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Unemployment Hysteresis: Attached or Mismatched?

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Abstract

This paper investigates the empirical significance of the unemployment problem whether it is structural or temporary on the basis of region-based, income-based and aggregate classifications of different countries for the yearly data from 1991 to 2018. In the first part of the paper, we examine the stationary position of unemployment series by way of using individual unit-root tests. Since the series are possibly subjected to the structural breaks, we also use additional approaches in which the effects of the break dates are checked in the analysis. Furthermore, we compare the initial findings of univariate unit-root tests along with panel unit-root testing procedures to critically assess the statistical validity of the hysteresis hypothesis in unemployment for given samples. The empirical findings imply that we cannot reject the hysteresis hypothesis for different classifications of the countries against the alternative of a natural rate even in the presence of structural breaks.

Keywords: hysteresis; unemployment rate; individual unit-root test; panel unit-root test; structural break.

JEL classification: C10; E20; E24.

1. INTRODUCTION

One of the critical issues in the current economic system is based on the explanation of the reasons for why the unemployment rates are above the equilibrium level almost over many countries. The existing literature has mainly discussed both the inner dynamics and the quality of a high degree of unemployment over time. In particular, this is the focal point of policymakers in which they are responsible for making a relevant policy background to prepare sound conditions for well-functioning labor markets. Therefore, in order to assess the unemployment puzzle which is mostly originated from the lack of policy agenda for the labor markets, one should be in caution for making analysis through the long-term variations in unemployment rate whether it points to structural or cyclical problems (Akdogan, 2017, p. 1416). One of the best ways to release from *structural* unemployment problem is to make policy recommendations in line with the changes in the actual conditions of labor markets.

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However, if there exists a *cyclical* unemployment problem in an aggregate economy, preparing policies oriented to proper demand management should be carried out by the authorities. Therefore, for the case of a high correlation between cyclical deviations and emerging of structural problems should capture the policy tools which control for country-specific requirements.

However, before getting into deep for the explanations of the link between cyclical and structural variations in unemployment, one should be focused on the definitions of employment and should be categorized the types of employment. Regarding the definition of employment, we can introduce two kinds of employment which are full-employment and under-employment, respectively. And further, depending on different types of employment, employees may have various entitlements. For instance, five main employment types are involved in these employment structures: (i) fixed-term employees, (ii) causal employees, (iii) trainees, (iv) agency staff for labor hire, and (v) hired employees. In consideration of this outline about the employees' entitlements, one of the major aims of the world economies could be subjected to supply a full-employment level. If any country fully utilizes its factors of production in the production line, it is referred to as a situation in which the full-employment level is satisfied. If there is an undesired output gap in the production system, then some part of the employment could be meant that it is not incorporated into productive activities. According to the traditional view, the national income positively responds to an increase in the employment level and thereby leads to higher economic growth rates. Meanwhile, long-term economic stability stimulates a positive sense for foreign countries to invest in the host country.

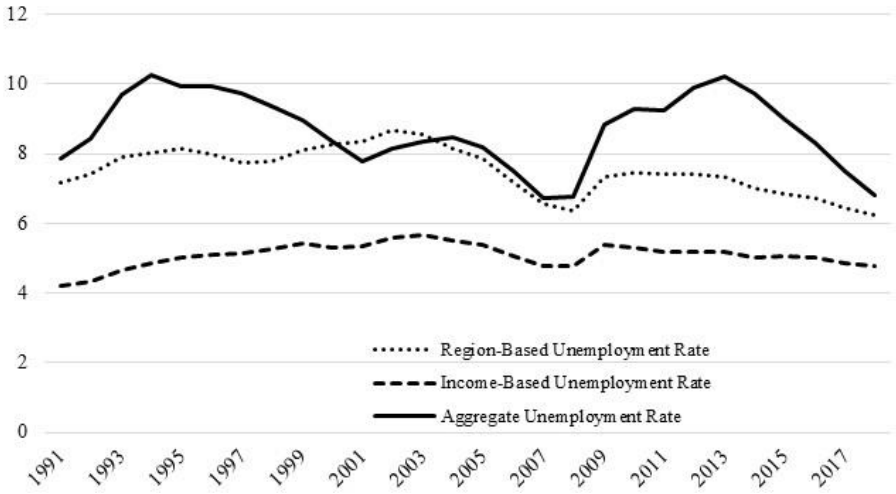
In particular, the unemployment rate has some dynamic trends in which the existing literature explains them in the context of *hysteresis* approach. While the term of hysteresis was primarily initiated by Ewing (1881) in determining the stress-thermoelectric quality of metals nexus[1], Samuelson (1965) integrated this term into the economics to overcome the handicaps in modeling of the benchmark economic theories which are inherently linked to social ingredients. Phelps (1972) also used this term in order to explain the reasons for soaring unemployment level in Europe over the post-1960s and Sachs (1986) ranged some possible effects of hysteresis on policy regimes. According to the traditional wisdom (e.g., Phelps, 1968; Friedman, 1968; Modigliani, 2003), the current deviation in unemployment rate in Europe was defined as temporary, which were theorized by the concept of non-accelerating inflation rate of unemployment (NAIRU). On the contrary, Blanchard and Summers (1986b) pointed to the existence of *path-dependence* of steady-state equilibrium unemployment through defining the hysteresis hypothesis. Therefore, according to Blanchard and Summers (1986a), the historical process of the actual unemployment rate should be kept in mind for the explanation of unemployment puzzle in which the country-specific and time-variant effects of an exacerbated shocks in unemployment were positioned as some of the major determinants over 1980s Europe. In particular, the economic shocks could not be temporary but could be permanent in the long-run since there might be labor market rigidities. In consideration of these factors, demand management policies might be a good choice to avoid *path-dependent* long-run unemployment.

The persistence in unemployment has been deemed as one of the most critical socio-economic and even political problems across almost all countries over the past three decades. In that vein, some of the potential reasons related to a soaring unemployment rates in many countries can be ranged as follows in the presence of hysteresis hypothesis: First, the shocks might have more intense effects on the unemployment hysteresis in some countries or regions relative to others mostly due to lack of employment opportunities and lack of job recoveries.

Second, there might be no evidence of the hysteresis hypothesis for the implication of short-run policies to stimulate an aggregate demand in which the employees have different characteristics. A potential reason might be the level of self-employment which exacerbates the economic downturns by way of leading to long-run effects on employment structure. Third, if the pattern of employment conditions differs across the countries or regions that would be resulted in the case of partial effect of hysteresis in unemployment over time. Therefore, these kinds of differences in employment standards would be in need of implying various policy usage in the presence of shocks.

The level of unemployment has substantially been fluctuating two-digit numbers in many emerging countries since the beginning of the global financial turmoil of 2007/2008. This is very commonly assumed in recent literature as the worst economic downturn rooted in the financial sector since the Great Depression of 1929. According to the potential reasons behind the ongoing financial crisis, the supply-side policies have remained incapable to solve the financial turmoil and the problems in productive activities. Therefore, the concept of hysteresis has been readopted by the economic discipline in which aggregate demand shocks can have a significant long-run impact on unemployment. For instance, Blanchard *et al.* (2015, p. 5) confirm that the after-effects of recessions "…has brought the issue again to the fore" and then they argue that output has dropped below potential output. According to Ball (2014, p. 2), these considerations should be assumed as evidence of hysteresis effects in the Great Recession[2]. Draghi (2014) also argues at the Jackson Hole Speech that "the risks of "doing too little" – i.e. that cyclical unemployment becomes structural – outweigh those of "doing too much" – that is, excessive upward wage and price pressures". Further, OECD reports that,

> "Fiscal support during economic downturns – both through automatic fiscal stabilisers (i.e. increases in government spending and declines in tax revenues that occur directly as a result of a downturn in economic activity) and additional discretionary measures – promotes labour market resilience by stabilising aggregate demand. It also reduces the risk of hysteresis, i.e. the risk that cyclical changes in unemployment or productivity as a result of the crisis persist even after aggregate demand has recovered." (OECD, 2017, p. 49).



