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ABSTRACT

Unemployment hysteresis of the Middle East and North African (MENA) countries is investigated under a battery of unit root testing frameworks in the extant literature, including a recently proposed Panel SUR Dickey-Fuller-like unit root test with Fourier and Exponential Smooth Transition Regression (ESTR) nonlinearities. The Fourier function allows for smooth nonlinear breaks, while the ESTR nonlinearity allows for instantaneous breaks. The two nonlinearity types make the recent approach quite appealing. It has, however, been scarcely applied to empirically test unemployment hysteresis hypothesis. Although we find conflicting stances from ADF, FADF and ADF-SB testing frameworks, evidence of unemployment hysteresis effect in Lebanon is consistent across all three tests. The ADF and FADF tests confirm the hysteresis hypothesis in Kuwait and Lebanon, while FADF-SB rejects the unemployment hysteresis hypothesis across all the 19 MENA countries. The results from the KSS and FKSS unit root testing frameworks consistently affirmed the hysteresis effect in Oman and Turkey, while there are mixed stances for Kuwait and Lebanon. The results from SURADF and SURKSS only support the hysteresis hypothesis in Turkey, while the same is confirmed only for Bahrain under the SURFADF and SURFKSS testing frameworks. Unemployment

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hysteresis hypothesis is confirmed for 12 (about 63.15% of the total number considered) MENA economies.

Keywords: Unemployment rate; MENA countries; Fourier function; Seemingly Unrelated Regression; Panel data; Unit root test
JEL Classifications: C22, C23, E24, J64

1. Introduction

Middle East and North Africa [hereafter, MENA] countries have had the highest rates of unemployment, globally, since the early 2000s. This has been the focus of intense research and policy discussion, as the region also has the highest youth population proportion (World Bank, 2018; Chaaban, 2009). Unfortunately, the positive engagement of the seemingly youthful population in the MENA countries is greatly lacking, which has consequently led to social unrest, emanating from frustrated youth populace. The divergence in the unemployment dynamics of MENA countries is influenced by the following factors: large proportion of young persons that fail to complete early school levels amidst accessible education; mismatch between educational investments and effective utilization of human capital; immediate returns that are not commensurate with investment in university education; existence of gender bias; only a small proportion of young persons in paid employment have written contracts as well as basic entitlements; engagement of considerable percentage of young persons in the informal sector; untenable expectations of being employed in the public sector; weak labour markets conditions and low female participation in the labour market; the disparities in the levels of the MENA countries' financial sector development; the differences in the size of the informal sector; and the disparities in terms of migration patterns; among others (see Veganzones and Pissarides, 2005; Jelili, 2010; International Labour Organization, 2016). These factors cut across MENA countries, emphasizing on the region's weak labour markets and consequent poor economic performance occasioned by the end of the oil boom that negatively impacted on the region's (Kabbani and Kothari, 2005).

With high inflation rates experienced in the MENA region, investigating plausible persistence in the unemployment rates of member countries will not only interest readers but also contribute to the ongoing debate on unemployment in the area. Unemployment rates are real-valued (as magnitude), while persistence talks about memory property in the level series. This memory property is the stationarity stance of the series that has economic implications, depending on its size. This results in either of the two prominent economic theories or hypotheses of unemployment: the non-accelerated inflation rate of unemployment [NAIRU] (see Phelps, 1967; Friedman, 1968) and the hysteresis hypotheses (Blanchard and Summers, 1986). The former assumes fluctuation of the rate of inflation around an equilibrium level, which corresponds to the rate of unemployment being a stationary time process. Blanchard and Summers (1986) find path-dependence of the equilibrium level of unemployment rate on the actual historic data, a stationarity condition that characterizes such data series. The path-dependence of the equilibrium level of unemployment on history cum maintenance of its natural dynamics over time is supported by the unemployment hysteresis hypothesis (Mitchel, 1993; Song and Wu, 1998). Gomes and da Silva (2008) emphasize the hysteresis hypothesis of unemployment rates as when the rates are not only path-dependent but with a weak tendency to return to its equilibrium level. In such a circumstance, the unemployment rate is classified as a nonstationary process.

The present paper, therefore, investigates the unemployment hysteresis hypotheses in the MENA region, using 19 countries as a case study. This is to ascertain the nature of the unemployment rates in the area, as to having mean-reverting properties or not, as this could be a pointer to how effective the existing policies have been and whether more strict measures should be put in place to control unemployment. The annual unemployment rates dataset for these countries spans from 1991 to 2019. We consider more robust time series analysis methods, hardly used in investigating time-series stationarity. Furuoka (2017) documents a framework in the univariate setting, which considers Fourier Augmented Dickey-Fuller with instantaneous breaks (FADF-SB) with other restricted tests (see also Yaya, Ogbonna and Mudida, 2019). Fourier approximations are shown to easily mimic the pattern of unknown (including non-periodic) functions, due to its ability to integrate functions with high precision (Becker et al., 2004; Pascalau, 2010; and Enders and Lee, 2012a). Fourier functions allow for smooth breaks in the series dynamics, making the entire model nonlinear. We herein apply the power of panel unit root testing framework induced by the Seemingly Unrelated Regression (SUR) system, hinging on the test's proven outperformance over extant non-panel frameworks, as it allows for cross-correlation effects among the series (see Breuer et al., 2002). This is the case of SUR-ADF unit root test of Breuer et al. (2002). A SUR system that incorporates smooth break by Fourier form (F) and instantaneous break induced in the test (similar to KSS test (Kapetanios et al., 2003)) is proposed as SURFKSS unit root test (He et al., 2014). Other unit root tests using SUR system include SUR-FADF (Furuoka, 2017) and SURKSS (Christoupolos and Leon-Ledesma, 2010).

