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ARTICLE

Jobless growth: empirical evidences from the Middle East and North Africa region

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Abstract In this study, we use Okun's Law to examine whether growth has been jobless in seventeen MENA countries. The methods used are the ARDL approach for the individual country and the panel data analysis for the entire sample. The period considered in this study is from 1980 to 2013. To test for results robustness, we estimate the dynamic difference and three gap models based on three detrending techniques: the HP filter, the BK filter, and the quadratic trend. Our findings can be summarized as follows: First, the estimation results suggest that Okun's Law is valid, and hence job creation is associated with growth in only six of the seventeen countries, namely Algeria, Egypt, Iran, Jordan, Lebanon, and Turkey. Second, our results reveal that the valid estimates are, in general, bigger in Arab than non-Arab countries in the sample. Third, the CUSUM of squares test confirms that Okun's Law is stable in Algeria, Egypt, and Iran, unstable in Jordan, and ambiguous in Lebanon and Turkey. Fourth, our panel data analyses suggest that Okun's Law is valid for the entire MENA sample; however, our estimations reveal that the impact of GDP growth is weak on job creation in the region. Finally, our individual and panel estimations are not robust as they are sensitive to the choice of the estimation model and to the de-trending method.

Keywords Jobless Growth · Okun's Law · Hodrick and Prescott Filter · Baxter and King Filter · Quadratic Trend · ARDL · CUSUM of squares Test · ARDL · Panel Data Regression · MENA Region

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1 Introduction

In this study, we empirically use Okun's Law to examine whether growth has been jobless in a sample of Middle Eastern and North African (MENA) countries. Okun's Law measures the responsiveness of unemployment to output growth rate. Okun suggested that a one percent increase in the unemployment rate is associated with three percent loss in real GDP. This change in output relative to change in the unemployment rate is known as Okun's Law Coefficient (OLC). Okun's finding was interesting since a reduction in unemployment is associated with a larger than the proportionate effect on output implying that considerable output gains can be realized by: "induced increases in the size of the labor force; longer average weekly hours; and greater productivity" (Okun 1962). After the 1970s' oil shock and the persistent high unemployment and low growth rates, it was clear that the US economy experienced structural changes that led some scholars to doubt the stability and the robustness of Okun's 3:1 estimation (Clark 1983; Friedman 1988; Prachowny 1993; Attfield and Silverstone 1998; and Freeman 2001). A reduction in output was believed to be associated with more loss in jobs than originally estimated by Okun. Mankiw (1994) revised Okun's 3:1 original rule of thumb to 2:1.

Okun's Law can answer a number of questions important to implement and design macroeconomic policies. Policy makers are interested to know the cost of cyclical unemployment rate (when the unemployment rate is above its natural rate) in terms of aggregate output. In other instances, they are interested to know the growth rate needed to lower the unemployment rate to some desirable level or the rate at which unemployment rate is growing when output growth is zero. In addition, "the effectiveness of disinflation policy depends on the responsiveness of unemployment on the output growth rate (sacrifice ratio)" (Soegner and Stiassny 2002). It is important to note that Okun's Law represents a net effect of several structural mechanisms governing the labor market (Perman and Tavera 2005); it is a statistical relationship that varies with the changes in the examined country's macro economy.

Several studies in the Okun's Law literature, including Okun's original work itself, confused between using two kinds of regressions: regressing the unemployment rates on the GDP growth rates and regressing the GDP growth rates on the unemployment rates. The reciprocal of the first regression coefficient is used instead of estimating the coefficient of the second regression. This would work only if the relationship between the two variables in the first regression is consistent and stable. If not, then the prediction of the mean value of the GDP growth rate given the known values of the unemployment rates is not reliable and amiss, especially when using it for policy recommendations. Estimating one of the two regressions would depend on the type of prediction one needs to conduct. If what is needed is to predict the mean value of the unemployment rate given the known values of the GDP growth rates, we need to regress the unemployment rates on the GDP growth rates. However, if what is needed is to predict the mean value of the GDP growth rate given the known values of the unemployment rates, we need to regress the GDP growth rates on the unemployment rates. In this study, we are interested in predicting the mean value of the unemployment rate given the known values of the GDP growth rates in the MENA region.