Source: World Bank, World Indicators Database

Figure no. 1 - Unemployment rates (%), on average, 1991-2018

Contrary to the assumptions of mainstream approach, demand-side driven factors might have critical importance on the level of unemployment and indirectly on the production system. Some potential reasons can be put forward to explain jobless growth and employment sluggishness for the post-1980s as follows: wage rigidities (Hall, 2005; Shimer, 2005, 2012), job polarization and disappearance of middle-income jobs (Jaimovich and Siu, 2012), decrease in union power (Berger, 2012), and heterogeneity of unemployment appeal (Wiczer, 2013). Therefore, in connection with the hysteresis hypothesis of these reasons, Røed (1997, pp. 398-405) also ranges some sources of hysteresis as follows: path-dependence and the formation of preferences, insider-outsider effects in wage determinations, depreciation of skills and search effectiveness, path-dependent stigma effects, labor hoarding and labor market rigidities, firing costs and voluntary quits, institutional effects of cyclical unemployment, capital formation, and coordination failures. In consideration of these factors, Figure no. 1 presents the total unemployment rates, on average, for regions, income levels, and aggregates. All the data presenting in the following figures are yearly adjusted for the 1991-2018 period.

This paper investigates hysteresis effects on unemployment employing panel data for different categories of countries by using yearly series for the period 1991-2018. The major procedure to test the hysteresis term will follow the consideration of both individual and panel unit-root methods. In that sense, given the presence of unit-roots in unemployment, the paper will also examine the empirical validity of the hysteresis hypothesis in line with the existence of structural breaks in yearly data to determine whether there exists any kind of effect of potential break dates on unemployment. In particular, if the series has unit-root, this will be meant that at least one type of economic problem has a permanent effect on unemployment (Galí, 2015). Therefore, the main contribution of this paper to the existing literature about hysteresis in unemployment is to test for unit-roots in the unemployment series employing time-series without structural breaks proposed by Dickey and Fuller (1979, 1981), Phillips and Perron (1988) and Kwiatkowski *et al.* (1992) and with structural breaks developed by Zivot and Andrews (1992) and Clemente *et al.* (1998), and using panel unit-root tests produced by Hadri (2000), Choi (2001), and Im *et al.* (2003). The main reason why we imply the panel unit-root tests is to investigate the effects of heterogeneity in the cross-section dynamics on unemployment (León-Ledesma, 2000, p. 2).

Additionally, the major reason for using the unit-root tests considering the structural breaks depends on several factors. First, in the presence of a near integrated process, the unit-root tests ignoring the structural breaks may have low power explanations (Bai and Ng, 2004). Second, the unit-root tests without structural breaks may have low power explanations in the context of using small sample data. Therefore, in consideration of the yearly data, the implementation of unit-root tests with structural breaks will be many conclusive results in comparison to the traditional methods.

The hysteresis in unemployment addressed is important for three reasons. First, different countries from different regions have various dynamics in terms of labor markets and thus employment to a large extent, as well as the policy regimes. Second, the historical context may have differential effects on the changing conditions of unemployment over time. Third, while socio-economic and political contexts are different for several countries, the regional basis may produce a different rationale to compare the long-run trends in unemployment rates. Therefore, regarding these potential factors related to the unemployment, two central questions can be presented to reveal whether the hysteresis hypothesis is almost prevailing in the context of different economic contexts or partially explain the whole story. First, is the

unemployment hysteresis follow the same path for different economic categories? Second, is there a significant impact of shocks on an optimal level of unemployment?

Following the above-mentioned methods for unit-roots, our findings show that the hysteresis hypothesis is statistically significant for many of the samples by way of using both individual and panel unit-root tests. Having provided motivation for the study, the rest of the paper is organized as follows. The second section is devoted to the explanation about the theoretical underpinnings for hysteresis in unemployment. The third section is divided into three sub-sections which include the model description, theoretical details on individual unit-root tests and panel unit-root tests, respectively. The fourth section presents the empirical results for unit-root methods. The last section concludes the study.

2. HYSTERESIS IN UNEMPLOYMENT: THEORETICAL UNDERPINNINGS

From a theoretical point of view, there are four distinctive but also idiosyncratic theories for understanding the long-run correlation between unemployment dynamics and the behavior of business cycles. The first of these theories calls as natural rate of unemployment (NRU) hypothesis which were initially developed by Phelps (1967) and Friedman (1967, 1968) and states that the business cycles may generate cyclical movements in the unemployment rate but they are temporary and thus the rate tends to revert to its equilibrium in the long-run. In that vein, the long-run unemployment rate is accepted as exogenous to the economic downturns and has a mean-reverting process over time (Lee and Chang, 2008). In consideration of standard models, there is a sharp distinction between equilibrium (e.g., the determinants are labor market institutions) and actual unemployment in which the equilibrium in unemployment deviates from its optimal level mostly due to sudden changes in demand and supply and returns to its initial level by way of triggering changes in the inflation rate (Blanchard and Summers, 1986b). On the one side, the supply-side factors related to the labor market conditions include differences in age, gender and human capital (Pikoko and Phiri, 2018). On the other hand, differences in job creation, technological innovation level, and educational background are some of the major factors affecting the labor market. As Friedman (1968, p. 11) notes on that dynamic, "…there is always a temporary trade-off between inflation and unemployment; there is no permanent trade-off. The temporary trade-off comes not from inflation per se, but from unanticipated inflation, which generally means, from a rising rate of inflation". Only the non-permanent and short-term shocks are in effect for understanding the change in long-run equilibrium and thus NRU exhibits a constant and stationary process in case of unemployment.

In the similar context, NRU transformed into the NAIRU to explain the cyclical component of the aggregate unemployment rate in which the latter hypothesis implies that aggregate demand and monetary policy shocks can induce a change of unemployment from the NAIRU in the short-run (Bechny, 2019). However, as in the case of NRU, the NAIRU hypothesis points out that it converges to the optimal level in the long-run, which is substantially independent of the effects of monetary policies and structural components of the aggregate economy. In other words, the level of unemployment tends to revert back to the steady-state, or so-called the natural rate of unemployment in the long-run (Christopoulos and León-Ledesma, 2007). Regarding this long-run dynamics of unemployment, Friedman (1968, p. 8) states that "the 'natural rate of unemployment'…is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them

the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on". Therefore, the deviations in unemployment caused by the shocks can be described the NAIRU as fluctuations in unemployment just around the optimal rate, which is subjected to a mean reversion process (Akay *et al.*, 2011, p. 489). However, in relation to a surge in inflation rates, Jump and Stockhammer (2018, p. 3) note that the NAIRU could not easily explain this negative change during the 1980s in most European economies, in contrast to the mild rates of inflation in 1960s and the early 1970s. The distinguishing feature of this phenomenon is that the European job market is relatively more rigid than the other economic regions, which results in high rates of unemployment (Nickell, 1997).

