Hysteresis in European labour market

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Abstract

This paper revisits the hysteresis and unemployment problem in Europe by using new data and some innovative methods. Blanchard and Summers are among first researchers to detect the existence of unemployment hysteresis and to attribute the hysteresis effects to the European unemployment problem (Blanchard and Summers, 1986). Despite numerous empirical inquiries on this topic, researchers have not decided whether the hysteresis would exist in unemployment. Thus, this paper chooses five countries in the region, namely France, Germany, Italy, Spain and United Kingdom, and examines systematically their unemployment behaviours by employing several different econometric tests, such as the SUR-ADF test (Breuer *et al.*, 2002), the Fourier ADF (FADF) test (Enders and Lee, 2012) and the SUR-Fourier ADF (SUR-FADF) test. These four tests produced consistent findings that unemployment rates in these five European countries could be described as the unit root process. In other words, these different unit root tests uniformly detected the existence of hysteresis in these five countries in line with the hysteresis hypothesis.

Key words
Unemployment hysteresis, Europe, unit root, nonlinear

JEL codes
E24, C22

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1. Introduction

In their seminal paper, Blanchard and Summers pointed a problem of unemployment hysteresis and its impacts on the European labour market (Blanchard and Summers, 1986). Their assertion to attribute the existence of hysteresis to the persistently high rates of unemployment has some important theoretical and policy implications. From a theoretical perspective, the existence of hysteresis in unemployment dynamics would pose a challenge to an important theoretical foundation of the mainstream macroeconomics which is known as the natural rate of unemployment (Mitchell, 1993; Song and Wu, 1998). According to the natural rate hypothesis, the higher-than-normal unemployment rate would automatically revert to the equilibrium level after an economic recession (Phelps 1967; Friedman, 1968; Phelps 1968). However, by going against the tide, Blanchard and Summers (1986) boldly questioned the validity of natural rate hypothesis and effectively denied the mean-reversion characteristics of unemployment behaviours.

Furthermore, from a policy perspective, the existence of hysteresis in unemployment rates means that the policymakers would have a grave responsibility to deal with high unemployment problems. According to the hysteresis hypothesis, the higher-than-normal unemployment rates would not revert to the equilibrium level after an economic downturn. In other words, the higher level of unemployment rate would persist without an appropriate government intervention. By contrast, the proponents of the natural rate hypothesis may have a strong faith in the innate ability of the labour market and the endogenous mechanism of the labour transaction. In other words, the natural rate hypothesis may predict that the labour market would naturally recover from a recession without any external intervention. In this sense, the policymakers should have a responsibility to improve the labour market fundamentals in the long-run, but they should not pay too much attention to "temporary" deviations of unemployment in the short-run.

There have been numerous empirical inquiries to test the validity of hysteresis hypothesis for more than three decades. However, the empirical findings are mixed and contradictory (Fosten and Ghoshray, 2011; Cheng *et al.*, 2012). In other words, researchers have not decided whether hysteresis would exist in the unemployment dynamics. Thus, this paper aims to revisit the hysteresis and European unemployment problem by using new data and some innovative methods. For this purpose, the current study selects five countries in Europe, namely France, Germany, Italy, Spain and United Kingdom, and examines their unemployment dynamics by employing several different econometric tests, such as the SUR-ADF test (Breuer *et al.*, 2002), the Fourier ADF (FADF) test (Enders and Lee, 2012) and the SUR-Fourier ADF (SUR-FADF) test.

From an empirical economics perspective, there are three major contributions in this study. Firstly, this paper systematically and innovatively revisits the old but crucial issue of the labour market in Europe. The highly persistent unemployment problem is the unsolved puzzle that has still intrigued many researchers in two contradicted schools of thoughts. Some researchers who believe in the market-clearing mechanism of the labour market still deny the existence of unemployment hysteresis while other researchers who claim the path-dependency of unemployment behaviour urge policymakers to take necessary steps to deal with unemployment problem. In this sense, the findings from current study would have some important research and practical implications. Secondly, the lack of sufficient data on unemployment rates has become a hindrance to conduct empirical analysis to examine the existence of hysteresis in unemployment dynamics. In order to overcome the insufficient