The literature adequately estimated Okun's Law for developed countries. To name a few, Moosa (1997) estimated Okun's Law for the G7 Countries, Apel and Jansson (1999) for Canada, the UK and the US, Lee (2000) for 16 OECD countries, and Moazzami and Dadgostar (2009) for OECD countries. Few studies on the subject are found for developing countries; one possible reason is the lack of unemployment data and the lack of a unified methodology on how to measure unemployment rate across countries and over time. Bhalotra (1998) investigates Okun's Law in India, Marinkov and Geldenhuys (2007) for South Africa, Lal et al. (2010) for five Asian countries, and Hanusch (2012) for eight East Asian countries.

As for the MENA region, a limited number of studies have been conducted on Okun's Law to systematically investigate the relationship between growth and unemployment in the region. According to our search of the literature, Moosa (2008) was among the very few studies that estimated and explored the validity of Okun's Law for a number of MENA countries: Algeria, Egypt, Morocco, and Tunisia. He found that Okun's Law is invalid in the four countries attributing this result to three reasons. First, unemployment in these countries is not cyclical but rather structural and/or frictional. Second, hiring in these countries was done primarily by the public sector that contributed to the rigidity of their labor markets. Third, these economies are dominated by sectors that are not labor-intensive, which explains why unemployment rate is not associated with growth.

Estimating Okun's Law for the MENA region is an interesting case study. The economies of the region have failed to create enough jobs for its growing population, especially the youth sector (Keller and Nabli 2002). The frustrated youth marched down the Arab streets demanding more political participation, respect for human rights, and decent jobs and living conditions. According to the UN World Youth Report (2011), "there is no doubt that one of the contributing factors to the recent Arab Spring uprisings is the disturbingly high level of youth unemployment in the MENA region". Table 1 shows that the total and the youth unemployment rates in the MENA region are the highest among other world developing regions in 2013. Also, Table 1 shows that the region has the lowest labor participation rate compared to other world developing regions. Such dismal labor market outlook and the scarcity of research on Okun's Law in the region motivate us to systematically investigate the relationship between growth and unemployment rates and whether growth has created enough jobs in the region.

Our sample includes seventeen MENA countries, namely Algeria, Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, Turkey, United Arab Emirates (UAE), and Yemen. Depending on the data availability, the study covers the period from 1980 to 2013. Table 1 shows that in 2013, Yemen recorded the highest total unemployment rates, Egypt recorded the highest youth unemployment rate and Jordan recorded the lowest labor participation rate among the seventeen MENA countries in our sample. In the late 2010 and 2011, turmoil triggered regime changes in Tunisia and Egypt, major political and socioeconomic instabilities in Syria and Yemen and key constitutional reforms in Algeria, Morocco and Jordan. The study will try to answer four main questions: In which of the seventeen MENA countries is Okun's Law valid, and hence job creation is associated with growth? Are our individual estimations robust with different estimation models and methods? Are our estimations for individual countries stable throughout the periods considered in this study? Finally, is Okun's Law valid and robust in the entire MENA region? The paper will proceed as follows: we present the methodology used in section two, we analyze the data used in the study in section three, we present the empirical results in section four, and we conclude this study in section five.

Table 1 The Labor Market Outlook in the Seventeen MENA Countries Compared to Other Word Developing Regions, in 2013

Country/ Region	Labor Force (in million)	Unemployment Rate (in %)	Youth Unemployment Rate (in %)	Participation Rate (in %)
Algeria	12.1	9.8	24.0	46.5
Bahrain	0.7	7.4	27.9	71.8
Egypt	29.0	12.7	38.9	52.7
Iran	26.6	13.2	29.7	47.2
Jordan	1.7	12.6	33.7	43.6
Kuwait	1.9	3.1	19.6	70.1
Lebanon	1.6	6.5	20.6	51.6
Morocco	12.3	9.2	18.5	52.5
Oman	2.0	7.9	20.5	67.1
Qatar	1.6	0.5	1.5	87.3
Saudi Arabia	11.8	5.7	28.7	56.5
Sudan	12.1	15.2	24.5	54.5
Syria	6.0	10.8	29.8	45.7
Tunisia	4.0	13.3	31.2	51.2
Turkey	27.4	10.0	20.4	53.5
UAE	6.2	3.8	9.9	80.2
Yemen	7.3	17.4	29.8	50.4
East Asia & Pacific	1135.5	4.5	11.5	76.2
Europe & Central Asia	116.0	9.7	20.2	63.2
Latin America & Caribbean	255.0	6.0	12.6	71.1
Middle East & North Africa	112.7	12.7	31.2	49.1
Sub-Saharan Africa	371.5	7.7	14.0	71.1
South Asia	661.1	3.9	10.2	58.4
World	3337.3	6.0	14.0	68.5