The second theory of unemployment is called as the hysteresis hypothesis in the related literature, which was developed by Blanchard and Summers (1986b) and proposes that the business cycles have permanent effect on the level of unemployment, and therefore, the unemployment is assumed as having a non-stochastic process that never reverts to its equilibrium on the heels of a shock due to labor market rigidities and inflexibilities. Even in the case of ephemeral cyclical fluctuations and reasonably stable institutional environment, the non-stochastic process may be prevalent, in which the equilibrium is path-dependent. Since the transitory shocks may have permanent effects on the level of unemployment in the context of the hysteresis hypothesis, the natural rate is subjected to the changes in the path of actual unemployment and the effect of history of actual unemployment (Ball, 2009; Blanchard and Summers, 1986b; León-Ledesma and McAdam, 2004; Røed, 1997). Jump and Stockhammer (2018, p. 3) state that deflationary policies or adverse shocks can raise the unemployment rate and thereby indirectly the NAIRU, which exacerbates the permanent effect of a surge in unemployment rate over time[3]. If the permanent effects over the long-run period are left by themselves, they may increase the problems related to the divergence between equilibrium and actual unemployment even in the long-run[4] (Song and Wu, 1998).

Blanchard and Summers (1986b, pp. 1-2) state the hysteresis hypothesis can be defined in two cases; *membership theories* and *duration theories*. In membership theories, they identify a model, called as insider-outsider model, in which the loss of the influences on wage-settings and union behaviors can be considered as the major factors for the explanation of high persistence in unemployment, especially in case of European countries. Regarding the theoretical background of the model, two of these theories are based on the changes in wage bargaining. One of the major aspects of the model is the asymmetries in the process of wage determination between the insiders who are currently employing in the job and the outsiders who are currently unemployed. In particular, the unemployed people (i.e. outsiders) have been in a position in which their legal rights are to a large extent dissolved by the policymakers and the wages are substantially determined on behalf of the people who are currently employed (i.e., insiders). Therefore, any kind of shock affecting the economic structure in a negative trend leads to an employment sluggish and thereby a surge in the level of unemployment (Blanchard and Summers, 1986a p. 16). This is the case that causes the emergence of hysteresis in unemployment by way of changing the level of employment and the optimal wage rate. In consideration of this economic fact pursuant to membership theories, Blanchard and Summers (1986b, p. 2) note that "…wage setting is largely determined by firms' incumbent workers rather than by the unemployed." However, the duration theories also consider the time effects and make a distinction between short-term and long-term

unemployed. Again, following Blanchard and Summers (1986b, p. 2), the duration theories investigate the fact that "…the long term unemployed exert little pressure on wage setting."

In addition to the standard insider-outsider model, Gottfries and Horn (1987), Lindbeck and Snower (1989, 2001) and Lindbeck (1993) develop this model by constituting microeconomic foundations. The newly updated insider-outsider model of Lindbeck and Snower (1989) is predicated on five integrated propositions which can be ranged as follows: First, the existence of labor turnover costs leads to make insiders more powerful in the market conditions. Second, the economic interests in wage negotiations lead insiders to ignore the interests of outsiders. Third, in a given economic structure, the market power is to a large extent upon by the insiders. Fourth, there is no way to escape from being an outsider if the insiders lose their jobs. Fifth, there is a positive correlation between wage costs and insider wages[5].

Finally, the third and fourth theories of unemployment are also dominant in the existing literature as well as the former two theories mentioned above. The first is the persistence view[6], which implies that there is a mean-reverting process of unemployment even though equilibrating mechanism towards the optimal point has a slow speed of change, and therefore, it can be assumed that this view has a near unit-root process and long-lasting effects on unemployment[7] (León-Ledesma, 2000). There should be a sufficient period of time to re-establish the equilibrium[8] (Akay *et al.*, 2011, p. 490). Ayala *et al.* (2012) also note that the unemployment rate has a constant long memory process according to the persistence view. This is also supported by the arguments of Mitchell (1993), in which the effects of the shocks on unemployment are assumed as having long durations. Further, the second is the structuralist view, pioneered by Phelps (1994), the shocks have not permanent effects on unemployment even though they are highly persistent to resolve over time. In other words, the level of unemployment is subjected to changes in structural factors, especially in the institutional environment. Although the shocks, which results from supply-side factors such as oil prices, real interest rates, exchange rates, stock prices (Phelps, 1999), and the productivity changes (Pissarides, 2017), lead to a high persistence changes in unemployment rate, the actual unemployment rate is fluctuated around the NRU and has also a stationary process subject to occasional but not temporary structural changes (Pikoko and Phiri, 2018). Regarding these assumptions, the structuralist view assumes that there exist structural breaks in the equilibrium level of a stationary stochastic process subject to structural changes, which may deviate the equilibrium from the actual unemployment rate.

3. MODEL AND UNIT-ROOT TESTING PROCEDURES

3.1 Model

In consideration of the theoretical background of hysteresis, which was advocated by Blanchard and Summers (1986b), the benchmark insider-outsider model of the labor market can be represented as the Eq. (1)[9]:

$$y_t = f(m_t - p_t) \tag{1}$$

where y_t is the aggregate demand, m_t is the money supply and p_t is the average price level[10]. The aggregate demand, or equivalently the total output, basically depends on the changes in both money supply and inflation. The production is subjected to constant returns to scale. Further, the labor, l_t, is the only production factor in producing goods and services, and

therefore, the profit maximization leads to $p_t = w_t$, where w_t represents the nominal wage level. When the equilibrium condition holds for aggregate demand and supply, we get the following relations representing in Eq. (2):

$$l_t = f(m_t - w_t) \tag{2}$$

We also subtract the expected values of the variables and we get the Eq. (3):

$$l_t - l_t^e = f(m_t - m_t^e) - f(w_t - w_t^e) \tag{3}$$

Since the wages are given regarding union behavior, $w_t = w_t^e$, the union's expectations can be expressed as $l_t^e = \alpha l_{t-1}$ and can be put into the Eq. (4) as follows:

$$l_t^e = \alpha l_{t-1} + f(m_t - m_t^e) \tag{4}$$

The difference between m_t and m_t^e defines the unexpected shocks to the money supply, which is assumed as having a random process. In that case, we can reformulate Eq. (4) as follows:

$$l_t^e = \alpha l_{t-1} + \varepsilon_t \tag{5}$$

where ε_t is an i.i.d. error term. In Eq. (5), we also have an explanation for the expectations of insiders (i.e., currently employed people), in which they assume that the current employment is being a function of the past employment, and therefore, l_t^e is equal to αl_{t-1}, with $0 < \alpha < 1$. However, they do not take into account the positions of outsiders (i.e., unemployed people). Regarding the Eq. (5), if $\alpha = 1$, we can consider that employment will follow a random walk with potential shocks to economic indicators, in which the shocks have practical importance on a permanent basis[11]. However, if $\alpha \neq 1$, the model will incline to the validity of the hysteresis hypothesis.

3.2 Individual unit-root tests

This section will consider the underpinnings of the methodological framework for pure unit-root tests considering both with and without structural breaks. First, the pure time-series unit-root tests will be conducted on the methodologies of Dickey and Fuller (1979, 1981), Phillips and Perron (1988), and Kwiatkowski *et al.* (1992). Second, the inclusion of the effects of structural breaks into the unit-root testing procedure will be based on the methods of Zivot and Andrews (1992) and Clemente *et al.* (1998).

First and foremost, following the so-called mainstream methods on unit-root testing for time-series, the paper will apply the Augmented Dickey-Fuller (ADF) test advocated by Dickey and Fuller (1981) and the Phillips and Perron (1988) test for unemployment series to specify whether the hysteresis effect exists. Additionally, traditional wisdom on pure unit-root tests is also based on the analysis of the Lagrange multiplier (LM) procedure developed by Kwiatkowski *et al.* (1992) to identify that the unemployment series are faced with the hysteresis effects. However, the major problem of these methods is that they all ignore the possible breakpoints in the series. Besides the exclusion of the structural breaks, all these

methods may suffer from the small sample size, in which they have low explanation power (Song and Wu, 1998). Eq. (6) presents an ADF (p) test regression as follows:

$$\Delta y_t = \mu + \beta t + \phi y_{t-1} + \sum_{k=1}^{p} \gamma_k \Delta y_{t-k} + \varepsilon_t \quad (6)$$

where y_t shows the unemployment rate, Δy_{t-k} are used to approximate the autoregressive moving-average (ARMA) structure of the errors, μ is the constant, t is the linear time trend, and ε_t is an i.i.d, white-noise, serially uncorrelated and homoscedastic error term. The focal point of adding lags into the regression is based on the aim that the presence of serial correlation should be corrected from the auxiliary regression. To determine the optimal lag length (p), the Akaike Information Criteria (AIC) is used in the regression analysis, which also solves biased parameters emerging in the estimation. However, additional lags reduce the power of the test (Mednik *et al.*, 2012). Therefore, the choice of the methodological background should be well-designed for the selection of lag length.

