

# Hysteresis vs. Natural Rate of Unemployment: One, the Other, or Both?

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## *Abstract:*

This paper re-examines the empirical validity of the hysteresis hypothesis in unemployment rates by education level in 17 OECD countries. To this end, for an unbalanced panel, we employed Pesaran's Cross-Sectional Dependence (CD) and Cross-Sectionally Augmented ADF (CADF) tests. Our empirical findings provide evidence favorable to the non-stationarity of unemployment rates according to levels of primary and secondary education attainment in total unemployment, and therefore the existence of hysteresis for these levels of education. There is no evidence, however, of hysteresis for unemployment rates by tertiary education.

**Keywords:** Cross-Sectional Dependence, Hysteresis, Unit Root

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## 1. Introduction

There has been an intense and lively academic and political debate on unemployment in world economies during the last 25 years, notably for European economies. Two major hypotheses on the time series properties of unemployment can be distinguished: the natural rate hypothesis (NRH) and the hysteresis hypothesis (HH). The NRH characterizes unemployment dynamics as a mean reverting process, which means that the unemployment rate tends to revert to its equilibrium in the long run. On the other hand, HH states that cyclical fluctuations have permanent effects on the level of unemployment; therefore, the level of unemployment can be characterized as a non-stationary process.

If the HH holds, then the unemployment dynamic tends to be a non-stationary or unit root process that does not return to its long run equilibrium. This has significant policy implications. High levels of unemployment, if left unattended by the government, may persist and continue to be a serious problem. If the unemployed are unemployed for such a long time, they lose valuable skills, grow incompetent and hence remain unemployable. Thus, unemployment has negative impacts on economic growth, social stability, individual self-confidence, income distribution and individual

morale or altitude. Due to its importance, widespread empirical literature has developed around the topic of unemployment HH (Liew et al. 2009). On the other hand, if unemployment follows the I(0) process, the effects of the shock will merely be transitory, thus rendering 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 NRH.

Despite a burgeoning literature on testing HH and NRH (e.g., Blanchard and Summers, 1986; Mitchell, 1993; Song and Wu, 1998; Leon-Ledesma, 2002; Chang et al., 2005) through time series and panel data unit-root

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methodology, there are still some methodological debates associated with the empirical literature.

First of all, the dynamics of the aggregate unemployment rate is neglected in many studies (Gustavsson and Osterholm, 2006). Due to discouraged-worker and added-workers effects, particularly in less skilled workers, new empirical works have started to turn their attention to examining variations in the labor force participation rate and employment rate<sup>1</sup> (e.g., Gustavsson and Osterholm, 2007; Madsen et al., 2008). One other issue that has been addressed in time-series analyses of HH is whether there has been a structural break in the unemployment series. Several studies illustrate that structural breaks could provide an explanation for hysteresis or persistence in the equilibrium rate of unemployment (e.g., Papell et al. 2000; Summers, 2003; Lee and Chang, 2008). The last methodological problem is that cross-sectional dependencies are not taken into account in panel data analysis of HH (e.g., Camarero et al., 2006; Berger and Everaert, 2008). This problem is stated explicitly by Christopoulos and Ledesma (2007). They applied a battery of second-generation panel unit root tests that allow for cross-sectional correlation. Although the data set was the same used in Ledesma's (2002), contrary to Ledesma's findings, the hypothesis of unemployment hysteresis in the EU is rejected. The study shows that, contrary to previous empirical literature, hysteresis does not characterize EU unemployment.

In this paper, we re-examine the informational value of unemployment rates in studies of hysteresis from disaggregated perspectives. In this paper, second generation panel data unit root methodology is employed to investigate the differences between unemployment among workers categorized by their level of educational attainment for 17 OECD countries. This approach allows us to abstract from changes in the composition of the unemployed labor force by focusing on particular educational groups while accounting for the presence of cross-sectional dependence.

The paper is organized as follows: Section II presents the data used. The econometric techniques and the empirical results are discussed in Section III. The final section concludes the paper.

<sup>1</sup> Labor force skill level and expansion of the educational system may affect the employability of workers and hence the cyclicity of both employment and unemployment rates (Murphy and Topel, 1997; Keane and Prasad, 1993; Hoynes, 1999; Gustavsson and Osterholm, 2007; Camarero et al., 2008).

## 2. Data

This study uses unemployment indicators including the percentage distribution of a country's total unemployed according to level of educational attainment. Data for both indicators were collected from the International Labour Organization-ILO (2007) and the World Bank's World Development Indicators (WDI) online database. The major classifications used in the databases are unemployment with primary education (UPE), unemployment with secondary education (USE) and unemployment with tertiary education (UTE). The sample is an unbalanced panel data that comprises 17 OECD countries with a time length that varies between 12 to 27 years. For details about data, please see the Appendix.

## 3. Methodology and Analysis

A traditional testing procedure to empirically examine HH is to apply unit root tests on the unemployment rate. Because hysteresis is consistent with non-stationary unemployment rates, unit root tests provide a convenient methodological framework. Starting with Levin and Lin (1992), much work has also been done on testing for unit roots in panels, including papers by Maddala and Wu (1999), Choi (2001), Im et al., (2003) and others. In addition, as shown in two simulation studies by Banerjee et al. (2004a, 2004b) if panel members are cross-correlated, all these tests experience strong size distortions and restricted power. For this reason, panel unit root tests relaxing the assumption of cross-sectional independence have recently been proposed in the literature by Choi (2002), Bai and Ng (2003), Moon and Perron (2003), Pesaran (2003), Phillips and Sul (2003) and Pesaran (2005).