number of observation, this paper uses the Bootstrap method to estimate the critical values (Park 2003). The Bootstrap method is expected to produce more accurate critical values for the empirical analysis of the unemployment behaviours with insufficient data. Finally and more importantly, this paper uses the SUR-Fourier ADF (SUR-FADF) to examine the unemployment dynamics in the region. The SUR-FADF test is a Fourier function based-extension of the SUR-ADF test which is suggested by Breuer *et al.* (2002). This new unit root test is based on the Fourier approximation function to capture the unknown structural breaks or unattended nonlinearity in the deterministic component in the time-series data. According to Enders and Lee (2012), a Fourier approximation could be used to capture unknown structural breaks or unattended nonlinearity in the deterministic component of the model. At same time, this new test is also based on a system of equations estimated by the Seemingly Unrelated Regressions (SUR) method. Increasingly robust economic and business ties among the five countries in Europe are accompanied by a higher interdependence and a deeper integration of their labour markets. Therefore, the SUR-FADF tests is expected to yield better empirical results because these tests employ the SUR method that can take into account the contemporaneous cross-correlations of the error terms (Breuer *et al.* 2002).

This paper consists of five sections. Following this introductory section, the second section briefly reviews the existing literature on unemployment hysteresis in Europe. The third section discusses about the data and empirical methods. The fourth section reports the empirical findings. The final section is conclusion.

2. Literature review

Blanchard and Summers are among the first researchers who detected existence of hysteresis in unemployment dynamics and examined systematically unemployment problem in European labour market. They used the autoregressive moving average (ARMA) method to examine the unemployment dynamics in three countries in Europe, namely France, Germany and UK, for the period of 1953-1984. They pointed a persistently high unemployment in Europe from the 1970s to the 1980s and they attributed existence of unemployment hysteresis to persistent unemployment problems in Europe. Blanchard and Summers refuted the basic assumption of the natural rate hypothesis that the "temporary" fluctuations in unemployment rates in the short-run would not have impact on the unemployment dynamics in the long-run. Instead, they argued that the increases in unemployment would have "permanent" impacts on the equilibrium level of unemployment rates (Blanchard and Summers, 1986).

Since then, numerous empirical studies have been devoted to examine unemployment hysteresis. The summary of major findings on the unemployment hysteresis in Western Europe is reported in Table 1.[2] As table shows, empirical findings are mixed and contradictory. Some researchers offered empirical findings to support the natural rate hypothesis (Camarero and Tamarit, 2004; Chang *et al.* 2005; Lin *et al.* 2008; Lee *et al.* 2009; Bolat *et al.* 2014) while other researchers provided empirical proofs for the hysteresis hypothesis (Mitchell, 1993; Røed, 1996; Strazicich *et al.*, 2002; León-Ledesma, 2002; Chang *et al.* 2005; Camarero *et al.,* 2006; Christopoulos and León-Ledesma, 2007; Chang, 2011; Chou and Zhang, 2012).

[2] There are several studies on unemployment hysteresis in Central and Eastern Europe (Furuoka, 2014a; Furuoka, 2014b). Furuoka (2014a) examined the unemployment hysteresis in Visegrad countries and Furuoka (2014b) analysed the unemployment hysteresis in fourteen regions of Czech Republic.

Discrepancies in their finding could be explained by differences in research methods. Since the 1990s, researchers have used the univariate unit roots, such as the augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test and the Dickey-Fuller Generalised Least Square (DF-GLS) test, to examine the unemployment hysteresis in Europe and they found existence of hysteresis in Europe (Mitchell, 1993; Røed, 1996; León-Ledesma, 2002; Christopoulos and León-Ledesma, 2007). For example, Mitchell (1993) used the ADF test and PP test to examine unemployment dynamics in France, Germany, Italy and UK for the period of 1960Q1-1991Q3 and found the unit root process of unemployment rates in these countries. Similarly, Røed (1996) employed the same test to test the unemployment hysteresis in France, Germany, Italy, Spain and UK for the period of 1970Q1-1994Q4. He also found the existence of hysteresis in unemployment rates in these countries. León-Ledesma (2002) applied the ADF test to examine the unemployment hysteresis in France, Germany, Italy, Spain and UK for the period of 1985Q1-1999Q4 and detected the unit root process of unemployment rates in these countries. Christopoulos, and León-Ledesma (2007) revisited the empirical study by Leon-Ledesma (2002) by using the same data with same countries and by applying the ADF test and DF-GLS test for empirical analysis. Their findings confirmed those from León-Ledesma (2002).