In order to eliminate the bias in regression, the ADF test should be regressed in consideration of choosing the optimal lag length. Whereas the ADF test ignores that kind of problem, the so-called PP test, produced by Phillips and Perron (1988), developed an alternative unit-root testing procedure to get rid of this problem. In that vein, the following regression in Eq. (7) shows the form of the PP test:

$$\Delta y_t = \mu + \beta t + \phi y_{t-1} + u_t \quad (7)$$

where u_t is *I(0)* and may possibly be heteroskedastic. The null hypothesis of a unit-root is tested as $\phi = 0$ against the stationary alternative hypothesis of $\phi < 0$. According to DeJong *et al.* (1992), the PP test may also have low testing power, analogous with the ADF testing procedure, to unfold the differences between near-stationary and pure unit-root processes. In addition, the serial correlation problem in the error term can be addressed by the PP testing procedure. One exception, however, is the differences in the form of the auxiliary regression in the PP test than the ADF test. Therefore, the ADF and PP testing methods differ on the basis of their mechanisms to deal with serial correlation and heteroskedasticity in the errors. In consideration of having these kinds of issues in the disturbance, the PP test benefits from non-parametric correction for the *t*-statistics to acquire robust estimators. In contrast to the ADF test, the PP test has no further need for the determination of lag length since the use of heteroskedasticity and autocorrelation-consistent estimator, developed by Newey and West (1987), removes such kind of diagnostic problems. Even though the disturbance term has eliminated from these problems, the PP test may also suffer from size distortion if the autocorrelation in the error term is predominantly negative (Akay *et al.*, 2011, p. 495), in which the only condition for comparing the advantages of PP test over ADF test depends on the correction of size distortion (Schwert, 1989).

On the one hand, the null hypothesis for all these two tests indicates that time series of $unemp_t$ is integrated of order one; on the other hand, the stationary tests are for the null hypothesis that $unemp_t$ is integrated of order zero. One of the alternative method (i.e., the KPSS) to test the stationary process, is pioneered by Kwiatkowski *et al.* (1992), where the series y_t is trend stationary under the null hypothesis. The relevant model for the KPSS test can be represented as in Eq. (8):

$$y_t = \mu + \beta t + \gamma_t + u_t \quad (8)$$

where γ_t is a pure random walk with innovation variance σ_t^2 and can be shown as follows:

$$\gamma_t = \gamma_{t-1} + \varepsilon_t \quad (9)$$

The null hypothesis of a stationary process is tested as H_0: $\sigma_t^2 = 0$, in which $unemp_t$ is *I(0)*, against the alternative that H_a: $\sigma_t^2 < 0$, and the LM statistics are produced just as in Eq. (10) (Kwiatkowski *et al.*, 1992, p. 163):

$$LM = \sum_{t=1}^{T} S_t^2 / \hat{\sigma}_\varepsilon^2 \quad (10)$$

where the partial sum process of the residuals can be defined as $S_t = \sum_{i=1}^{t} e_i \ \ (t = 1,2, \dots, T)$.

One of the most critical distinguishing features of further tests on unit-root depends on the fact that the former tests include the detection of structural breaks in the series. Primarily, the testing procedure of Zivot and Andrews (1992) is founded on Phillips and Perron (1988) test, which allows for an exogenous break in the series through specifying the break date endogenously from the given data[12]. Similar to the theoretical background of Phillips and Perron (1988) methodology, the basis of Zivot and Andrews (1992) method is conducted on three different models, i.e., *Model A* includes a shift in intercept, *Model B* includes a change in slope, and *Model C* considers the change of both parameters. Including all the above-mentioned models, the null hypothesis ($\partial = 0$) remarks that the series are integrated into the case that there is no exogenous structural break where the alternative hypothesis ($\partial \neq 0$) suggests the inverse situation (Saatcioglu and Korap, 2007, p. 112). In consideration of each model, the null hypothesis indicates that the unemployment series have a trend-stationary process where the break date is unknown. The determination of breakpoint is based on the minimum *t*-statistics regressed on the autoregressive dependent variable, including the time for $1 < T_B < T$. Therefore, the augmented regressions for testing the unit-root in these models can be represented as follows, respectively:

$$Model\ A: y_t = \hat{\mu}^A + \hat{\theta}^A DU_t(\hat{\lambda}) + \hat{\beta}^A t + \hat{\alpha}^A y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^A \Delta y_{t-j} + \hat{u}_t \quad (11)$$

$$Model\ B: y_t = \hat{\mu}^B + \hat{\beta}^B t + \hat{y}^B DT_t^*(\hat{\lambda}) + \hat{\alpha}^B y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^B \Delta y_{t-j} + \hat{u}_t \quad (12)$$

$$Model\ C: y_t = \hat{\mu}^C + \hat{\theta}^C DU_t(\hat{\lambda}) + \hat{\beta}^C t + \hat{y}^C DT_t^*(\hat{\lambda}) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^C + \Delta y_{t-j} + \hat{u}_t \quad (13)$$

where DU_t shows the indicator dummy variable for a mean shift emerging at each possible breakpoint and DT_t indicates the corresponding trend shift variable. Essentially, $DU_t(\lambda) = 1$ if $t > T\lambda$, 0 otherwise; $DT_t^*(\lambda) = t - T\lambda$ if $t > T\lambda$, 0 otherwise. Moreover, Δ is the difference operator, k is the number of lags determined for each possible point for the structural break and u is the random-walk error term. Theoretically, the major aim of using Δy_{t-j} shows to

eliminate the autocorrelation problem emanating in models. In particular, Zivot and Andrews (1992) scrutinize the presence of endpoints because of the reason that there might be the existence of asymptotic distribution of given statistics in which it diverges towards infinity. Therefore, to specify the exact region, some of the endpoints of a given sample is excluded from the model[13] (Waheed *et al.*, 2006 p. 5).

Secondly, Clemente *et al.* (1998) allows for two potential endogenous breaks in the presence of two approaches, which are innovative outlier (IO) (i.e., indicating a sudden occur of structural breaks where two breaks belong to the innovational outliner) and additive outlier (AO) (i.e., implying that the shifts are better and the deterministic part of the variables is eliminated through AO). In this sense, Eq. (14) refers to the IO model whereas Eq. (15) indicates the AO model. Additionally, the minimal *t*-ratio for the $\rho = 1$ hypothesis is given as follows:

$$y_t = \mu + \rho y_{t-1} + \delta_1 DTB_{1t} + \delta_2 DTB_{2t} + d_1 DU_{1t} + d_2 DU_{2t} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \quad (14)$$

and

$$\tilde{y}_t = \sum_{i=0}^{k} \omega_{1i} DTB_{1t-i} + \sum_{i=0}^{k} \omega_{2i} DTB_{2t-i} + \rho \tilde{y}_{t-1} + \sum_{i=1}^{k} c_i \Delta \tilde{y}_{t-i} + u_t \quad (15)$$

where DTB_{it} is the pulse variable and DU_{it} is the indicator dummy variable for a mean shift, which are all emerged in each possible breakpoint. Additionally, TB_1 and TB_2 are the dates when the shifts in mean emerge. $DTB_{it} = 1$ if $t = TB_i + 1$ and 0 otherwise; $DU_{it} = 1$ if $t = TB_i > 1$ and 0 otherwise.