Results obtained in the present paper will be of relevance to interested readers and labour economists in the MENA region on the dynamics of unemployment, as it is being affected by inflationary shocks in the area as well as other socio-economic factors. Section 2 of the paper reviews relevant literature; Section 3 presents the data issues and pretests; Section 4 presents an exposition of the statistical method used; while the empirical results are discussed in Section 5, and Section 6 concludes the paper and suggests relevant policies.

2. Review of Literature

The Natural rate of unemployment (hereafter NRU), which refers to an equilibrium point of supplied and demanded wages, is affected/determined not only by the factors influencing the supply or demand wage but also by the level of productivity, compared to the reservation wage (see Blanchard and Katz, 1997). The NRU relates to full employment equilibrium, real/supply-side factors, as well as steady price level (see Shulman, 1989). Determinants of NRU remains an ongoing issue in extant economic literature. Two theoretical explanations are prominent in the literature – the natural rate of unemployment hypothesis [hereafter, NRUH] and unemployment hysteresis hypothesis [hereafter, UHH]. The NRUH[2] has been criticized on the ground that it lacked theoretical, empirical and predictive contents (Shulman, 1989 and Farmer, 2013).

Blanchard and Summers (1986) propose the UHH. According to them, the impacts of shocks to NRU are likely to span a more extended time period. The word, "hysteresis" only applies when the equilibrium unemployment rate is genuinely dependent on history and is indicative that the data follows a nonstationary process. By implication, it is possible that more robust policies are needed to cause the rate to revert to its mean level, such that NRU then depends on economic agents' responses to macroeconomic variable policy shocks, and likewise the labour market flexibility (see Cross, 2013).

The empirical literature on the explanation of natural rate by the hysteresis hypothesis has documented mixed results/findings, and it keeps expanding with the development of new unit root approaches and/or improvement on the existing techniques. A handful of these findings is hereby reviewed. Blanchard and Summers (1986) examine the UHH for France, Germany, the UK, and the US between 1953 and 1984. Their findings support the hysteresis effect in France, Germany and the UK. Brunello (1990) finds similar results using unemployment data for Japan. The hysteresis hypothesis is also found to explain the natural rate in Canada, Germany and the UK (Jaeger and Parkinson, 1994). Empirical evidence from Neudorfer et al. (1990) and Røed (1996) equally supports the hysteresis effect in the Organization for Economic Cooperation and Development (OECD) countries. These studies employ conventional unit root tests (ADF and PP) and cannot reject the unit root null. Similar studies include: Mitchell (1993) who applies Zivot-Andrews unit root test (Zivot and Andrews, 1989) and accounts for a structural break in the unemployment data for OECD labour markets; Everaet (2001) employs the ADF and KPSS unit root frameworks for OECD economies;

[2] See Shulman (1989) and Cross (2013) for the criticisms by other notable economists of the natural rate of unemployment hypothesis.

Camarero and Tamarit (2004) examine 19 OECD countries using SURADF panel unit root approach; Yilanci (2008) employs Kapetanios et al. (2003) linear and nonlinear unit root tests. Fabio and Cleomar (2008) examine UHH for Brazil and Chile, using an LM unit root test with two endogenous breaks and do not reject the null of hysteresis in both countries.

Song and Wu (1998) employ Levin and Lin's (1992) panel unit root testing framework on the US and sixteen European Union (EU) countries' unemployment data and cannot validate hysteresis effect in the unemployment. Hysteresis effect could not be validated. León-Ledesma (2002) uses Im, Pesaran and Shin (2003) panel unit root approach and finds that the hysteresis effect could not be established in the US case, but finds support in the sixteen EU countries. Chang and Su (2014) consider unemployment rates in Taiwan using linear panel unit root test, with cross-sectional independence specification and found rejection for the hysteresis hypothesis. But when structural breaks are accounted for, mixed results are found; and upon using a nonlinear model, hysteresis effect is observed.

Similarly, Kula and Aslan (2010) use data on unemployment by educational attainment in 17 OECD countries for 12 to 27 years (depending on the country). Hysteresis effect holds for workers with lower educational attainment (primary and secondary school) but rejects for workers with higher educational attainment (post-secondary). Kanaliciakay, Nargeleçekenler, and Yilmaz (2011) tests unemployment hysteresis effects for 23 OECD countries from 1963 to 2007 using univariate and panel unit root tests, and the results obtained point to the rejection of the hysteresis hypothesis. Findings from the authors do not support unemployment hysteresis for the 23 OECD countries' data, subjected to panel unit root testing framework approach with and without a break.

By applying Enders and Lee (2012a; b) flexible Fourier unit root testing model, Greece, Ireland, Italy, Portugal and Spain are found to support unemployment hysteresis hypothesis. More recently, findings from some studies (Garcia-Cintado et al., 2015; Marjanovic et al., 2015; Munir and Ching, 2015; Klinger and Weber, 2016; Marques et al., 2017; Albulescu and

Tiwari, 2018; and Caporale and Gil-Alana, 2018) also support hysteresis effect in unemployment, while others (Akdoğan, 2017; Khraief and Azan, 2018; and Xie et al., 2018) reject the hysteresis effect, to mention a few.

Following Furuoka (2017), Yaya, Ogbonna and Mudida (2019) employ the FADF-SB model and its plausible subsets to investigate UHH in selected countries in Africa. Their findings are mixed with FADF-SB test revealing support for hysteresis effect in seven countries, while standard unit root tests show stationarity in more than 60% of the sampled countries. Similarly, findings from Furuoka (2017) are mixed for the four Nordic countries using the FADF-SB model and its subsets; however, the FADF-SB results do not support UHH in the countries considered. The nonlinear FADF-SB test, in contrast with ADF test, ADF with structural break test (ADF-SB) and FADF test, seems to be the preferred approach.