To check if our sample is characterized by cross-section dependence, Pesaran's cross-sectional dependence test is applied.

Pesaran (2004) presents a simple cross-sectional dependence test (CD) that can be applied to both balanced and unbalanced panels. The test is based on the average of pair-wise correlation coefficients ( $\hat{\sigma}_{ij}$ ) of the residuals obtained from the individual augmented Dickey-Fuller (ADF) regression. The CD statistics for an unbalanced panel is computed as:

$$CD = \sqrt{\frac{2}{N(N-1)}} \left( \sum_{i=1}^N \sum_{j=i+1}^N \sqrt{T_j} \hat{\sigma}_{ij} \right) \quad (1)$$

Table 1 contains CD statistics that obtain residuals from ADF estimations with intercept and linear trend regression. The hypothesis of zero cross-section correlation is rejected for all series at the 1%-level of significance.

Test results	UPE	USE	UTE
CD statistic p-value	17.171 (0.000)	22.647 (0.000)	38.377 (0.000)

**Notes:** The CD statistic is asymptotically normally distributed. The p-values refer to a two-sided test.

**Table 1:** Pesaran's cross-sectional dependence test

A very important issue in panel unit root and also cointegration tests is cross-sectional dependence. In fact, the properties of all panel unit root and cointegration tests are based on the assumption that the error terms are not cross-correlated. Therefore, cross-sectional dependence should be taken into account.

To this end, second generation panel unit root tests can be adopted that reject the cross-sectional independence, including those of Phillips and Sul (2003) and Pesaran (2005), Bai and Ng (2004), Moon and Perron (2004). In this paper, we consider the test defined in Pesaran (2005) to be helpful for small panels<sup>2</sup>.

Pesaran (2005) proposes the following ADF regression with the cross-section averages of lagged levels and first differences of the data:

$$\Delta y_{it} = c_{i0} + c_i t + \beta_i y_{i,t-1} + \sum_{j=1}^p \gamma_{ij} \Delta y_{i,t-j} + \varphi_i \bar{y}_{t-1} + \sum_{j=0}^p \eta_{ij} \Delta \bar{y}_{t-j} + u_{it} \quad (2)$$

where  $\bar{y}_t = \sum_{i=1}^N y_{it} / N$ . The t-ratio of  $\beta_i$  is used as the test statistic for a unit root and is called the cross-sectionally augmented ADF (CADF) statistic. Its critical values have been generated by Monte Carlo and are tabulated in Pesaran (2005). The results reported are the  $Z(N, T)$  version, which is normally distributed under the null hypothesis of the unit root defined as:

$$Z(N, T) = \frac{1}{\sqrt{N}} \sum_1^N \phi^{-1}(P_{it}) \quad (3)$$

where  $P_{it}$  is the p-value corresponding to the unit root test of the  $i^{th}$  individual cross-section unit.

Table 2 shows the CADF statistics for the UPE, USE and UTE series within our samples. The null hypothesis of a unit root cannot be rejected for the UPE and USE series with all lag specifications. But we are able to reject the null hypothesis of a unit root for the UTE series with 0 and 1 lag specifications.

p	UPE	USE	UTE
0	-0.161 (0.436)	-1.283 (0.100)	-2.696* (0.004)
1	0.880 (0.810)	0.992 (0.839)	-1.545** (0.061)
2	3.856 (1.000)	2.717 (0.997)	1.836 (0.967)

**Note:** p is average lags. p-values in brackets. \* and \*\* indicates significance at the 1% and %10 levels, respectively.

**Table 2:** Pesaran's CADF test

Our results from CADF statistics are consistent with the HH for the UPE and USE series. However, the empirical evidence does not indicate HH for the UTE series for our sample. These results indicate that shocks have permanent effects on unemployment for those with lower levels of educational attainment, while unemployment for those with a higher level of educational attainment tends to revert to its equilibrium in the long run after a shock.

#### 4. Conclusion

We have applied CADF unit root tests to unemployment rates by educational attainment in the total unemployment for 17 OECD countries during the period 1980–2007 with unbalanced panel data. After controlling for educational attainment, we find significant differences between unemployment rates. More specifically, we can conclude that the evidence is favorable to the non-stationary of unemployment rates by primary and secondary education attainment in total unemployment, and therefore the existence of hysteresis in primary and secondary education.

However, we also find that there is no evidence of hysteresis for unemployment rates by tertiary education in total unemployment. The results also point to the

<sup>2</sup> Because Pesaran's method does not require the direct estimation of idiosyncratic components from the data, it can be beneficial for small panels where estimation of factors is difficult (Moon and Peron, 2007).

importance of considering some degree of heterogeneity with educational differences in labour markets. 

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## Appendix

Country	Age	Data availability
Australia	15+	1989-2007
Austria	15+	1985-2007
Belgium	15+	1994-2007
Canada	15+	1980-2007
Denmark	15-66	1994-2007
Finland	15-77	1995-2007
Germany	15+	1996-2007
Italy	15+	1993-2007
Japan	15+	1987-2007
Netherlands	15-64	1995-2007
New Zealand	15+	1990-2007
Norway	16-74	1996-2007
Spain	16+	1980-2007
Sweden	16-64	1987-2007
Switzerland	15+	1991-2007
United Kingdom	15-64	1987-2007
United States	25+	1994-2007