The testing procedure of Clemente *et al.* (1998) implies that the possible breaks are designed for the case that the series follows a first-order autoregressive process, which leads to conduct for testing hypotheses. In this sense, on the one hand, Eq. (16) shows the null hypothesis for the methodology of Clemente *et al.* (1998); and, on the other hand, Eq. (17) describes the alternative hypothesis.

$$H_0: y_t = y_{t-1} + \delta_1 DTB_{1t} + \delta_2 DTB_{2t} + u_t \quad (16)$$

$$H_1: y_t = \mu + d_1 DU_{1t} + d_2 DTB_{2t} + e_t \quad (17)$$

3.3 Panel unit-root tests

There will be used three types of panel testing methods for detecting the unit-root in the models, which can be ranged as follows: (i) Hadri LM stationary test, (ii) Im-Pesaran-Shin test (hereafter, IPS), and (iii) Fisher-type test. First and foremost, the stationary test designed by Hadri (2000) is based on the fact that the null hypothesis refers that the panel series have no unit-root against the alternative hypothesis. The unique feature of this procedure is that the individual specific variances and correlation patterns are allowed in the testing process (Hlouskova and Wagner, 2006). Along with this phenomenon, the stationary test is conducted on residual-led LM method where the residuals are obtained by the following regression:

$$\Delta y_{it} = \delta_{mi} d_{mt} + \varepsilon_{mi} \tag{18}$$

In the theoretical context, the residuals are denoted as $\hat{e}_{it}$ and the partial sum of these residuals is specified as $S_{it} = 1/T \sum_{j=1}^{t} \hat{e}_{ij}$. By considering these factors, the Hadri's LM test statistic can be obtained from the Eq. (19):

$$H_{LM,m} = \frac{1}{NT^2} \sum_{i=1}^{N} \sum_{t=1}^{T} \frac{S_{it}^2}{\hat{\sigma}_{ei}^2} \tag{19}$$

where $\hat{\sigma}_{ei}^2 = 1/T \sum_{t=1}^{T} \hat{e}_{it}^2$. Related to the LM test statistic, Z-statistic is represented in Eq. (20):

$$Z_{LM,m} = \frac{\sqrt{N}(H_{LM,m} - \xi_m)}{\zeta_m} \Rightarrow N(0,1) \tag{20}$$

In Eq. (20), if the model includes only constant, the optimal numbers for the parameters will be $\xi = 1/6$ and $\zeta = 1/45$; however, if the other conditions are prevailing, the optimal numbers for the parameters will be $\xi = 1/15$ and $\zeta = 1/6300$ (Hadri, 2000 pp. 153-154).

Second, the IPS is a bit different testing procedure for detecting the unit-root since it allows for each panel to obtain its unique autocorrelation coefficient. In that vein, the IPS panel unit-root test has its own independence for statistical correction to the heterogeneity among the panel units and thus differs from the others advocated by Harris and Tzavalis (1999) and Levin *et al.* (2002). Eq. (21) produces the first autoregressive process for y_{it} as follows:

$$y_{it} = (1 - \emptyset_i)\mu_i + \emptyset_i y_{i,t-1} + \varepsilon_{it} \tag{21}$$

in which the Δy_{it} can be denoted from the following regression in Eq. (22):

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \varepsilon_{it} \tag{22}$$

The null hypothesis states that all panels have a unit-root (H_0: $\beta_i = 0$) against the alternative (H_1: $\beta_i < 0$). In consideration of these factors, *t*-statistics for the IPS test can be produced as follows:

$$\tilde{t} - bar_{NT} = \frac{1}{N} \sum_{i=1}^{N} \tilde{t}_{iT} \tag{23}$$

In addition to the estimated standardized $\tilde{t} - bar_{NT}$ statistics in Eq. (23), the W_{t-bar} statistics can be formulated in Eq. (24):

$$W_{t-bar} = \frac{\sqrt{N}\left\{t - bar_{NT} - \frac{1}{N}\sum_{i=1}^{N} E[t_{iT}(p_i, 0)|\beta_i = 0]\right\}}{\sqrt{\frac{1}{N}\sum_{i=1}^{N} VAR[t_{iT}(p_i, 0)|\beta_i = 0]}} \overset{T,N}{\Longrightarrow} N(0,1) \tag{24}$$

Finally, Maddala and Wu (1999) and Choi (2001) produced the Fisher-type panel unit-root testing procedure in the context of Fisher (1932) results which integrates all *p*-values from the individual time-series unit-root tests such that Augmented Dickey-Fuller and Phillips-Perron. In order to have asymptotic estimation results, the Eq. (25) can be regressed through the Fisher-type unit-root testing procedure:

$$-2\sum_{i=1}^{N}\log(\pi_i) \rightarrow \chi^2_{2N} \tag{25}$$

where π_i expresses the *p*-value from individual unit-root tests for the *i*-th cross-section *i*.

Within the case of the given estimation framework, Choi (2001) also obtains the asymptotic results along with using the following regression in Eq. (26):

$$Z = \frac{1}{\sqrt{N}}\sum_{i=1}^{N}\phi^{-1}(\pi_i) \rightarrow N(0,1) \tag{26}$$

where ϕ^{-1} is the inverse of the standard normal cumulative distribution function. Each panel unit-root test statistics corresponds to have standard normal limiting distributions.

4. ESTIMATION RESULTS

The existing literature on unemployment hysteresis provides challenging and controversial results, which of those are indicated that the major empirical question and hypothesized proposition remain as to whether the theoretical underpinnings are statistically relevant. In order to have a valid structure for a given theory on unemployment hysteresis, this section applies both univariate and panel unit-root tests on the series with and without structural breaks. To carry out these testing procedures, the study uses annual data on unemployment rates for different economic classification on the basis of region-based, income-based and aggregate analyses over the period 1991-2018. Since these classifications cover various economic units, it leads to an advantageous environment to produce an empirical output for an aggregate explanation in terms of the validity of unemployment hysteresis.

4.1 Standard time series unit-root tests

Table no. 1 points to the empirical results for three individual unit-root tests on annual, seasonally-adjusted series for unemployment rates of different economic classifications. First, the empirical outputs of the ADF unit-root tests provide a piece of information that the unemployment hysteresis cannot be rejected for all types of analyses considering region-based, income-based, and aggregate for the given period of time. In each case, the null hypothesis of non-stationary for time-series does not being rejected, which means that the ADF results are statistically insignificant, and thereby, lead to the acceptance of hysteresis phenomenon for unemployment series covering a wide array of countries from different regions and income groups. Second, the same empirical results obtained from the ADF testing procedure are provided for the PP test, which shows that none of the unemployment series are stationary. Finally, the KPSS test reveals that 10 unemployment series out of 19 categories are non-stationary. In particular, in an aggregate analysis, we provide a piece of information

about the world category including both countries to check that the unemployment series for the average of all countries are stationary, in which the null hypothesis of trend stationary is rejected for all individual time series unit-root tests.

Whereas the pure unit-root tests in time series provide crucial implications towards the statistical validity of unemployment hysteresis, they do not consider the effects of structural breaks, in which each category of the analysis may have different dynamics for a given time period. For instance, a number of economic shocks and socio-political variations among different economic categories may possibly lead to a change in the validity of the hysteresis hypothesis along with the existence of break dates. In that vein, we have to deal with the possible effects of structural breaks emerging over time to assess the statistical importance of stationarity of the unemployment series. Therefore, we approach two different kinds of unit-root testing procedures, which of those allow for both a single break in intercept and/or trend and the double mean shifts. In consideration of these procedures, on the one hand, Table no. 2 shows the unit-root test results with structural breaks for a single break in intercept and/or trend developed by Zivot and Andrews (1992); on the other hand, Table no. 3 and Table no. 4 provide empirical results for the unit-root tests with double mean shifts, considering both additive outlier and innovative outlier models, advanced by Clemente *et al.* (1998).