Lastly, Dogan and Erdogan (2016) examine the hysteresis effect in the MENA countries with cross-sectionally ADF [CADF] (Pesaran, 2007). Findings indicate the hysteresis effect in the 19 countries considered. Extant studies with respect to the unemployment in the region have been considered using tests that do not account for salient features such as nonlinearity and different forms of structural breaks. Thus, the study fills the gap in the literature using a more robust unit root testing framework that takes cognizance of more salient features that extant literatures may have neglected. Thus, this study, following Furuoka (2017) and Yaya et al. (2019a; b), investigates if the unemployment rate in MENA countries has unit root process.

3. Data and Preliminary Results

Annual unemployment rates of 19 MENA countries, namely Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, Turkey, United Arab Emirate (UAE) and Yemen are considered. These are obtained from the World Bank database (World Bank, 2018). The series span from 1991 to 2019. Table 1 summarizes the unemployment rate of the MENA countries in a form that shows the spread of the data across the time period considered. Hence, the rates at the start and end dates, minimum and maximum rates are reported. The least and highest unemployment rates coincide with Qatar and Algeria, respectively, while single-digit rates, ranging between 1.22% and 8.98%, are observed for Bahrain, Kuwait, Lebanon, Oman, Qatar, Saudi-Arabia and UAE, in terms of the maximum recorded unemployment rates within the sampled period. The observed double-digit rates range between 10.35% and 31.84% and are observed for 12 out of 19 MENA countries. Also, we find Egypt, Iran, Syria, Tunisia, Turkey, UAE and Yemen to have higher rates of unemployment in 2019 than in 1991, which could be suggestive of cases of worsening situations in the rates of unemployment. Also, the observed range between the minimum and maximum rates suggests varying levels of fluctuation in the rates of unemployment, which are highest for Algeria. To establish dependencies of panel variables that warrant SUR modelling, Person moment correlation analysis is conducted; its results reported in Table 2. The pairwise correlations are significant at 1 and 5% levels in most of the pairs. Also, cross-correlations that allow for up to 12 lags were conducted, and the results (though not reported) show significant cross-correlations in many variable pairs.

INSERT TABLE 1 ABOUT HERE

The plot of unemployment rates for the MENA countries is presented in Fig. 1. All the MENA countries' unemployment rates appear to be characterized by nonlinearity and structural shifts. While it appears to be quite challenging to ascertain the number of significant shifts in the investigated unemployment rates graphically, the plots suggest that these rates cannot be appropriately modelled without the inclusion of structural breaks. The presence of structural shifts could also be a possible contributing factor to the nonlinear nature exhibited in the unemployment rates. This must also be appropriately taken into account. Therefore, in testing the unit root stance of these rates, the two identified salient features have to be incorporated into the test model framework, as ignoring these salient features will be tantamount to model misspecification. The recent development by Furuoka (2017) that includes both Fourier functions and structural breaks would be useful to capture nonlinearity and plausible structural shifts.

INSERT FIGURE 1 ABOUT HERE

INSERT TABLE 2 ABOUT HERE

Lastly, as part of pretest analysis, we conduct nonlinearity test by using the FADF regression model in which the significance of sine and/or cosine function parameters implies nonlinearity of the time series. The results, as reported in Table 3, show that unemployment rates in MENA countries are nonlinear; while with the same model setup, Bahrain, Iran and Turkey, unemployment are not nonlinear. By dropping the linear trend component in the model, leaving the Fourier function with only intercept and Fourier parameters, and tested the model the second time, the Fourier parameters are found to be significant for these three countries. These results corroborate the non-linear nature of the unemployment rates for the MENA economies as shown in Figure 1.

INSERT TABLE 3 ABOUT HERE

4. Statistical Method

For the unit root testing methodology, we start with the unrestricted unit root framework – the FADF-SB test (see Furuoka, 2017), which is an extension of Enders and Lee (2012a; b) Fourier ADF (FADF). The FADF-SB model framework, which simultaneously incorporates nonlinearity and with plausible structural breaks, has been found to outperform extant conventional classical unit root tests such as the ADF and ADF-SB tests, even when the time series at hand is of the small sample size which constrained the augmentation lag to 1 (see Furuoka, 2017; Yaya et al., 2019b; among others). However, by employing a battery of unit root tests could strengthen the researcher's decision on the unit root stance of a series (see Yaya et al., 2019a; among others).

The FADF-SB unit root testing regression model is given as:

$$\Delta Y_t = \beta_0 + \beta_1 t + \delta DU_t + \theta D(T_B)_t + (\rho - 1)Y_{t-1} + \sum_{i=1}^{p} c_i \Delta Y_{t-i} + \sum_{j=1}^{m} \lambda_j \sin(2\pi jt/N) + \sum_{j=1}^{m} \gamma_j \cos(2\pi jt/N) + \varepsilon_t \quad (1)$$

where Y_t is the unemployment rate at time period t, with $t = 1, 2, \ldots, T$; β_0 and β_1 are respectively the constant and trend coefficient; δ and θ are coefficients for structural break dummy (DU_t) and one-time break dummy $(D(T_B)_t)$, respectively, where T_B is the break date; ρ is the coefficient of the lagged unemployment rate that indicates the presence of unit root whenever it equals unity, and absence, otherwise; in the augmented component, c denotes the slope coefficient, while p denotes the optimal lag length, where in this context, due to small sample sizes of time series that apply to Fourier function unit root tests, p is usually set to 1; λ_j and γ_j are, respectively, the Fourier component dynamics' amplitude and displacement parameters that capture the nonlinearity characteristics; N is the sample size, while the optimal number of frequencies is $m \leq N/2$, and the Fourier frequency $j = 1, 2, \ldots, m$; π is approximated to be 3.142; while ε_t is the disturbance term. Furthermore, $DU_t = \begin{cases} 1 & if\ t > T_B \\ 0, & otherwise \end{cases}$ and $D(T_B)_t = \begin{cases} 1 & if\ t = T_B \\ 0, & otherwise \end{cases}$.