In the 2000, researchers started using more advanced methods, such as the unit root with structural break or the SUR-ADF test. Their findings are mixed. Some supported natural rate hypothesis (Camarero and Tamarit, 2004; Chang *et al.* 2005; Lin *et al.* 2008; Lee *et al.* 2009) while others supported hysteresis hypothesis (Strazicich *et al.*, 2002; Camarero *et al.,* 2006). For example, Strazicich *et al.* (2002) used the Lagrange Multiplier (LM) unit root test with structural break to examine the unemployment behaviours in France, Germany, Italy, Spain and UK for the period of 1955-1999 and pointed unit root process of unemployment rates in these countries. Camarero and Tamarit (2004) employed the SUR-ADF test to examine the unemployment dynamics in France, Germany, Italy, Spain and UK for the period of 1956-2001 and argued that unemployment rates in these countries are generally stationary process. Chang *et al.* (2005) also used the SUR-ADF test to examine the hysteresis in unemployment in France, Italy and UK and detected the unemployment hysteresis in these countries. Furthermore, Camarero *et al.* (2006) used the stationary test with structural break to examine unemployment behaviours in France, Germany, Italy, Spain and UK for the period of 1956-2001 and asserted that unemployment rates in these countries are unit root process. Furthermore, Lin *et al.* (2008) applied the threshold autoregression (TAR) unit root test to examine the unemployment hysteresis in France, Germany and UK for the period of 1970M1-2005M4 and pointed stationary process of unemployment rates in these countries. Lee *et al.* (2009) also used the Lagrange Multiplier (LM) unit root test with two structural breaks to examine the unemployment behaviours in Germany, Italy, Spain and UK for the period of 1956-2001 and pointed stationary process of unemployment rates in these countries.

More recently, researchers employed the Fourier unit root test or unit root unit with structural break for their analysis. Some researchers detected hysteresis in unemployment (Chang, 2011; Chou and Zhang, 2012) and other researcher denied the existence of hysteresis (Bolat *et al.* 2014). For example, Chang (2011) examined the unemployment hysteresis in France, Italy, Spain and UK for the period of 1960-2009 by using the Fourier (Kwiatkowski–Phillips–Schmidt–Shin) KPSS test and pointed existence of hysteresis in these countries. Chou and Zhang (2012) used the SUR-ADF test and SUR-KSS (Kapetanious-Shin-Snell) test to examine the unemployment hysteresis in France, Germany, Italy, Spain and UK for the period of 1980-2008 and detected the hysteresis in these countries. Bolat *et al.* (2014) used

the panel KSS test and panel Fourier KSS test to examine the unemployment behaviours in France, Germany, Italy and Spain for the period of 1980-2008 and asserted the stationary process of unemployment rates in these countries.

3. Data and methods

This paper examines the unemployment hysteresis in five countries in Europe, namely France, Germany, Italy, Spain and United Kingdom, for the period of 1991-2013. This paper uses the annual data of unemployment rates in these five countries which were obtained from the Eurostat (2014). The unemployment dynamics in these five European countries are depicted in Figure 1. Despite some minor differences, there are similar patterns in the unemployment dynamics in these five countries. In the beginning of the 1990s, unemployment rates in these countries are relatively low and gradually increased in the middle of the 1990s. In the end of the 1990s, unemployment rates in these countries, except Germany, started decreasing and reached the lowest levels of unemployment rates before the European economic crisis in the end of the 2000s. The unemployment rate in France was 7.4 percent in 2008 and increased to 10.3 percent in 2013. Similarly, the unemployment rate in Italy was 5.1 percent in 2007 and increased to 12.2 percent in 2013. Unemployment rates in Spain are relatively higher than other four countries. Its unemployment rate was 8.2 percent in 2007 and jumped up to 26.1 percent in 2013. By contrast, the unemployment rates in UK were relatively low among these five countries and its unemployment rate was 5.3 percent in 2007 and increased to 7.6 percent in 2013. On the other hand, the European economic crisis seems to have relatively low negative impact on the German labour market. Its unemployment rate was 11.2 percent 2005 and gradually decreased in the end of the 2000s and reached its lowest level or 5.2 percent in 2013 (Eurostat, 2014).

