sample Properties*. Journal of Econometrics, 108(1), 1-24.

Maddala, G.S., Wu, S. (1999), *A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test*. Oxford Bulletin of Economics and Statistics, 61(S), 631-652.

Mitchell, W.F. (1993), *Testing for Unit Roots and Persistence in OECD Unemployment Rates*. Applied Economics, 25(12), 1489-1501.

Moon, H.R., Perron, B. (2004), *Testing for a Unit Root in Panels with Dynamic Factors*. Journal of Econometrics, 122(1), 81-126.

Ng, S., Perron, P. (2001), *Lag Selection and the Construction of Unit Root Tests with Good Size and Power*. Econometrica, 69(6), 1519-1554.

Papell, D.H., Murray, C.J., Ghiblawi, H. (2000), *The Structure of Unemployment*. Review of Economics and Statistics, 82(2), 309-315.

Perron, P. (1989), *The Great Crash, the Oil Price Shock and the Unit Root Hypothesis*. Econometrica, 57(6), 1361-1401.

Perron, P. (1997), *Further Evidence on Breaking Trend Functions in Macroeconomic Variables*. Journal of Econometrics, 80(2), 355-385.

Pesaran, M.H. (2004), *General Diagnostic Tests for Cross Section Dependence in Panels*. IZA Discussion Paper Series, 1240.

Pesaran, M.H. (2007), *A Simple Panel Unit Root Test in the Presence of Cross-section Dependence*. Journal of Applied Econometrics, 22(2), 265-312.

Phelps, E. (1968), *Money-wage Dynamics and Labor-market Equilibrium*. Journal of Political Economy, 76(4), 678-711.

Phillips, P.C.B., Sul, D. (2003), *Dynamic Panel Estimation and Homogeneity Testing under Cross Section Dependence*. Econometrics Journal, 6(1), 217-259.

Roed, K. (1996), *Unemployment Hysteresis-macro Evidence from 16 OECD Countries*. Empirical Economics, 21(4), 589-600.

Romer, D. (2011), *Advanced Macroeconomics*. Fourth Edition, New York: McGraw-Hill/Irwin.

Sarafidis, V., Yamagata, T., Robertson, D. (2009), *A Test of Cross Section Dependence for a Linear Dynamic Panel Model with Regressors*. Journal of Econometrics, 148(2), 149-161.

Zivot, E., Andrews, D. (1992), *Further Evidence on the Great Crash, the Oil Price Shock, and the Unit Root Hypothesis*. Journal of Business and Economic Statistics, 10(3), 251-270.