Three sub-models can be obtained from the FADF-SB (Furuoka, 2017) model by simply imposing restrictions, separately or jointly, on the break dummies' and Fourier components' parameters. First, the FADF-SB model becomes the FADF model (Enders and Lee, 2012a; b) whenever the coefficients (δ and θ) of the break dummies (DU_t and $D(T_B)_t$) are not statistically different from zero or are restricted to zero. Second, the FADF-SB model reduces to ADF-SB model (Zivot and Andrews, 1992) if both coefficients of the Fourier components (λ_j and γ_j) are not statistically different from zero or restricted to zero. Third and final, the FADF-SB model becomes the ADF model (Dickey and Fuller, 1979) whenever λ_j, γ_j, δ and θ are all not statistically different from zero. Imperatively, the restricted features are simple and are not pronounced in the regression model. Consequently, the null hypothesis of $\rho-1=0$ is tested for all four model constructs using the t-statistic, such that statistically significance will imply the absence of unit root.

Following methodologies in extant literature (Kapetanios et al., 2003; Christoupolos and Leon-Ledesma, 2010; and Breuer et al., 2012), Li and Peng (2013) and He et al. (2014) independently proposed a SUR panel unit root testing framework. The above test in Eq. (1) (and other restricted models) are for testing unit root in univariate time series, while Breuer et al. (2012) SUR-ADF test (a Dickey-Fuller-like unit root tests) allows for cross-correlations in residuals of the panels.[3] Meanwhile, the ADF structure is linear in its form and does not allow for testing structural breaks of different forms. By considering the ability of exponential smooth transition regression nonlinearity in KSS (Kapetanios et al., 2003) test as abrupt structural breaks and by allowing for smooth breaks as in Enders and Lee (2012a; b), Li and Peng (2013) and He et al. (2014) propose SURFKSS unit root testing framework, which has proved to outperform other contending alternatives in SUR system.

The system of equations for unit root testing in panel SURFKSS for Fourier frequency k = 1 is as follows:

$$\begin{array}{l}
\Delta Y_{1,t} = \beta_{01} + \beta_1 Y^3{}_{1,t-1} + \lambda_1 \sin\left(2\pi t/N\right) + \gamma_1 \cos\left(2\pi t/N\right) + \sum_{i=1}^{p_m} c_{1,i}\Delta Y_{1,t-i} + u_{1,t} \\
\Delta Y_{2,t} = \beta_{02} + \beta_2 Y^3{}_{2,t-1} + \lambda_2 \sin\left(2\pi t/N\right) + \gamma_1 \cos\left(2\pi t/N\right) + \sum_{i=1}^{p_m} c_{2,i}\Delta Y_{2,t-i} + u_{2,t} \\
\vdots \qquad \vdots \qquad \vdots \qquad \qquad \vdots \qquad \qquad \vdots \qquad \qquad \vdots \qquad \vdots \\
\Delta Y_{N,t} = \beta_{0N} + \beta_N Y^3{}_{N,t-1} + \lambda_N \sin\left(2\pi t/N\right) + \gamma_1 \cos\left(2\pi t/N\right) + \sum_{i=1}^{p_m} c_{N,i}\Delta Y_{N,t-i} + u_{N,t}
\end{array} \qquad (2)$$

[3] As it applies to cross-correlations in variables.

where $t = 1,2,3,.......,T$ for N panels. The augmentation components $\sum_{i=1}^{p_m} c_{j,i} \Delta Y_{j,t-i}$ correcting the serial correlation of the error terms are driven by parameters $c_{j,i}$ where in the actual sense, minimum information criteria determine the optimal lags of this augmentation. The residuals $u_{j,t}$ have contemporaneous cross-equation error correlation which makes the entire system a SUR.

From Eq. (1), N pairs of null (alternative) hypotheses of unit root (no unit root) are tested individually as,

$$\begin{array}{l} H_0^1: \beta_1 = 0; \ H_A^1: \beta_1 < 0 \\ H_0^2: \beta_2 = 0; \ H_A^2: \beta_2 < 0 \\ \quad \vdots \\ H_0^N: \beta_N = 0; \ H_A^N: \beta_N < 0 \end{array} \tag{3}$$

where SUR system in Eq. (2) provides the test statistics, which are computed in a similar manner to the univariate variants. Thus, SUR system produces more efficient estimators and more powerful test statistics compared to those of the univariate unit root testing approach, by exploiting the advantage of information inherent in the error covariance.

The SURFKSS system of equations in (2) becomes the SURKSS when the Fourier form parameters are not significant, while the system of equations becomes the SURFADF when the nonlinear AR component $Y_{i,t-1}^3$ $(j = 1,...,N)$ is replaced with the linear AR component $Y_{i,t-1}$. The SURFKSS model becomes the SURADF model if both the Fourier and KSS nonlinear parts are absent or not significant. The KSS and FKSS models are the equivalent univariate models.

5. Empirical Results

Following Yaya et al. (2019a; b) on the adoption of a battery of unit root tests, we consider here the unrestricted FADF-SB (column 5) unit root testing model and its restricted variants (columns 2 – 4) – the ADF, FADF and the ADF-SB models, respectively (Table 4). From the ADF test, in which the lag augmentation has been restricted to unity, the hysteresis hypothesis is rejected in all cases except for the cases of Kuwait and Lebanon. However, when the Fourier function is incorporated, there seems to be a large reduction in the number of rejections of the hysteresis hypothesis. As such, we find 47.4% (that is, nine out of 19) rejections and these include Algeria, Bahrain, Egypt, Iran, Jordan, Libya, Morocco, Oman and Yemen. On ADF-SB model, the null of UHH is not rejected in Lebanon, while the hysteresis hypothesis is rejected in all 19 MENA countries under FADF-SB model framework. While incorporating Fourier functions alone appears to slightly weaken the power of the test to reject the hysteresis hypothesis, simultaneously incorporating both salient features of nonlinearity and structural breaks strengthens the power of the test. It also appears that examined MENA countries' unemployment rates are plagued more by the presence of structural shifts rather than nonlinearity. These shifts or structural breaks may have emanated from the changes in policies surrounding women participation in the labour market and entrepreneurship drive, among other factors. Imperatively, addressing the issue of structural shifts by incorporating structural breaks results in the non-rejection of the hysteresis hypothesis in Lebanon only. Interestingly, the estimated break-dates from the ADF-SB and FADF-SB models coincide for all the MENA member countries except Egypt, Iran, Iraq, Israel, Jordan and Lebanon. Results for the North African countries align with Yaya et al. (2019b).