For the purpose of empirical analysis, this study employs the following four unit root tests, namely the ADF test (Dickey and Fuller, 1979), the SUR-ADF test (Breuer *et al.* 2001), the FADF test (Enders and Lee, 2012) and the SUR-FADF test. Among these four different tests, the SUR-Fourier ADF (SUR-FADF) test is a new unit root test which is based on the Seeming Unrelated Regressions (SUR) to capture the interdependency among the labour markets in Europe and the Fourier function to approximate the nonlinearity in the time series data. The number of observation is 23. The insufficient number of observation becomes a hindrance to conduct empirical analysis on unemployment hysteresis. In order to overcome the insufficient data, this paper uses the Bootstrap method to estimate the critical values (Park, 2003).

First of all, the SUR-ADF tests and FADF test could be considered as an extension of the ADF test. The linear ADF test is based on the following regression (Dickey and Fuller, 1979):

$$\Delta y_t = \alpha + \rho y_{t-1} + \sum_{j=1}^{p} \delta_j \Delta y_{t-j} + \varepsilon_t \qquad (1)$$

where Δ is difference operator, y_t is variable of interest, α is intercept, ρ and δ_j are the slope coefficients, p is the lag order of the autoregressive process and ε_t is the error term. Due to limited number of observation, the number of lag length is set as one and the present study estimates critical values for the ADF tests by using 10,000 replications of the Bootstrap simulation.

Secondly, the SUR-ADF tests employ the seemingly unrelated regressions (SUR) to estimate a system of the ADF equations. In this study, the system of the ADF equations can be expressed as (Breuer *et al.* 2001):

$$\Delta y_{1,t} = \alpha_1 + \rho_1 y_{1,t-1} + \sum_{j=1}^{p} \delta_j \Delta y_{2,t-j} + \varepsilon_{1,t}$$

$$\Delta y_{2,t} = \alpha_2 + \rho_2 y_{2,t-1} + \sum_{j=1}^{P} \delta_j \Delta y_{2,t-j} + \varepsilon_{2,t}$$

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$$\Delta y_{N,t} = \alpha_N + \rho_N y_{N,t-1} + \sum_{j=1}^{p} \delta_j \Delta y_{N,t-j} + \varepsilon_{N,t} \quad (2)$$

where ρ_i is the autoregressive coefficient for series *i*. In the SUR-ADF procedure, the significance of each ρ_i can be tested. Breuer *et al.* (2001) maintained that the SUR-ADF test could examine the unit-root null hypothesis for each individual panel member. They also suggested that one lagged augmentation was sufficient to address any problem arising from the serial correlation. Therefore, the lag length is set to be one in the current study. Current study also estimates critical values for the SUR-ADF test by using the Bootstrap simulation.

Thirdly, Enders and Lee (2012) have developed an ADF-type unit root test that uses a selected frequency component of a Fourier function to approximate the deterministic component of the model. Enders and Lee (2012) suggested using a Fourier approximation to capture unknown structural breaks or unattended nonlinearity in the deterministic component of the model. The nonlinear Fourier ADF statistic (τ_{DF}) is based on the following equation (Enders and Lee, 2012):

$$\Delta y_t = \alpha + \rho y_t + \gamma_1 \sin(\frac{2\pi kt}{T}) + \gamma_2 \cos(\frac{2\pi kt}{T}) + \sum_{j=1}^{p} \delta_j \Delta y_{t-j} + \varepsilon_t \quad (3)$$

where *k* is the selected frequency for the Fourier approximation, γ are the parameters for the Fourier approximation, *t* is the trend term, *T* is the number of observations, $\pi = 3.1416$. The Fourier ADF statistic (τ_{DF}) is the *t*-statistic for the null hypothesis $\rho = 0$ in Equation 3. Due to limited number of observation, the number of lag length is set as one and the frequency is also set as one. Furthermore, the current analysis estimates critical values for the FADF tests by using 10,000 replications of the Bootstrap simulation.