Source: the World Bank World Development Indicators and the International Labor Organization

2 Methodology

The estimation of Okun's Law is, in general, sensitive to the chosen model, the de-trending techniques used to extract the long-run trends from the unemployment and growth series and whether the model is static or dynamic (Moosa 2008). To test for robustness of Okun's Law in the MENA region, this study estimates two versions of Okun's Law: the difference and the gap versions for the seventeen individual countries in our sample. The study will also test the stability of the obtained coefficients for the seventeen countries using the CUSUM of squares test. Finally, we test Okun's Law for the entire MENA sample using panel data regression.

The difference version assumes that a positive growth rate would lead to job creation and a decline in the unemployment rate. The relationship between the absolute difference of unemployment rate and output growth rate is as follows:

$$u_t = a + by_t + \varepsilon_t \tag{1}$$

Where u_t and y_t denote the absolute difference of the unemployment rate and the growth rate of real GDP respectively. The coefficient (b) measures the change of u_t per a change in y_t and it is expected to have a negative sign as the relationship between the two variables in Eq. 1 is inversely related. The coefficient (a) denotes the intercept and ε_t is the error term respectively.

The gap version of Okun's Law has been used extensively in the literature to estimate the Okun's Law (Attfield and Silverstone 1998; Freeman 2000; Lee 2000; Grant 2002; and Villaverde and Maza 2009). The gap version of Okun's Law is based on the gap notion or the deviations of unemployment rate and real GDP from their long-run trends such as:

$$U_t^c = U_t - U_t^P \tag{2}$$
$$Y_t^c = Y_t - Y_t^P \tag{3}$$

Where U_t^c, U_t, U_t^P, Y_t^c, Y_t and Y_t^P are the cyclical unemployment rate, the actual unemployment rate, potential unemployment rate, logarithm of cyclical output, logarithm of real GDP, and logarithm of potential real GDP respectively. In this study, the long-run trends, U_t^P and Y_t^P, are obtained by applying three kinds of filters or de-trending: the Hodrick-Prescott (1997) (HP) filter, the band-pass filter proposed by Baxter and King (1995) (BK Filter), and the quadratic trend.

The derivation of the quadratic trend is simple and straight forward contrary to the other two filters that are based on advanced statistical methods. Below is a brief description of the derivation of the other two filters. The HP filter decomposes the observed time series into trend and cycle series. The trend is calculated by optimizing the following problem:

$$\min_{(g_t)}\{ \sum_{t=-\infty}^{\infty} [y_t - g_t]^2 + \lambda \sum_{t=-\infty}^{\infty} [(g_{t+1} - g_t) - (g_t - g_{t-1})]^2 \} \tag{4}$$

Where λ, y_t and g_t are the smoothing parameter, the observed time series and the long-run trend path required to be estimated by HP filter. The larger the λ, the smoother the trend and as λ approaches infinity (∞), the trend becomes more of a linear trend. Baxter and King (1995) proposed a finite moving-average band pass by removing higher and lower frequencies. Applied to annual data, the BK filter extracts the cyclical component as follows:

$$X_t^c = \sum_{k=-1}^{k=1} a_k X_{t-k} = a(l)X_t \tag{5}$$

Where L is the lag operator. The coefficient a_k can be derived from minimizing the following:

$$\min_{aj} Q = \int_{-\pi}^{\pi} [\beta(\omega) - \alpha(\omega)]^2 \tag{6}$$

Where $\beta(\omega)$ is the ideal filter and $\alpha(\omega)$ is the Fourier transformation of the frequency response function. The BK filter is adjusted by setting a constraint $\alpha(0) = 0$ which means that the sum of the moving average coefficients must be equal to zero. When applying the BK filter, two years of data is scarified at the beginning and at the end of the each time series.

According to Eqs. 2 and 3, U_t^c measures the absolute difference between unemployment rate and its long-run trend in percent and Y_t^c measures the percent deviation of real GDP from its long-run trend, both in logarithmic forms. The gap model argues that when unemployment rate is above its long-run trend, we expect that several factors of production are left idle; hence, the actual real GDP is below its potential level. On the contrary, when unemployment is below its long-run trend, more resources are mobilized and we expect the actual GDP to be above the potential level. This relationship can be shown by the below static gap version of Okun's Law:

$$U_t^c = \rho + \delta Y_t^c + \nu_t \tag{7}$$

The coefficient δ measures the impact of Y_t^c on U_t^c and it is expected to have a negative sign as the two variables are inversely related. The coefficient ρ is the intercept and ν_t is the error term.