INSERT TABLE 4 ABOUT HERE

In Table 5, we present the results for KSS, KFSS and their SUR versions. The essence of involving the univariate unit root tests, KSS and KFSS tests is just to re-assess the performance of ADF-SB and FADF-SB, noting that both of them cater for abrupt/instantaneous breaks and both break types (smooth and instantaneous), respectively. The lag augmentation is also restricted to unity for these tests as in the ones reported in Table 4. The KSS test leads to the rejection of hysteresis hypothesis in all cases considered except in the case of Oman and

Turkey (see results in Table 5). However, the result from the FKSS test indicated a downturn in the number of rejections of the hysteresis hypothesis. In particular, hysteresis is found in the unemployment rates of Kuwait, Lebanon, Oman and Turkey. This finding is in tandem with the discovery between the ADF and the FADF tests reported in Table 4. The incorporated Fourier function tends to weaken the power of the test in MENA unemployment rates. However, results from the SUR-based tests prove to be better as expected. We included the SUR version of the ADF and FADF tests to make a juxtaposition with the univariate ADF and FADF tests. As expected, the SURADF rejects UHH in all except Turkey. A similar result is achieved for the SURFADF test, as the unemployment hysteresis hypothesis is not rejected in Bahrain only. Interestingly, the SURKSS and SURFKSS tests reach the same conclusion as the SURADF and SURFADF tests, in which rejection is achieved in Turkey and Bahrain, respectively. Thus, the SUR versions of the tests proved more potent than the univariate tests and its inclusion bridges the gap between the Fourier-based tests and their non-Fourier counterparts.

INSERT TABLE 5 ABOUT HERE

6. Conclusions and Policy

We examine nineteen (19) MENA countries' unemployment rates from 1991 to 2019 with a combination of unit root tests, to ascertain their behaviours with respect to the hysteresis hypothesis. We employ a battery of unit root tests, which includes the conventional univariate (ADF, ADF-SB and KSS), Fourier-based (FADF, FADF-SB and FKSS) and panel-based (SURADF, SURFADF, SURKSS and SURFKSS) unit root tests, to test for hysteresis in a bid to ensure that all plausible salient data features are taken into cognizance and the precision of determining the true nature of unemployment rate in MENA countries is increased.

The countries where hysteresis holds are Kuwait and Lebanon. When the Fourier function is incorporated into the ADF test, we find that the hysteresis hypothesis holds for more countries (Iraq, Israel, Kuwait, Lebanon, Qatar, Saudi-Arabia, Syria, Tunisia, Turkey and UAE) than in the ADF case. This shows that tests that do not account nonlinearity, whenever they exist, are likely to be misleading. Our findings here are in contrast with those of Furuoka (2017) and Yaya et al. (2019b); who apply similar methods to five (5) European countries and forty-two (42) African countries, respectively; and find FADF model to be more potent than the ADF test in determining the stationarity stance of unemployment. The inclusion of structural breaks to the ADF and FADF models further improves the performance of the tests. The ADF-SB test rejects the existence of hysteresis effect in all except Lebanon, while the hysteresis hypothesis is rejected in all the MENA countries under the FADF-SB testing framework; thus, revealing that accounting for structural breaks, when existing, is also essential.

Further findings from the nonlinear KSS and FKSS tests indicate that hysteresis holds in the unemployment rates of Kuwait, Lebanon, Oman and Turkey under the FKSS test and Oman and Turkey alone under the KSS test. Incorporating Fourier functions alone appears to weaken the power of the test to reject unemployment hysteresis hypothesis of the MENA countries. By harnessing the advantage of panel unit root tests under SUR estimation procedure, it is discovered that SUR-ADF and SUR-KSS could not reject the existence of hysteresis effect in Turkey. In contrast, when the Fourier function is incorporated into the tests, SUR-FADF and SUR-FKSS tests reject the hysteresis hypothesis in all except Bahrain. Going by the results from these tests, hysteresis holds in 12 of the 19 MENA countries namely, Bahrain, Iraq, Israel, Kuwait, Lebanon, Qatar, Oman, Saudi-Arabia, Syria, Tunisia, Turkey and UAE. Thus, these 12 countries do not support the natural rate of unemployment hypothesis (NRUH) and can be said to have a nonstationary unemployment rate.

This finding is in contrast to Dogan and Erdogan (2016) who reveal hysteresis in all the 19 MENA economies. By implication, unemployment rates in these 12 MENA economies are higher than usual and do not revert to their natural rates even after temporary shock or stimulus.

Consequently, policymakers in countries with confirmed hysteresis would be required to put in place more effective programs aimed towards efficiently deal with the high rate of unemployment. This could be done by enacting laws that reduce gender biases, facilitate commensurate returns on the educational investment of young people, among others. The remaining seven MENA countries are observed to support the NAIRU hypothesis regardless of the unit root testing framework considered. In other words, the hysteresis hypothesis is consistently rejected across the recognized unit root testing frameworks when different salient features are either incorporated or excluded. These seven MENA countries with higher-than-normal unemployment rate but have a tendency to return to the natural rate of unemployment, may only require policymakers to pursue long-run strategies aimed at strengthening the labour market fundamentals.