Finally, the SUR-FADF test is based on the SUR method to estimate a system of the Fourier ADF (FADF) equations. In this study, the system of the FADF equations can be expressed as:

$$\Delta y_{1,t} = \alpha_1 + \rho_1 y_{1,t-1} + \gamma_{1,1} \sin(\frac{2\pi kt}{T}) + \gamma_{1,2} (\frac{2\pi kt}{T}) + \sum_{j=1}^{p} \delta_{1,j} \Delta y_{1,t-j} + \varepsilon_{1,t}$$

$$\Delta y_{2,t} = \alpha_2 + \rho_2 y_{2,t-1} + \gamma_{2,1} \sin(\frac{2\pi kt}{T}) + \gamma_{2,2} (\frac{2\pi kt}{T}) + \sum_{j=1}^{p} \delta_{2,j} \Delta y_{2,t-j} + \varepsilon_{2,t}$$

•
•
•

$$\Delta y_{N,t} = \alpha_N + \rho_N y_{N,t-1} + \gamma_{N,1} \sin(\frac{2\pi kt}{T}) + \gamma_{N,2} (\frac{2\pi kt}{T}) + \sum_{j=1}^{p} \delta_{N,j} \Delta y_{N,t-j} + \varepsilon_{N,t} \quad (4)$$

Similar to the SUR-ADF test, one lagged augmentation can be considered as sufficient number of lag length to address any problem arising from the serial correlation. Therefore, the lag length in the SUR-FADF test is set to be one in the current study. Furthermore, similar to the FADF test, the frequency is also set as one. The current study estimates critical values for the SUR-FADF tests by using 10,000 replications of the Bootstrap method.

4. Empirical findings

This study applies several different econometric methods, including the SUR-ADF test, the FADF test and the SUR-FADF test, to examine the unemployment dynamics in five European countries. First of all, as a preliminary analysis, the paper uses the autoregressive moving average (ARMA) method and examines unemployment hysteresis in three European countries, namely Germany, United Kingdom and France. The ARMA method was used by Blanchard and Summers (1986). The findings from their research and current study are reported in Table 2. As the table indicates, empirical results from current study generally confirm findings from the seminal research by Blanchard and Summers. More importantly, the slope coefficients for the first-order autoregressive terms are statistically significant in all five European countries. These facts imply that unemployment rates in these European countries are unit root process.

Secondly, the findings from the ADF tests and their critical values are reported in Table 3. As the findings in the table indicate, the ADF tests fail to reject the null hypothesis of unemployment hysteresis in all these five countries in Europe. In other words, the findings from the ADF tests confirm those from the ARMA analysis that indicated the unit root process of unemployment rates in Europe.

Thirdly, the empirical findings from the SUR-ADF tests and their critical values are reported in Table 4. As the table shows, the SUR-ADF tests failed to reject the null hypothesis of unit root in four countries in Europe, namely France, Germany, Italy and Spain. It means that unemployment rates in these countries are unit root process. On the other hand, the SUR-ADF test rejects to null hypothesis for UK. It implies that unemployment rates in UK can be considered as the stationary process.

Fourthly, the findings from the FADF tests and their critical values are reported in Table 5. As the empirical findings indicated, the FADF tests failed to reject the null hypothesis of hysteresis in all five countries in Europe. It means that the findings from FADF test confirm those from the ARMA method and the ADF tests that indicated that unit root process of unemployment rates in Europe.

Finally, the empirical findings from the SUR-FADF tests and their critical values are reported in Table 6. As findings indicated, the SUR-FDAF tests failed to reject the null hypothesis of hysteresis in all four countries. It means that the SUR-FADF tests confirmed those from the ARMA method, the ADF tests and FADF tests that showed the unit root process of unemployment rates.

In short, despite minor discrepancy, four different tests, namely the ADF test, the SUR-ADF tests, the FADF test and the SUR-FADF test produced consistent findings that unemployment

rates in these five European countries could be described as the unit root process. In other words, these different unit root tests uniformly detected the existence of hysteresis in these five countries in line with the hysteresis hypothesis.