Table no. 1 – Univariate time-series unit-root tests: ignoring structural breaks

Classification	***ADF***	***PP***	***KPSS***
Region-Based Analysis			
Arab World	-2.35	-2.41	0.108
Central Europe & the Baltics	-1.65	-1.72	0.144*
East Asia & Pacific	-0.78	-0.99	0.259***
Europe & Central Asia	-2.57	-2.60	0.101
Latin America & Caribbean	-2.40	-1.82	0.157**
Middle East & North Africa	-2.54	-2.42	0.09
North America	-2.08	-1.78	0.105
South Asia	-2.50	-2.20	0.086
Sub-Saharan Africa	-1.90	-2.06	0.153**
Income-Based Analysis			
High-Income	-1.90	-1.92	0.075
Low & Middle Income	-2.60	-2.15	0.209**
Low Income	-1.69	-1.70	0.215**
Lower-Middle Income	-2.25	-2.02	0.193**
Middle Income	-2.60	-2.15	0.207**
Upper-Middle Income	-2.81	-2.16	0.208**
Aggregate Analysis			
Euro Area	-2.08	-2.09	0.101
European Union	-2.21	-2.15	0.076
OECD Members	-1.96	-1.94	0.078
World	-2.31	-2.31	0.196**

*Note: *** p<0.01, ** p<0.05, * p<0.10. Lag selection is determined by the AIC*

Table no. 2 presents that the empirical results of Zivot-Andrews unit-root testing procedure support the pure time-series unit-root test results. Even though some of the minimum-*t* statistics become statistically significant, indicating that the series is stationary, the overall view over the hysteresis hypothesis is still relevant for different economic categories.

First, the unit-root test statistics with structural breaks for a single break in intercept are stationary for Central Europe & the Baltics, Middle East & North Africa, South Asia in case of region-based analysis, are stationary for only lower-middle income countries in case of income-based analysis and are stationary for Euro Area, European Union, and OECD member countries in case of aggregate analysis. Second, the unit-root test statistics with structural breaks for a single break in trend are stationary for Central Europe & the Baltics, and East Asia & Pacific in case of region-based analysis. Third, the unit-root test statistics with structural breaks for a single break in both are stationary for Central Europe & the Baltics, East Asia & Pacific, Middle East & North Africa, and North America in case of region-based analysis, are stationary for only high-income economies in case of income-based analysis and are stationary for European Union and OECD member countries in case of aggregate analysis.

Table no. 2 – Zivot-Andrews unit-root test results: single structural break

Classification	**Region-Based Analysis**								
	Intercept			***Trend***			***Both***		
	k	***min-t***	***T_B***	***k***	***min-t***	***T_B***	***k***	***min-t***	***T_B***
Arab World	2	-4.14	2004	2	-2.81	2010	2	-4.28	2006
Central Europe & the Baltics	1	-4.92**	1999	1	-4.59**	2005	1	-4.87*	2005
East Asia & Pacific	0	-2.02	2001	0	-5.30***	2004	0	-5.31**	2002
Europe & Central Asia	1	-4.52	2009	1	-3.69	2016	1	-4.50	2009
Latin America & Caribbean	1	-3.15	2005	1	-2.72	1996	1	-2.61	2010
Middle East & North Africa	2	-5.71***	2006	2	-2.81	1999	1	-5.43**	2006
North America	1	-4.34	2008	1	-3.74	2014	1	-6.87***	2009
South Asia	1	-4.93**	2006	1	-2.51	2011	1	-4.65	2006
Sub-Saharan Africa	1	-4.50	2006	1	-2.66	2014	1	-3.38	2006
	Income-Based Analysis								
	Intercept			***Trend***			***Both***		
	k	***min-t***	***T_B***	***k***	***min-t***	***T_B***	***k***	***min-t***	***T_B***
High-Income	1	-4.48	2009	1	-3.37	2016	1	-6.96***	2009
Low & Middle Income	0	-3.49	2006	0	-3.17	1995	0	-2.99	1993
Low Income	1	-3.94	1999	1	4.01	2003	1	-4.06	1999
Lower-Middle Income	2	-4.91**	2006	2	2.92	2000	2	3.58	2006
Middle Income	0	-3.60	2006	0	-3.15	1995	0	-2.96	1993
Upper-Middle Income	0	-3.07	1994	0	-3.32	1995	0	-3.09	1994
	Aggregate Analysis								
	Intercept			***Trend***			***Both***		
	k	***min-t***	***T_B***	***k***	***min-t***	***T_B***	***k***	***min-t***	***T_B***
Euro Area	1	-5.34***	2009	1	-3.65	2006	1	-4.52	2012
European Union	1	-5.21**	2009	1	-3.27	2002	1	-4.89*	2012
OECD Members	1	-4.81**	2009	1	-3.29	2015	1	-7.13***	2009
World	0	-2.76	1993	0	-2.80	2000	0	-3.18	2004

*Note: In all models, the trim value is accepted as 0.05. Lag length is determined by Akaike-Schwarz information criteria (AIC). min-t is the minimum t-statistic measured. The critical values of t-statistics are as follows: intercept: -5.34 (1%), -4.80 (5%), -4.58 (%10); trend: -4.93 (1%), -4.42 (5%), -4.11 (10%); both: -5.57 (1%), -5.08 (5%), -4.82 (10%). *** p<0.01, ** p<0.05, * p<0.10. Lag selection is determined by the AIC.*

In consideration of these empirical outputs considering the single structural break in the series, the null hypothesis of non-stationary does not reject in many of the categories in the dataset due to the fact that the min-*t* values are smaller than the critical values in levels. In

this sense, the unit-root test results in first-differences of the unemployment series should be stationary in the presence of structural breaks. However, all these empirical outputs lead us to argue that the hysteresis hypothesis is still prevailing for almost all country classifications within the case of a single structural break.

While Table no. 2 presents unit-root test results for a single structural break, Table no. 3 and Table no. 4 summarize the empirical outputs for double mean shifts for both additive outlier and innovative outlier models. Therefore, these further results approached by Clemente *et al.* (1998) allow for an extended version of the Zivot-Andrews method by introducing double mean shifts of the unemployment series. First, we obtain information from the additive outlier model in Table no. 3 that the break dates are not specific to any year in which they range in a wide array of time horizons. Irrespective of region-based, income-based, or aggregate analyses, the break dates change in the presence of several determinants including both socio-economic and political factors, and thus, any kind of interruption in those mentioned factors may have an effect on unemployment rates in the long-run, which then lead to a change in the effectiveness of the hysteresis hypothesis. In that vein, the empirical results imply that almost all statistics reveal that the non-stationary position of unemployment series is prevailing for almost all classifications, except the Arab World, Central Europe & the Baltics, Europe & Central Asia, and the Middle East & North Africa in case of region-based analysis.