Among the 19 countries covered in this paper, 16 are Arab countries where unemployment is significantly found among youth. The dominance of youth unemployment could be likened to high female participation in the labour force recently in the Arab region, particularly in Gulf Cooperation Council (GCC) countries where female unemployment rate is about ratio 7 to 1. Skills mismatch in Arab region is a serious problem, where youths are trained for professions that are not marketable (Jelili, 2010). Other factors that are responsible for unemployment hysteresis in MENA regions are the lack of sufficient employment opportunities and public sector employment and pay policies.

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Table 1: Data Summary

Country	Code	1991 rate	2019 rate	Minimum rate	Maximum rate
Algeria	DZA	20.60	12.35	9.82	31.84
Bahrain	BHR	0.97	0.97	0.84	1.22
Egypt	EGY	9.38	11.29	7.95	13.15
Iran	IRN	11.10	11.99	9.10	13.52
Iraq	IRQ	10.35	7.91	7.89	10.35
Israel	ISR	13.39	3.93	3.93	14.08
Jordan	JDN	19.48	14.94	11.90	19.70
Kuwait	KWT	0.70	2.16	0.70	2.90
Lebanon	LBN	8.22	6.20	6.11	8.98
Libya	LBY	19.42	17.30	16.10	21.14
Morocco	MOR	12.89	9.03	8.91	13.98
Oman	OMN	4.60	3.08	3.08	5.07
Qatar	QTR	1.32	0.14	0.14	1.70
S. Arabia	SAR	6.99	5.92	4.35	7.20
Syria	SYR	6.75	8.18	6.75	11.68
Tunisia	TUN	15.07	15.51	12.37	18.33
Turkey	TUR	8.21	11.90	6.50	12.55
UAE	UAE	1.63	2.64	1.63	3.12
Yemen	YEM	8.04	12.81	7.98	14.02

Note: Rates are given in percentages.