5. Conclusion

This paper aimed to revisit the hysteresis and unemployment problem in Europe by using new data and some innovative methods. From a historical perspective, Blanchard and Summers (1986) are among first researchers to detect the existence of unemployment hysteresis and to examine systematically high unemployment problem in Europe in the middle of the 1980s. Since then, there are countless research efforts are devoted to examine the unemployment hysteresis in Europe and other regions. However, researchers failed to produce consistent findings and have not decided whether the hysteresis would exist in unemployment. Thus, this paper chose five countries in the region, namely France, Germany, Italy, Spain and United Kingdom, and examined their unemployment behaviours by employing several different econometric tests, such as the SUR-ADF test, the FADF test and the SUR-FADF test. Despite some minor difference, these four tests produced consistent findings that unemployment rates in these five European countries could be best characterised as the unit root process. In other words, these different unit root tests uniformly detected the existence of hysteresis in these five countries in line with the hysteresis hypothesis.

The empirical evidence from current study could offer some policy implications. The empirical findings indicated high unemployment problem seemed to persist in these five countries in Europe. It means that any shocks in the countries tend to have permanent effects on the unemployment rates. In other words, these findings could suggest that economic crisis, such as the European financial crisis in the end of the 2010s, could have persistent negative impact on the labour markets in Europe. It means that the higher-than-normal level of unemployment rates would not revert to the natural rate and the labour markets in these countries do not seem to have innate ability to recover from economic crisis. Furthermore, the findings also indicated that policymakers in these Europe countries should pay due attention to unemployment problem during the economic crisis. They should use appropriate policy to promote the employment to overcome the high unemployment problem. At same time, these policymakers in these European countries should make serious efforts to improve the labour market fundamentals, such as the employment regulations, human resource conditions, demographic tendencies, in order to improve the efficacy and functionality of labour market in the long-run.

This paper used the Eurostat database as the data source. The number of observation is only 23. The future analysis could use more accurate and longer time-series data on the unemployment rates from national economic database from each European country. Furthermore, the current paper offered a detailed procedure to examine the unemployment hysteresis. This statistical procedure could be applied to examine the unemployment hysteresis in other regions, such as other European countries in Central and East Europe as well as the developing countries in Asia, Africa, Middle-East and Latin America. Furthermore, researchers may employ advanced methods, such as the unit root test with structural break for their studies. The findings from such studies would give much needed insights on the issue of unemployment hysteresis and would add better perspectives to the policy implications for unemployment problem in Europe.