Table no. 3 – Additive outlier model results: double mean shifts

Classification	***Region-Based Analysis***					
	T_{B1}, T_{B2}	***min-t***	du_1	***t-stat*** (du_1)	du_2	***t-stat*** (du_2)
Arab World	1993, 2005	-5.66**	0.216	0.64	-2.499	-12.1
Central Europe & the Baltics	2000, 2009	-5.29*	0.503	0.53	-2.814	-2.89
East Asia & Pacific	1998, 2011	-3.72	1.261	9.86	-0.215	-1.61
Europe & Central Asia	1995, 2002	-5.27*	1.521	2.92	-1.672	-4.14
Latin America & Caribbean	1996, 2005	-2.78	1.839	5.12	-1.623	-5.49
Middle East & North Africa	1993, 2005	-6.40***	0.086	0.31	-1.904	-10.8
North America	2008, 2016	-4.77	1.699	3.27	-3.082	-3.19
South Asia	2000, 2008	-4.12	0.208	2.00	-0.065	-0.62
Sub-Saharan Africa	1996, 2005	-4.03	0.317	2.65	-1.392	-14.1
	Income-Based Analysis					
	T_{B1}, T_{B2}	***min-t***	du_1	***t-stat*** (du_1)	du_2	***t-stat*** (du_2)
High-Income	2010, 2016	-4.49	0.265	0.82	-1.922	-3.40
Low & Middle Income	1996, 2006	-3.55	1.024	7.99	-0.434	-4.09
Low Income	1996, 2015	-4.22	0.318	3.69	-0.412	-3.60
Lower-Middle Income	1997, 2008	-2.82	0.671	5.50	-0.427	-3.87
Middle Income	1996, 2006	-3.49	1.081	7.98	-0.429	-3.83
Upper-Middle Income	1996, 2006	-3.25	1.319	7.53	-0.290	-1.99
	Aggregate Analysis					
	T_{B1}, T_{B2}	***min-t***	du_1	***t-stat*** (du_1)	du_2	***t-stat*** (du_2)
Euro Area	2000, 2010	-4.85	-1.873	-3.67	1.713	3.17
European Union	2002, 2010	-4.43	-1.366	-2.76	0.708	1.30
OECD Members	2008, 2016	-4.47	0.753	2.82	-2.046	-4.12
World	1996, 2005	-3.53	0.717	5.55	-0.399	-3.76

Note: The 1% (***), 5% (**), and 10% (*) critical values of t-statistics with two breaks are -5.96, -5.49 and -5.24, respectively. T_B denotes the estimated breakpoints. The coefficients (du_i) are also reported in the table.

Second, the results of the innovative outlier model in Table no. 4 imply that the gradual changes in the unemployment series are statistically significant, which indicates that the differential norms in societal forms and their determinants have crucial impacts on given classifications. However, the exceptions of these outputs can be ranged as follows: Arab World, Middle East & North Africa, and North America in case of region-based analysis. Therefore, the non-stationary characteristics of the unemployment series are still prevailing for most of the given classifications, which directly imply that the hysteresis phenomenon can be accepted as a norm for a given time period.

Table no. 4 – Innovative outlier model results: double mean shifts

Classification	***Region-Based Analysis***					
	T_{B1}, T_{B2}	***min-t***	du_1	***t-stat*** (du_1)	du_2	***t-stat*** (du_2)
Arab World	2002, 2004	-5.29*	-1.047	-3.67	-0.634	-1.56
Central Europe & the Baltics	2003, 2009	-4.50	0.058	0.12	-1.358	-2.73
East Asia & Pacific	1996, 1999	-3.84	0.273	2.38	0.187	1.48
Europe & Central Asia	2003, 2016	-4.17	-0.648	-2.84	-0.662	-1.35
Latin America & Caribbean	1993, 2004	-3.24	1.205	2.48	-0.797	-2.88
Middle East & North Africa	1994, 2004	-5.73**	-0.234	-0.98	-1.513	-4.96
North America	2007, 2012	-5.32*	1.703	3.98	-1.909	-3.83
South Asia	2009, 2014	-3.79	-0.003	-0.04	0.017	0.16
Sub-Saharan Africa	2001, 2005	-4.87	-0.143	-1.49	-0.685	-3.44
	Income-Based Analysis					
	T_{B1}, T_{B2}	***min-t***	du_1	***t-stat*** (du_1)	du_2	***t-stat*** (du_2)
High-Income	2006, 2015	-4.02	0.245	1.31	-1.136	-2.96
Low & Middle Income	1996, 2004	-2.79	0.265	1.62	-0.245	-2.95
Low Income	2006, 2012	-2.77	0.004	0.08	-0.165	-2.39
Lower-Middle Income	1996, 2004	-3.89	0.281	2.48	-0.294	-4.28
Middle Income	1996, 2004	-2.69	0.268	1.54	-0.242	-2.81
Upper-Middle Income	1996, 2009	-4.04	0.512	2.55	-0.122	-1.56
	Aggregate Analysis					
	T_{B1}, T_{B2}	***min-t***	du_1	***t-stat*** (du_1)	du_2	***t-stat*** (du_2)
Euro Area	1998, 2007	-4.30	-1.270	-3.11	0.754	2.42
European Union	1999, 2006	-3.46	-0.682	-1.92	0.113	0.40
OECD Members	2006, 2015	-4.08	0.337	1.74	-1.073	-2.81
World	1996, 2004	-2.79	0.214	1.32	-0.251	-2.52

Note: The 1% (***), 5% (**), and 10% (*) critical values of t-statistics with two breaks are -5.96, -5.49 and -5.24, respectively. T_B denotes the estimated breakpoints. The coefficients (du_i) are also reported in the table.

4.2 Panel unit-root tests results

In this sub-section, we approach a panel unit-root test for unemployment rates through including country-specific effects, where the univariate unit-root testing procedures validate the hysteresis hypothesis is to a large extent statistically significant for different classifications of the analysis and make sense for most of the socio-economic structure. Table no. 5 presents the empirical results for three panel unit-root tests. In each analysis, the testing procedures allow for different technical ways in order to understand the effects of time trends and cross-sectional dependence on stationary conditions of unemployment series.

Table no. 5 – Panel unit-root test results

Panel Tests	***Test Statistic (p-value)***		
	Region-Based Analysis	***Income-Based Analysis***	***Aggregate Analysis***
Im-Pesaran-Shin (IPS) Test	-0.0768 (0.4694) Panel means included No time trend	-1.7739 (0.0380) Panel means included No time trend	-1.3014 (0.010) Panel means included No time trend
	-1.0669 (0.1430) Panel means included Time trend included	-0.0731 (0.4708) Panel means included Time trend included	-0.8527 (0.1969) Panel means included Time trend included
	Region-Based Analysis	***Income-Based Analysis***	***Aggregate Analysis***
Fisher-PP Test	Inverse χ^2 (p) = 1.7267 (0.4217) Inverse normal (z) = -0.1974 (0.4217) Inverse logit (L*) = -0.1860 (0.4283) Modified inverse χ^2 (P_m) = -0.1366 (0.5543)	Inverse χ^2 (p) = 1.5615 (0.4581) Inverse normal (z) = -0.1053 (0.4581) Inverse logit (L*) = -0.0991 (0.4616) Modified inverse χ^2 (P_m) = -0.2192 (0.5868)	Inverse χ^2 (p) = 0.9483 (0.6224) Inverse normal (z) = 0.3119 (0.6224) Inverse logit (L*) = 0.2946 (0.6125) Modified inverse χ^2 (P_m) = -0.5259 (0.7005)
	Region-Based Analysis	***Income-Based Analysis***	***Aggregate Analysis***
Hadri-LM Test	7.5722 (0.0000) Allow for cross-sectional dependence No time trend	2.0939 (0.0181) Allow for cross-sectional dependence No time trend	1.0447 (0.1481) Allow for cross-sectional dependence No time trend
	4.6232 (0.0000) Allow for cross-sectional dependence Time trend included	8.0823 (0.0000) Allow for cross-sectional dependence Time trend included	2.4618 (0.0069) Allow for cross-sectional dependence Time trend included

Note: Lag specification is chosen by Akaike Information Criteria (AIC) in the IPS panel unit-root test. The lagged differences are determined by two in the Fisher-type test and the Phillips-Perron unit-root tests conducting on each panel which includes both panel means and time trend. While the null hypotheses for IPS and Fisher-type unit-root tests imply that all panels contain unit-roots, the reverse case is prevailing for the Hadri-LM test in which all panels are stationary for the null hypothesis.