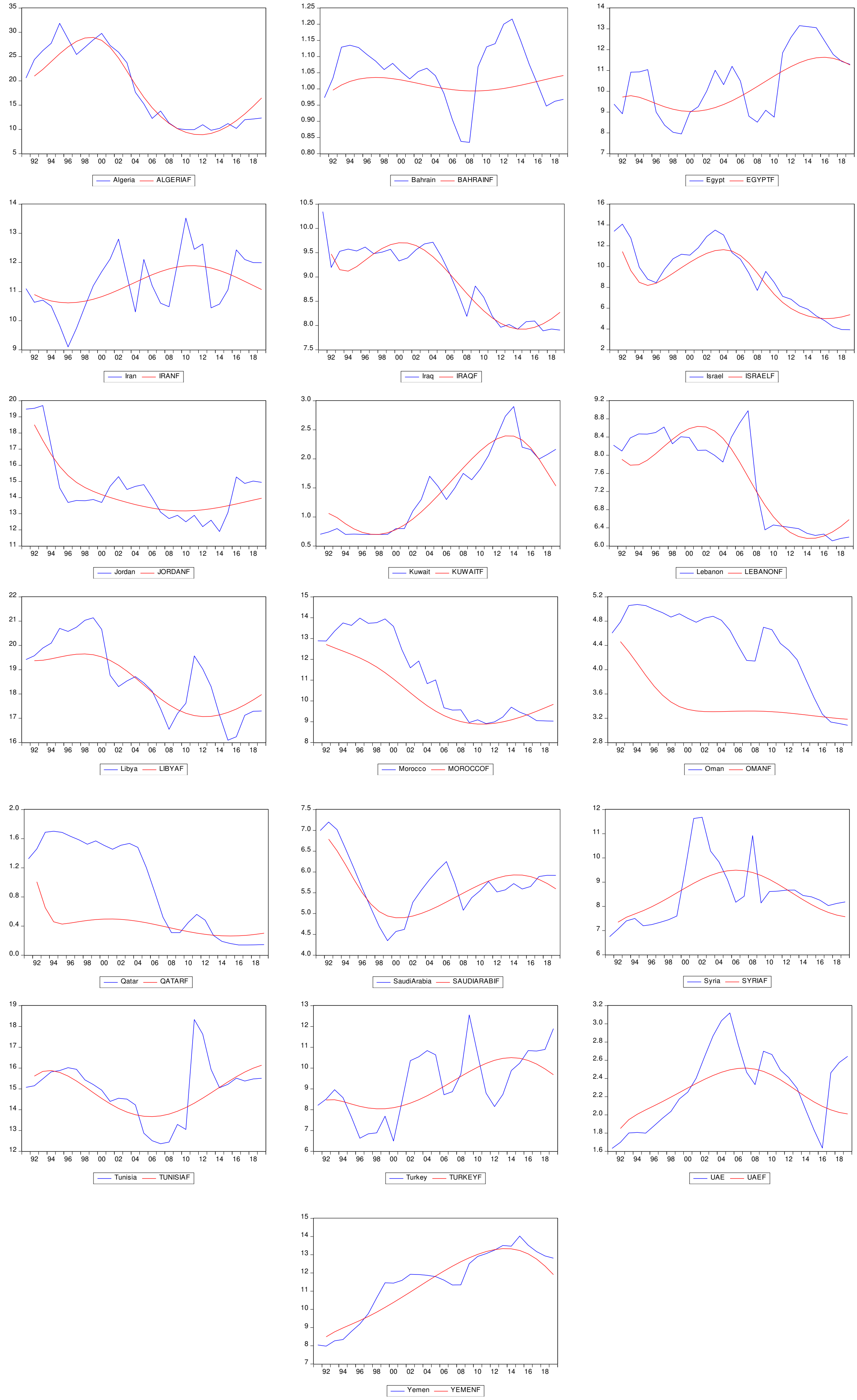

Figure 1. Fitted Nonlinearities for Unemployment rates

Table 2: Results of Unconditional correlations

	Algeria DZA	Bahrain BHR	Egypt EGY	Iran IRN	Iraq IRQ	Israel ISR	Jordan JDN	Kuwait KWT	Lebanon LBN	Libya LBY	Morocco MOR	Oman OMN	Qatar QTR	S.Arabia SAR	Syria SYR	Tunisia TUN	Turkey TUR	UAE UAE
Bahrain	0.184																	
Egypt	**-0.504****	0.330																
Iran	**-0.423***	-0.026	0.195															
Iraq	**0.801****	0.041	**-0.577****	-0.347														
Israel	**0.629****	-0.008	**-0.560****	-0.174	**0.878****													
Jordan	**0.426***	-0.113	-0.119	-0.122	**0.498****	**0.482****												
Kuwait	**-0.886****	0.084	**0.727****	0.355	**-0.871****	**-0.728****	**-0.522****											
Lebanon	**0.765****	-0.181	**-0.602****	**-0.487****	**0.843****	**0.771****	0.362	**-0.850****										
Libya	**0.811****	**0.405***	**-0.448***	**-0.410***	**0.690****	**0.534****	**0.262**	**-0.740****	**0.660****									
Morocco	**0.960****	0.205	**-0.525****	**-0.525****	**0.834****	**0.644****	**0.466***	**-0.889****	**0.783****	**0.848****								
Oman	**0.712****	0.356	**-0.546****	-0.319	**0.826****	**0.824****	0.200	**-0.735****	**0.739****	**0.758****	**0.735****							
Qatar	**0.924****	0.200	**-0.505****	**-0.404***	**0.924****	**0.816****	**0.465***	**-0.882****	**0.853****	**0.834****	**0.924****	**0.858****						
S. Arabia	-0.101	-0.039	0.302	-0.141	0.086	0.119	**0.696****	-0.020	0.042	-0.076	-0.030	-0.051	0.028					
Syria	-0.080	-0.178	0.010	**0.392***	-0.065	0.146	-0.315	0.178	-0.057	-0.332	-0.235	0.014	-0.049	**-0.470***				
Tunisia	0.154	**0.645****	**0.401***	-0.048	-0.144	-0.282	0.078	0.082	-0.266	**0.402***	0.154	-0.046	0.068	0.060	-0.327			
Turkey	**-0.641****	-0.244	**0.372***	**0.517****	**-0.440***	-0.309	-0.058	**0.580****	**-0.608****	**-0.799****	**-0.704****	**-0.540****	**-0.594****	0.178	0.281	-0.339		
UAE	-0.363	-0.243	0.020	**0.452***	-0.125	0.045	**-0.405***	0.309	-0.123	-0.300	**-0.468***	-0.077	-0.196	-0.239	**0.560****	**-0.424***	**0.513****	
Yemen	**-0.734****	0.015	**0.507****	**0.569****	**-0.751****	**-0.627****	**-0.704****	**0.835****	**-0.748****	**-0.665****	**-0.803****	**-0.647****	**-0.767****	**-0.448***	**0.416***	-0.022	**0.542****	**0.506****

Note: In bold significant correlations. ** and * imply significant correlations at 1 and 5% levels, respectively for 2-tailed test.

Table 3: Results of Fourier nonlinearity test

Country	Intercept	Time trend	Sin1	Cos1
Algeria	**3.6154**	**-0.2399**	**8.2365**	-0.2269
Bahrain	0.0442	-0.0031	-0.0140	0.0357
Egypt	-1.1480	0.0725	-0.3349	**0.8186**
Iran	-0.7115	00488	-0.2609	-0.2730
Iraq	**0.9596**	**-0.0627**	0.1658	**-0.2530**
Israel	**5.2151**	**-0.3389**	**-1.1481**	**-1.7793**
Jordan	**2.0678**	**-0.1445**	0.3476	**1.3352**
Kuwait	**-0.6777**	**0.0447**	**-0.4134**	0.0906
Lebanon	**1.1445**	**-0.0739**	0.2687	**-0.4861**
Libya	**1.2759**	**-0.0853**	**0.8533**	0.0485
Morocco	**1.6020**	**-0.1077**	**1.6623**	0.1809
Oman	**1.1100**	**-0.0725**	**-0.2280**	**-0.3076**
Qatar	**0.6403**	**-0.0419**	**0.3448**	**-0.1571**
S. Arabia	**0.8800**	**-0.0613**	**-0.5179**	**0.5256**
Syria	-0.7720	0.0577	-0.0521	**-1.2502**
Tunisia	-0.4385	0.0236	0.7290	**1.1354**
Turkey	**-1.4278**	**0.0960**	-0.4337	-0.1688
UAE	**-0.3589**	**0.0261**	-0.0568	**-0.4439**
Yemen	**-3.0120**	**0.2040**	-0.1238	**-0.6460**