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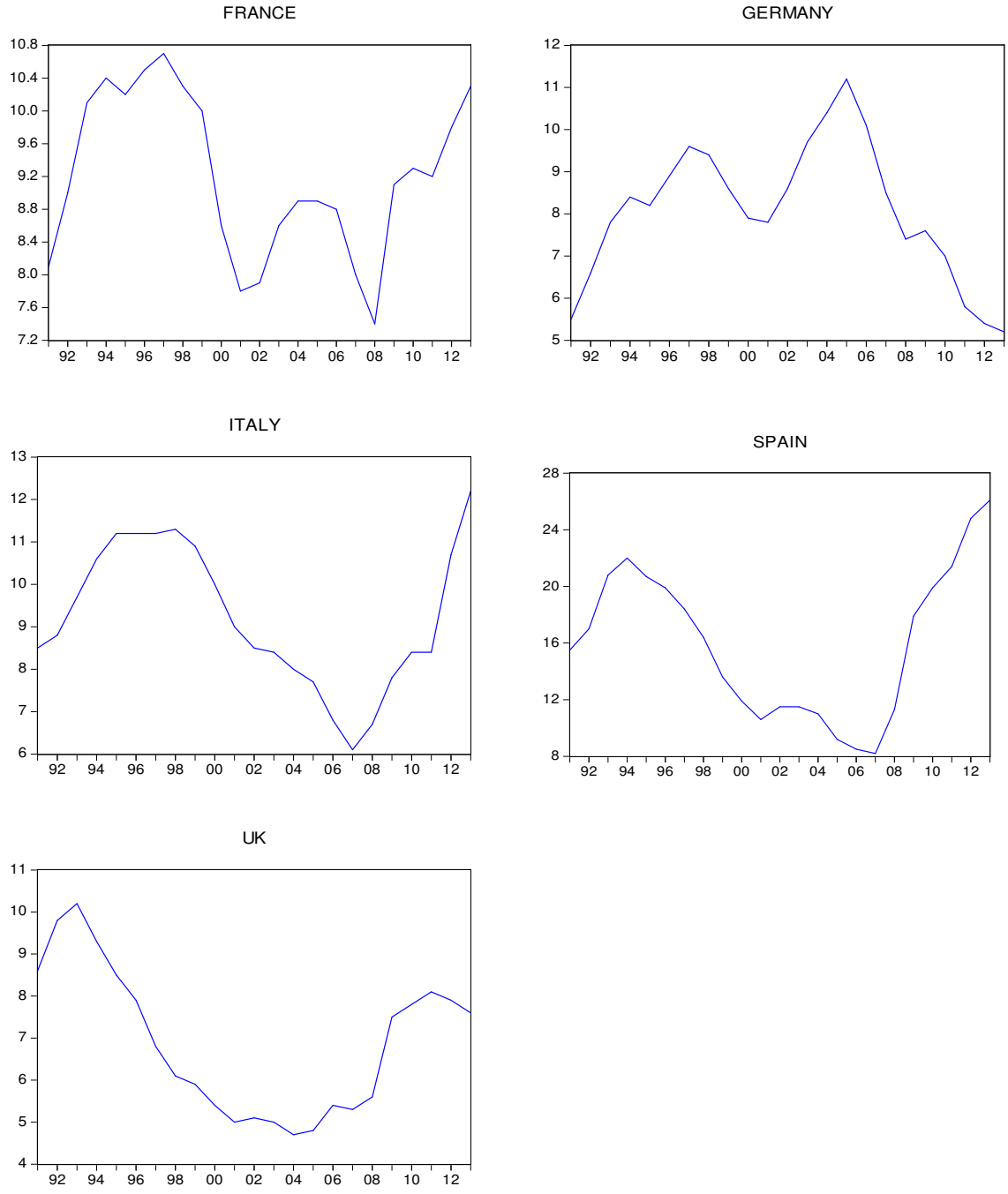
Appendix: Figures and Tables

Figure 1: Unemployment dynamics in selected five countries in Europe



Source: World Bank (2014)

Table 1: Summary of major findings on unemployment hysteresis in Europe

Authors (Year)	Countries	Variables	Data Source	Methods	Findings
Blanchard and Summers (1986)	France, Germany, and UK	Annual data of unemployment 1956-2084	OECD	1. ARMA method	Unit root process
Mitchell (1993)	France, Germany, Italy and UK	Quarterly data of unemployment 1960Q1-1991Q3	Main Economic Indicators, OECD	1. ADF test 2. PP test	Unit root process (France, Germany and UK) Stationary process (Italy)
Røed (1996)	France, Germany, Italy, Spain and UK	Quarterly data of unemployment 1960Q1-1991Q3	Main Economic Indicators, OECD	1. ADF test	Unit root process
Strazicich *et al.* (2002)	France, Germany, Italy, Spain and UK	Annual data of unemployment 1955-1999	Labour Force Statistics, OECD	1. LM test 2. LM test with structural break	Unit root process
León-Ledesma (2002)	France, Germany, Italy, Spain and UK	Quarterly data of unemployment 1985Q1-1999Q4	nil	1. ADF test	Unit root process
Camarero and Tamarit (2004)	France, Germany, Italy, Spain and UK	Annual data of unemployment 1956-2001	Labour Force Statistics, OECD	1. SUR-ADF test	Unit root process (Germany, Italy) Stationary process (France, Spain and UK)
Chang *et al.* (2005)	Germany, Italy, Spain and UK	Annual data of unemployment 1961-1999	AREMOS database, Ministry of Education, Taiwan	1. ADF test 2. SUR-ADF test	Unit root process
Camarero *et al.* (2006)	France, Germany, Italy, Spain and UK	Annual data of unemployment 1956-2001	Labour Force Statistics, OECD	1. KPSS test with structural breaks	Unit root process (Germany, Italy, Spain) Stationary process (France and UK)
Christopoulos, and León-Ledesma (2007)	France, Germany, Italy, Spain and UK	Quarterly data of unemployment 1985Q1-1999Q4	nil	1. ADF test 2. DF-GLS test	Unit root process (France, Germany, Italy and UK) Stationary process (Spain)
Lin *et al.* (2008)	France, Germany, and UK	Monthly data of unemployment 1970M1-2005M4	AREMOS database, Ministry of Education, Taiwan	1. threshold autoregression (TAR) test	Unit root process (UK) Stationary process (France, Germany)
Lee *et al.* (2009)	France, Germany, Italy, Spain and UK	Annual data of unemployment 1960-2004	Global Financial database	1. LM test with two structural break	Stationary process
Chang (2011)	France, Italy, Spain and UK	Annual data of unemployment 1960-2009	AMECO database	1. Fourier KSPP test	Unit root process (Italy, Spain, UK) Stationary process (France)
Chou and Zhang (2012)	France, Germany, Italy, Spain and UK	Annual data of unemployment 1980-2008	World Economic Outlook, IMF	1.SUR-ADF test 2. SUR-KSS test	Unit root process (France, Germany) Stationary process (Italy, Spain, UK)
Bolat *et al.* (2014)	France, Germany, Italy and Spain	Annual data of unemployment 2000-2013	Eurostat database	1.panel KSS test 2. panel Fourier KSS test	Unit root process (Italy) Stationary process (France, Germany and Spain)