The relationships in Eqs. 1 and 7 are purely contemporaneous: the current GDP growth rate impacts the current absolute difference of unemployment rate and the current cyclical output impacts the current cyclical unemployment rate. However, the absolute difference of unemployment rate might depend also on its lagged values and lagged values of GDP growth rates besides the current GDP growth rates. Also, the current cyclical unemployment rate might depend on its lagged values and lagged values of cyclical output besides the current cyclical output. That is why Eqs. 1 and 7 failed to account for the short-run dynamics that should be included in both equations. Following Weber (1995) and Moosa (1997, 1999 and 2008) dynamic specifications are added as follows:

$$U_t^* = \mu + \sum_{i=1}^{p} \gamma_i U_{t-i}^* + \sum_{i=0}^{q} \psi_i Y_{t-i}^* + \nu_t \tag{8}$$

Eq. 1 8 is a general formula that illustrates the dynam ic models of both the difference and gap version of Okun's Law. The variable U_t^* Can take the values of the first difference of unemployment rate or the cyclical component of unemployment while Y_t^* can take the values of the growth rate of GDP and cyclical components of the output. γ_i measures the lagged impact of U_{t-i}^* on U_t^*, ψ_i measures the contemporaneous and the lagged impact of Y_{t-i}^* on U_t^*, μ is the intercept, and ν_t is the error terms. The expected signs of γ_i are positive while the expected signs of ψ_i are negative. Eq. 8 is called autoregressive distributed lag model (ARDL) for including as explanatory variables the lag values of the dependent variables ($\sum_{i=1}^{p} \gamma_i U_{t-i}^*$) and the contemporaneous and lagged values of the independent variable ($\sum_{i=0}^{q} \psi_i Y_{t-i}^*$). The numbers of logs for the unemployment gap are represented by p whereas the number of lags for the output gap is represented by q and the ARDL model can be written as ARDL (p, q).

The ARDL approach to cointegration was proposed by Pesaran and Shin (1999). It has several advantages over the standard cointegration analysis methods such as Engle and Granger method (1987), Johansen's method (1988 and 1991) and Johansen and Juselius's method (1990). These methods require that the series are nonstationary, whereas the ARDL approach can be applied regardless of whether the series are I(0) (stationary) or I(1) (nonstationary) variables. In addition, the ARDL approach is more efficient in estimating cointegrating relationships in small samples (Ghatak and Siddiki 2001).

Eq. 8 is a dynamic short-run model that can also be used to show the impact of cyclical output on cyclical unemployment in the long-run. To obtain the long-run coefficient, we assume that the expectations of U_t^* and Y_t^* are identical in different time periods (t). In other words, we assume that $E(U_t^*) = U^*$and $E(Y_t^*) = Y^*$ for all t (where E denotes expectation). As such Eq. 8 can be re-written as follows:

$$U^* = \mu + \sum_{i=1}^{p} \gamma_i U^* + \sum_{i=0}^{q} \psi_i Y^* + \nu_t \tag{9}$$

Solving for U^* in terms of Y^*, we obtain:

$$U^* = \theta_0 + \theta_1 Y^* \tag{10}$$

Where

$$\theta_0 = \frac{\mu}{1 - \sum_{i=1}^{p} \gamma_i} \tag{11}$$

$$\theta_1 = \frac{\sum_{i=0}^{q} \psi_i}{1 - \sum_{i=1}^{p} \gamma_i} \quad (12)$$

where θ_1 represents the long-run slope that measures the total effects of Y^* on U^* over future time periods and it is expected to have a negative sign.

In this study, we are also interested in testing whether the values of the obtained coefficients are stable throughout the time periods considered in this study. If instability is detected, the model is said to experience a structural change or regime shift. One of the most used stability tests in the literature is Chow's test. However, this test suffers from a severe problem since it requires the selection of the timing when the structural change took place and such timing might not be defined. There are few methods that would allow us to select the timing in a systematic way. Mostly, the timing can be selected either arbitrarily or by prior knowledge of major events that are believed to cause regime change. Brown et al. (1975) proposed the CUSUM of squares test that is able to reveal model instability by detecting instability in the variance of the regression error without the need to define a specific date for structural change.