Note: In bold significant parameter estimates at 5% level

Table 4: Results of ADF, ADF-SB, FADF and FADF-SB unit root tests

Country	ADF	FADF	ADF-SB	FADF-SB
Algeria	**-4.1798**	**-4.6510 [2]**	**-251.1862 [2011, 72.4138]**	**-226.6772 [2011, 72.4138, 2]**
Bahrain	**-4.8443**	**-4.6979 [1]**	**-303.9806 [2012, 75.8621]**	**-267.0377 [2012, 75.8621, 2]**
Egypt	**-3.9194**	**-5.8538 [1]**	**-5.4575 [2013, 79.3103]**	**-10.2037 [2012, 75.8621, 1]**
Iran	**-3.8813**	**-4.6512 [1]**	**-5.0894 [2014, 82.7586]**	**-6.3058 [2013, 79.3103, 1]**
Iraq	**-3.8580**	-4.1750 [1]	**-4.7851 [1995, 17.2414]**	**-5.4964 [1994, 13.7931, 1]**
Israel	**-3.8513**	-4.1392 [1]	**-4.8678 [1996, 20.6897]**	**-5.4395 [1995, 17.2414, 1]**
Jordan	**-3.8659**	**-4.7252 [1]**	**-5.3680 [2016, 89.6552]**	**-6.5736 [2000, 34.4828, 1]**
Kuwait	-3.1968	-4.2972 [1]	**-4.6807 [2017, 93.1034]**	**-5.3806 [2017, 93.1034, 2]**
Lebanon	-2.6512	-3.5453 [1]	-3.6230 [2018, 96.5517]	**-4.6160 [1998, 27.5862, 1]**
Libya	**-3.7370**	**-4.2577 [2]**	**-181.5596 [2000, 34.4828]**	**-146.4390 [2000, 34.4828, 2]**
Morocco	**-3.6872**	**-4.2506 [2]**	**-168.4664 [2001, 37.9310]**	**-131.4765 [2001, 37.9310, 2]**
Oman	**-3.6540**	**-4.1957 [2]**	**-184.8730 [2002, 41.3793]**	**-143.0575 [2002, 41.3793, 1]**
Qatar	**-3.6328**	-4.1188 [2]	**-180.5263 [2003, 44.8276]**	**-132.8071 [2003, 44.8276, 1]**
S. Arabia	**-3.6169**	-4.0322 [2]	**-186.9188 [2004, 48.2759]**	**-136.2947 [2004, 48.2759, 1]**
Syria	**-3.6100**	-3.9750 [2]	**-203.4072 [2005, 51.7241]**	**-147.3437 [2005, 51.7241, 1]**
Tunisia	**-3.6096**	-3.9675 [2]	**-203.6342 [2006, 55.1724]**	**-160.0274 [2006, 55.1724, 2]**
Turkey	**-3.6150**	-4.0113 [2]	**-212.6035 [2007, 58.6207]**	**-184.0643 [2007, 58.6207, 2]**
UAE	**-3.6288**	-4.0981 [2]	**-203.0857 [2008, 62.0690]**	**-181.3197 [2008, 62.0690, 2]**
Yemen	**-3.6511**	**-4.1885 [2]**	**-200.7511 [2009, 65.5172]**	**-175.6889 [2009, 65.5172, 2]**

Note: The lag specification of the reported ADF statistics in column 2 is constrained to unity. The third column contains t-statistics and Fourier frequency in square brackets for the FADF test. The fourth column are the t-statistics, and break dates and break fractions in square brackets, for the ADF-SB test. The last column reports the t-statistics, and break dates, break fractions and Fourier frequencies, respectively, in square brackets, for the FADF-SB test. Figures in bold letterings indicate statistical significance at 5% level

Table 5: Results of KSS, FKSS test and their SUR Panel versions

Country	KSS	FKSS	SURADF	SURFADF	SURKSS	SURFKSS
Algeria	**-4.217**	**-4.453 [2]**	**-5.165**	**-6.839**	**-5.615**	**-6.980**
Bahrain	**-5.040**	**-5.163 [2]**	**-4.086**	0.584	**-4.588**	2.47E-6
Egypt	**-3.995**	**-3.918 [1]**	**-3.880**	**-6.121**	**-4.032**	**-6.335**
Iran	**-4.008**	**-3.917 [1]**	**-4.859**	**-5.747**	**-5.366**	**-5.949**
Iraq	**-4.009**	**-3.913 [1]**	**-4.408**	**-5.662**	**-4.917**	**-5.835**
Israel	**-4.019**	**-3.922 [1]**	**-5.453**	**-5.679**	**-5.599**	**-5.883**
Jordan	**-4.035**	**-4.047 [1]**	**-6.568**	**-5.665**	**-6.576**	**-5.898**
Kuwait	**-3.344**	-3.331 [1]	**-3.187**	**-4.807**	**-3.518**	**-5.008**
Lebanon	**-2.922**	-2.904 [1]	**-7.134**	**-4.403**	**-6.606**	**-4.634**
Libya	**-3.794**	**-3.990 [1]**	**-4.333**	**-5.120**	**-3.113**	**-5.404**
Morocco	**-3.796**	**-3.984 [1]**	**-11.709**	**-5.242**	**-15.167**	**-5.553**
Oman	-2.724	-2.862 [1]	**-4.664**	**-5.385**	**-7.885**	**-5.717**
Qatar	**-3.777**	**-4.051 [2]**	**-4.162**	**-5.449**	**-4.348**	**-5.769**
S. Arabia	**-3.768**	**-4.122 [2]**	**-5.595**	**-5.565**	**-5.755**	**-5.843**
Syria	**-3.740**	**-4.148 [2]**	**-5.088**	**-5.728**	**-5.147**	**-5.913**
Tunisia	**-3.731**	**-4.150 [2]**	**-7.326**	**-5.607**	**-7.518**	**-5.764**
Turkey	-2.681	-2.886 [2]	3.958	**-5.197**	3.792	**-5.321**
UAE	**-3.720**	**-4.008 [2]**	**-4.482**	**-6.927**	**-4.772**	**-7.049**
Yemen	**-3.711**	**-3.935 [2]**	**-29.237**	**-7.473**	**-29.064**	**-7.564**

Note: The lag specification of the reported KSS statistics in column 2 is constrained to unity. The third column contains t-statistics and Fourier frequency in square brackets for the FKSS test. The remaining columns are the t-statistics for the SURADF, SURFADF, SURKSS and SURFKSS tests respectively. Figures in bold letterings indicate statistical significance at 5% level. For critical values of the KSS test, see Kapetanios et al. (2003),

Appendix Table A: Critical Values of SUR-based Unit root tests

		1%	5%	10%
SURADF		-3.477	-2.568	-2.244
SURFADF	k = 1	-4.025	-3.136	-2.633
	k = 2	-5.064	-3.771	-3.428
SURKSS		-4.036	-3.058	-2.588
SURFKSS	k = 1	-4.273	-3.257	-2.760
	k = 2	-4.953	-3.843	-3.416