Table 2: Findings from Blanchard and Summers (1986) and current study

Blanchard and Summers (1986)			
Countries	AR(1) term	MA(1) term	R-squared
Germany	0.92** (14.8)	0.65 (0.39)	0.91
UK	1.02** (20.9)	0.77* (3.9)	0.95
France	1.12** (32.7)	-0.06 (-0.3)	0.97
Current study			
Countries	AR(1) term	MA(1) term	R-squared
Germany	0.78** (5.28)	0.72** (4.45)	0.85
UK	0.83** (6.81)	0.66* (3.44)	0.89
France	0.58* (2.71)	0.59* (2.73)	0.66
Italy	0.76** (4.98)	0.98** (15.57)	0.87
Spain	0.92** (7.02)	0.73** (4.57)	0.89

Numbers in the parentheses indicate *t*-statistics
** indicates significant at 1 percent level
* indicates significant at 5 percent level

Table 3: ADF test and its critical values

Countries	*ADF Statistics*	*Critical Values*		
		1 percent	*5 percent*	*10 percent*
France	-2.247	-4.024	-3.045	-2.660
Germany	-2.038	-3.579	-2.912	-2.579
Italy	-1.696	-3.355	-2.501	-2.117
Spain	-1.732	-2.940	-2.471	-2.249
UK	-2.550	-4.266	-3.494	-3.127

Notes: Critical values were estimated by 10,000 replications of the Bootstrap simulation

Table 4: SUR-ADF test and its critical values

Countries	*SURADF Statistics*	*Critical Values*		
		1 percent	*5 percent*	*10 percent*
France	-2.247	-5.136	-3.982	-3.499
Germany	-1.210	-4.548	-3.769	-3.325
Italy	-2.086	-4.419	-3.268	-2.807
Spain	-2.836	-4.252	-3.534	-3.167
UK	-4.527*	-5.635	-4.599	-4.122

Notes: Critical values were estimated by 10,000 replications of the Bootstrap simulation
* indicates significant at the 10 percent level

Table 5: FADF test statistics and its critical values

Countries	*FADF Statistics*	*Critical Values*		
		1 percent	*5 percent*	*10 percent*
France	-3.773	-5.404	-4.226	-3.782
Germany	-3.342	-4.642	-3.858	-3.519
Italy	-0.510	-5.750	-4.444	-3.874
Spain	-3.120	-5.078	-4.159	-3.773
UK	-2.314	-5.100	-4.156	-3.715

Notes: Critical values were estimated by 10,000 replications of the Bootstrap simulation

Table 6: SUR-FADF test statistics and its critical values

Countries	*FADF Statistics*	*Critical Values*		
		1 percent	*5 percent*	*10 percent*
France	-3.771	-7.559	-6.074	-5.390
Germany	-3.596	-6.689	-5.530	-4.982
Italy	-1.261	-8.152	-6.340	-5.549
Spain	-4.005	-7.593	-5.989	-5.364
UK	-2.728	-7.518	-5.980	-5.809

Notes: Critical values were estimated by 10,000 replications of the Bootstrap simulation