The CUSUM of squares test uses the cumulative sum of the recursive residuals (ω_r^2) to obtain the following statistics:

$$S_r = \left(\sum_{j=k+1}^{r} \omega_j^2 \right) / \left(\sum_{j=k+1}^{T} \omega_j^2 \right), \quad r = k+1, \ldots\ldots, T \quad (13)$$

Under the null hypothesis (parameter constancy),

$$E\,|S_r| = t - k/T - K \quad (14)$$

Where E denotes expectation. To assess the significance of the departure of S_r from its expected value, the CUSUM test plots a pair of parallel straight lines around S_r. The movement of the mean value outside the critical lines suggests parameter or variance instability.

Finally, we use Eqs. 1 and 7 to estimate Okun's Law for the entire MENA sample using panel data regression. Specifically, we estimate four different models: the difference model and three gap models based on: the HP filter, the BK filter and the quadratic trend. The estimation method used is the panel seemingly unrelated regressions (SUR) as it corrects for both: the contemporaneous correlation and the cross-section heteroscedasticity and delivers efficient estimations.

3 Data analysis

The annual data of real GDP and unemployment rates are obtained from the IMF's World Economic Outlook (WEO) database, the World Bank's World Development Indicators (WDI) database, the International Labor Organization database and the national sources covering the period from 1980 to 2013. As discussed in the methodology section, the estimation of the gap model requires the extraction of the cyclical components of unemployment rate and real GDP from the original series. To do so, we applied three detrending techniques: the HP, the BK and quadratic trend filters. For the HP filter, we set the smoothing coefficient (λ) = 100 which is recommended for annual data (Backus and Kehoe 1992). For the BK filter, we choose a frequency length for the moving average equal to two so that only four data are scarified from each time series. The output and unemployment gaps are both measured in percent as the former is equal to the difference between the natural log of real GDP and its long-run trends and the latter is equal to the absolute difference between the unemployment rate and its long-run trends.

As discussed in the methodology section the ARDL approach can be applied even when the order of integration is a mixture between I(0) and I(1) processes. However, the ARDL approach could not be applied if the order of integration of a variable is greater than one since the critical values used to determine the existence of cointegration are obtained from a mixture of only I(0) and I(1) processes. That is why we have to run unit root tests to make sure none of our variables' order of integration is I(2).

Table 2 reports the Augmented Dickey-Fuller (ADF) unit root test for both the level and first difference models. The optimal lag orders are automatically selected according to the Schwarz Information Criterion. The test is applied for all the variables used in this study, namely y, the cyclical component of output based on HP filter, Yc(HP), the cyclical component of output based on BK filter, Y^c(BK), the cyclical component of output based on quadratic trend, Y^c(QT), u, the cyclical component of unemployment rate based on HP filter, U^c(HP), the cyclical component of unemployment rate based on BK filter, U^c(BK) and the cyclical component of unemployment rate based on quadratic trend, U^c(QT). The results of the level models show that the growth rate of GDP series are nonstationary for Algeria, Bahrain, Egypt, Morocco, Sudan and Tunisia. The other eleven growth rate series are stationary. All three cyclical components of output series are stationary. All absolute difference and cyclical components of unemployment rate series are stationary. The results for the first difference models show that all series are stationary including the series tested non-stationary in the level models. Hence, none of our series is integrated of order two.

Table 2 Augmented Dickey-Fuller Unit Root Test: Levels and First Difference, all variables