First, we can clearly assess the empirical results obtained by approaching IPS panel unit-root test at levels, in which the null hypothesis of non-stationarity conditions of panels cannot be rejected in the presence of time trend for both classifications of the analysis at lag length chosen by AIC. In this sense, we can infer that the series have unit-roots within the framework of using the IPS testing procedure, which allows for heterogeneous panels to get information for the case that the unemployment series is stationary or non-stationary. Therefore, the empirical results show that the hysteresis hypothesis is statistically valid for all analyses, including a wide array of countries.

Second, we obtain empirical results from panel Fisher-test approached by Choi (2001), which allows for individual unit-root processes, thus ρ_i may vary across cross-sections. The major aim of using the panel Fisher-PP test is to obtain panel-specific results, deriving from the combinations of the univariate unit-root tests. The tests statistics for panel Fisher-PP are statistically insignificant in all different classifications of the analysis, and therefore the *p*-values indirectly mean that the hysteresis phenomenon is still prevailing.

Third, we also approach the Hadri-LM test to consider the effects of the presence of both time trends and cross-sectional dependence. The empirical findings of the Hadri-LM unit-root

test show that the null hypothesis of stationary of the series is highly and statistically rejected for all classifications, including homogenous and heterogeneous cases.

All of these three empirical outputs for different panel unit-root testing procedures directly lead to the following conclusion that the hysteresis hypothesis is statistically significant and has economically prevailing for different country classifications, and thus, it supports the initial findings of Blanchard and Summers (1986b). In particular, the empirical results directly put forward to the validity of a permanent effect on unemployment rates. Therefore, the arguments towards the existence of path-dependence of steady-state equilibrium unemployment imply to the connection with the economic hysteresis where the country-specific and time-variant effects of economic shocks on unemployment series are considered in the analysis for each country classification. In consideration of these factors thus both of the structural and country-specific determinants should be included in the general context of the analysis to make further discussions for the fluctuations in unemployment all over the economies.

5. CONCLUDING REMARKS

This paper analyzes the empirical significance of unemployment hysteresis on the basis of the regional context, income- and aggregate-level over the 1991-2018 period by way of using both univariate and panel unit-root tests in the presence of the structural breaks in the series. While the traditional literature for the case of the hysteresis hypothesis implements mixed empirical results based on country-specific analysis, the classification-based analyses are not so pervasive in the empirical field. Therefore, this paper provides initial findings on the given topic in order to test whether the hysteresis phenomenon is still valid in the presence of different country classifications. In this sense, two main unit-root testing procedures (i.e., univariate and panel unit-root tests) are followed in the empirical analysis to show that all the two methods complement each other on the basis of empirical findings, which depend on different factors such as labor market rigidities, demand management policies, and structural deviations. The traditional arguments are taken form by theoretical differences, which cause the existence of idiosyncratic results to find out the long-run relationship between the deviations in unemployment rates and the behavior of business cycles. On the one hand, the natural rate of unemployment hypothesis argues that the long-run deviations in the unemployment rate emerging due to economic shocks will be reverted to the optimal level. On the other hand, the structuralist arguments state that there is a permanent effect of economic shocks on the unemployment rate since some of the determinants such as the change in the structural basis of economies and the institutional environment lead to the case that the shocks may highly persistent to being solved over time. Additionally, the persistence viewpoints that economic shocks may have long-lasting effects on unemployment rates due to the fact that there are near unit-root process and thus the equilibrium level of unemployment should need a sufficient amount of time to be re-established in the long-run.

In consideration of the challenging views, on the one hand, the first part of the empirical analysis focuses on univariate unit-root tests with and without structural breaks, which are ADF, PP, and KPSS for the former, and which are Zivot and Andrews (1992) and Clemente *et al.* (1998) for the latter. On the other hand, we approach panel unit-root tests, which are IPS, Fisher-PP, and Hadri-LM to test the empirical significance of unemployment hysteresis for different country classifications. The results show that the unemployment hysteresis is

statistically significant in the case of unit-root analyses, which means that the potential shocks and economic downturns have highly persistent and permanent effect on the unemployment rates confirming the arguments provided by Blanchard and Summers (1986b). Therefore, the given results provide a piece of information that the economic interruptions to a well-functioning economic system may lead to a change in the unemployment rate over the long-run period for the sample of different economic classifications largely due to differences in labor market institutions. Similar to that case, if there is a lack of structural reforms, this may exacerbate the economic problems and thus indirectly increases the unemployment rates. Accordingly, the loss of control over wage-settings and the change in union behaviors may negatively affect the unemployment problem over different economic classifications.

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Notes

[1] According to Ball and Mankiw (2002, p. 119), the term of hysteresis was originally taken from the physics and it denotes "…to the failure of an object to return to its original value after being changed by an external force, even after the force is removed".

[2] The development process of the theoretical underpinnings of hysteresis in unemployment were proceeded too slow before the Global Recession (Skott, 2005; Stockhammer, 2011).

[3] Ball (2009, p. 3) notes that "…it's clear that some form of hysteresis exists, but it's not clear why. The relationships among unemployment, the natural rate, and inflation appear to be non-linear, but it's hard to pin down the non-linearities precisely. As a result, policy implications are not crisp.".
[4] While Kienzler and Schmid (2014) and Galí (2015) remark that if the hysteresis in unemployment exists, the dual mandate of the central bank will be sufficient to equilibrate the adverse shocks, Ball *et al.* (1999) argues that the hysteresis will be resulted in high unemployment rates during recessions if the economic policies are not being relatively strong.
[5] For more information on the other sources of hysteresis please see Pissarides (1992), Sessions (1994), Røed (1997), Ball (1999, 2009), Roberts and Morin (1999), Blanchard (2003), Mikhail *et al.* (2003), Skott (2005), Christopoulos and León-Ledesma (2007), Stockhammer (2011).
[6] According to León-Ledesma (2002, p. 95), there is a theoretical difference between the hysteresis hypothesis and the persistence view. Therefore, one should not be confused one case with the other.
[7] Therefore, the persistence view can be assumed as a special case of NRU (Mitchell and Muysken, 2008, p. 101).
[8] Some of the studies are accepted two concepts, hysteresis and persistence, as completely similar with each other. Since the differences between two concepts are neglected, the explanation of the stationary position of the series are sometimes ignored in understanding of the hysteresis in unemployment. However, in the literature, unit-root process is entitled as "full hysteresis". Hence the persistence view is alternatively termed as "partial hysteresis" in the literature. Similar to the case of their differences in their nomenclature, the unit-root process is also differed, in which the persistence view is characterized by a near unit-root process. For instance, the NAIRU is basically reformulated by considering the short-run dynamics of hysteresis in unemployment, in which the unemployment acts as a stabilizer to reduce the voice of adverse interests over the income distribution between different classes (Layard *et al.*, 1991).
[9] The representation of the insider-outsider model is derived from the study of León-Ledesma (2000). Therefore, we use mostly the same notational procedure in the equations advocated by León-Ledesma (2000).
[10] Variables with lower case denote the logarithmic forms.
[11] The major aim of currently employed workers is to maximize their wages in case of unchanging union behaviors.
[12] Lumsdaine and Papell (1997) also extended the method provided by Zivot and Andrews (1992) which includes one structural break in the time series through accommodating of two structural breaks.
[13] According to Zivot and Andrews (1992), the "trimming region" is specified as 0.15T, 0.85T.

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