	y	Y^c (HP)	Y^c (BK)	Y^c (QT)	u	U^c (HP)	U^c (BK)	U^c (QT)
Levels								
Algeria	–1.51	–2.83**	–4.12**	–2.45*	–3.02**	–2.61**	–4.60**	–2.42*
Bahrain	–1.15	–2.77**	–5.24**	–2.04*	–4.07**	–3.12**	–4.78**	–2.53**
Egypt	–0.83	–4.23**	–4.10*	–4.24**	–3.64**	–5.22**	–5.44**	–4.68**
Iran	–3.09**	–5.17**	–4.87**	–4.90**	–4.81**	–2.78**	–5.18**	–2.23*
Jordan	–3.64**	–3.76**	–5.16**	–3.24**	–2.50*	–3.66**	–5.14**	–2.98**
Kuwait	–5.32**	–5.10**	–4.96**	–4.47**	–6.64**	–4.03**	–6.13**	–3.67**
Lebanon	–4.31**	–3.95**	–4.99**	–4.20**	–5.88**	–3.71**	–4.36**	–3.95**
Morocco	–0.60	–2.82**	–7.81**	–2.03*	–6.02**	–3.87**	–6.72**	–2.76**
Oman	–1.99*	–3.26**	–4.56**	–3.00**	–2.56**	–3.28**	–4.97**	–3.83**
Qatar	–3.01**	–5.25**	–5.74**	–2.86**	–3.82**	–4.20**	–6.32**	–4.58**
Saudi Arabia	–3.72**	–2.79**	–3.63**	–2.47*	–4.92**	–3.77**	–4.58**	–3.55**
Sudan	–1.39	–3.49**	–5.73**	–1.99*	–3.71**	–2.35*	–6.09**	–2.01*
Syria	–2.12*	–2.84**	–6.99**	–2.11*	–5.26**	–2.12*	–4.23**	–3.26**
Tunisia	–0.86	–4.99**	–4.75**	–2.36*	–4.58**	–3.58**	–5.60**	–2.36*
Turkey	–3.56**	–3.85**	–5.98**	–3.59**	–5.52**	–3.89**	–6.89**	–2.55**
UAE	–3.81**	–3.50**	–4.79**	–1.98*	–5.40**	–4.46**	–5.32**	–2.76**
Yemen	–2.41*	–3.71**	–4.18**	–4.14**	–6.65**	–4.75**	–4.92**	–4.70**
First Difference								
Algeria	–5.64**	–5.49**	–5.46**	–4.00**	–8.41**	–4.89**	–7.37**	–3.63**
Bahrain	–6.14**	–5.69**	–6.04**	–4.75**	–4.77**	–5.98**	–5.87**	–4.47**
Egypt	–5.52**	–4.01**	–5.90**	–407**	–8.47**	–4.33**	–6.92**	–4.69**
Iran	–4.73**	–5.07**	–4.80**	–4.23**	–9.08**	–5.86**	–6.08**	–5.09**
Jordan	–8.21**	–5.92**	–7.44**	–5.50**	–9.59**	–4.55**	–7.64**	–5.19**
Kuwait	–5.30**	–6.46**	–5.73**	–6.19**	–7.14**	–6.60**	–7.19**	–6.12**
Lebanon	–6.76**	–3.85**	–8.50**	–3.96**	–5.01**	–5.29**	–5.89**	–6.10**
Morocco	–11.15**	–7.80**	–11.83**	–13.22**	–7.99**	–6.23**	–8.65**	–6.38**
Oman	–7.60**	–4.67**	–6.23**	–4.33**	–2.23*	–5.87**	–7.04**	–5.48**
Qatar	–6.68**	–4.95**	–7.56**	–5.76**	–5.91**	–7.57**	–4.53**	–7.75**
Saudi Arabia	–6.16**	–6.40**	–5.90**	–5.19**	–7.72**	–5.86**	–6.13**	–4.83**
Sudan	–5.84**	–6.55**	–6.43**	–5.08**	–9.89**	–6.48**	–7.22**	–4.47**
Syria	–11.23**	–7.31**	–9.31**	–6.20**	–7.75**	–2.45*	–4.20**	–5.67**
Tunisia	–11.36**	–4.07**	–4.59**	–6.39**	–9.90**	–6.87**	–7.34**	–6.06**
Turkey	–10.00**	–7.03**	–8.57**	–7.39**	–5.87**	–6.35**	–5.97**	–5.49**
UAE	–3.11**	–6.28**	–6.26**	–5.01**	–8.28**	–4.51**	–4.26**	–5.13**
Yemen	–3.31**	–5.70**	–4.10**	–4.11**	–6.87**	–4.73**	–7.32**	–6.81**

u, *y*, U^C and Y^C represent the absolute difference of unemployment rate, the absolute difference of the GDP growth rate, the cyclical unemployment rate and the logarithm of the cyclical output respectively. *HP*, *BK* and *QT* refer to Hodrick-Prescott, the Baxter and King and the quadratic trend filters. The optimal lag orders are automatically selected according to the Schwarz Information Criterion

* and ** indicate 5 and 1 % confidence levels respectively

To examine the existence of a unit root in the variables used in the panel data regression, we use two different panel unit root tests: Livin, Li and Chu (LLC) and Im Pesaran and Shin (IPS). The LLC test assumes a common unit root process, whereas the IPS assumes an individual unit root process. The optimal lag orders in both tests are automatically selected by the Schwarz Criterion. Table 3 shows that the LLC and IPS tests confirm that all variables in the level forms are stationary as they exhibit neither common nor individual unit root processes. Hence, we use the variables in the level forms and there is no need to transform them to the first difference forms.

4 Empirical results

In this section, we present the four empirical estimations for each country using the general formula in Eq. 8: an estimation of the difference model and three estimations for the gap model based on the HP filter, Gap (HP), the BK

Table 3 Livin, Li and Chu and Im Pesaran and Shin Tests for unit root, panel data

Variable	Level Form	
	LLC (t-Stat)	IPS (W-Stat)
y	–15.73**	–16.61**
Y^c (HP)	–5.71**	–11.37**
Y^c (BK)	–14.82**	–17.94**
Y^c (QT)	–2.98**	–6.76**
u	–13.65**	–14.43**
U^c (HP)	–7.15**	–8.48**
U^c (BK)	–15.16**	–14.39**
U^c (QT)	–4.48**	–7.55**

u, y, U^C and Y^C represent the absolute difference of unemployment rate, the absolute difference of the GDP growth rate, the cyclical unemployment rate and the logarithm of the cyclical output respectively. HP, BK and QT refer to Hodrick-Prescott, the Baxter and King and the quadratic trend filters. LLC and IPS represent Livin, Lin & Chu and Im, Pesaran & Shin unit root tests respectively. The optimal lag length is selected by the Schwarz Criterion

* and ** indicate 95 and 99 % confidence levels respectively

filter, Gap (BK), and the quadratic trend, Gap (QT) as well as their corresponding long-run coefficients as specified in Eq. 12. After determining the validity of Okun's Law for individual countries, we check for the coefficients' stability over time using the CUSUM of squares test. Finally, we apply panel data analysis to test the validity of Okun's Law in the entire MENA sample by estimating Eqs. 1 and 7. The different ARDL regression results for individual countries are reported in Table 4. The optimal lag lengths, p and q, are selected based on Hannan-Quinn criterion (1979). For each country, we estimate four sets of parameters, (p, q). The obtained sets are dissimilar to each other in all countries in our sample.

The regression results prove that Okun's Law is valid and job creation is associated with growth in the short-run in Algeria as confirmed by the gap models based on the HP and quadratic trend filters; in Egypt as confirmed by the difference model and the gap model based on the HP filter; in Iran as confirmed by the four models; in Jordan as confirmed by the gap model based on the quadratic trend filter; in Lebanon as confirmed by the four models; in Syria as confirmed by the gap model based on the quadratic trend filter; and in Turkey as confirmed by the difference model and the gap models based on the HP and the BK filters. In the rest of the countries, (ψ_0) has either the right negative sign but statistically insignificant or the wrong positive sign and statistically significant indicating invalid Okun's Law in the short-run. Table 4 provides mixed evidence of persistent effects of the cyclical output on cyclical unemployment as some of the coefficients, (ψ_1) and (ψ_2), have the right signs and are statistically valid while others are statistically invalid for the same country.

The four regression estimations verify that Okun's Law is valid in the long-run in only six of the seventeen countries, namely Algeria, Egypt, Iran, Jordan, Lebanon, and Turkey as their coefficients (θ_1) are statistically significant with the right negative sign. Our findings contradict the results obtained by Moosa (2008) that Okun's Law is invalid in Algeria and Egypt. This contradiction might be due to the use of different data frequencies. Moosa (2008) used quarterly data extrapolated from annual data while this study used annual data. The values of our estimated coefficients for the same country are by far uniform in all countries. It varies from –0.52 to –1.44 in Algeria, from –0.26 to –0.54 in Egypt, from –0.10 to –0.36 in Iran, from –0.34 to –1.05 in Jordan, from –0.12 to –0.38 in Lebanon and from –0.11 to –0.29 in Turkey. Hence, we can presume that our estimates for the same country are not robust as they are sensitive to the choice of the model, whether the difference or gap model, and to the choice of method used to extract the cyclical components, HP filter, BK filter and quadratic trend. Our results suggest that cyclical unemployment in Algeria, Egypt, Iran, Jordan, Lebanon, and Turkey are dependent on cyclical output. In addition, our empirical findings indicate that unemployment rates in the six countries are associated with economic growth in the in the long-run. The averages of long-run coefficients in Table 4 are equal to –0.98, –0.43, –0.25, –0.81, –0.23 and –0.20 in Algeria, Egypt, Iran, Jordan, Lebanon, and Turkey respectively. Hence, the average estimates are not robust across countries in our sample as they are different from one country to another.

Comparing the magnitudes of the average estimates, they are stronger in the Arab countries, Algeria, Egypt and Jordan, than the non-Arab countries, Iran and Turkey. Lebanon is the only exception to this rule. The different responsiveness of cyclical unemployment to cyclical output reflects the disparities in production and the level of economic development among the different countries in our sample. It can also indicate different regulations governing the labor markets in these countries, especially the regulations that prohibit firing laborers during economic downturns that in turn prohibit the smooth adjustment of the labor market and discourage business firms from hiring when economic conditions improve. On the other hand, this disparity in values provides guidance to policymakers when planning and implementing policies related to labor markets. In countries where (θ_1) is low, as in Iran, Lebanon, and Turkey, the aggregate demand polices are more appropriate while in countries where (θ_1) is high or invalid, as in Algeria, Egypt and Jordan, the aggregate supply policies are more appropriate to reduce the unemployment rate (Villaverde and Maza 2009).

On the other hand, the regression results in Table 4 verify that the long-run coefficients (θ_1) are not statistically sig-

Table 4 Regression results of the short and long-run coefficients using the ARDL approach

Country	*Model*	*(p, q)*	μ	γ_1	γ_2	ψ_0	ψ_1	ψ_2	θ_1	R^2	*DW*	*BPG*	*N*
Algeria	Difference	(1, 1)	0.742*	0.393**		–0.148	–0.158		–0.516*	0.39	–1.00	1.03	32
	Gap (HP)	(0, 0)	–0.000			–0.608*			–0.608*	0.13	0.60	0.06	34
	Gap (BK)	(0, 2)	0.001			–0.420	–0.468*	–0.471	–1.359**	0.27	1.59	2.16	28
	Gap (QT)	(2, 0)	0.000	1.040**	–0.342**	–0.440**			–1.443**	0.81	2.09	0.56	32
Bahrain	Difference	(0, 0)	0.033			0.003			0.003	0.01	1.83	0.01	22
	Gap (HP)	(1, 0)	–0.000	0.343		0.043			0.066	0.14	None	0.36	22
	Gap (BK)	(2, 0)	0.001	–0.276	–0.425*	–0.042			–0.025	0.00	1.52	0.72	17
	Gap (QT)	(2, 0)	0.000	0.640**	–0.360	0.105			0.199	0.38	2.10	0.05	21
Egypt	Difference	(0, 0)	1.333**			–0.264**			–0.264**	0.33	2.38	0.10	30
	Gap (HP)	(0, 0)	0.000			–0.535**			–0.535**	0.45	1.46	2.09	31
	Gap (BK)	(2, 1)	–0.000	–0.251	–0.401	–0.389	–0.433		–0.469*	0.20	2.13	2.46	25
	Gap (QT)	(1, 0)	0.000	0.540**		–0.177			–0.456**	0.47	5.87	1.58	30
Iran	Difference	(0, 0)	0.547			–0.098*			–0.098*	0.13	1.87	0.60	32
	Gap (HP)	(1, 0)	0.000	0.496**		–0.183*			–0.362*	0.42	1.72	0.53	32
	Gap (BK)	(0, 0)	–0.000			–0.188*			–0.188*	0.08	2.04	0.01	29
	Gap (QT)	(2, 0)	0.001	0.775**	–0.261*	–0.173*			–0.342*	0.58	2.08	0.54	31
Jordan	Difference	(1, 2)	1.953**	–0.307**		–0.039	–0.207	–0.173*	–0.336**	0.49	0.60	0.14	29
	Gap (HP)	(1, 1)	–0.000	0.359**		–0.160	–0.469**		–0.991**	0.67	–1.32	0.74	30
	Gap (BK)	(1, 2)	0.000	–0.319*		–0.267	–0.422	–0.440*	–0.868**	0.45	–4.68	2.09	26
	Gap (QT)	(1, 0)	0.000	0.632**		–0.378**			–1.050**	0.69	–0.98	2.09	30
Kuwait	Difference	(2, 1)	–0.162	–0.324	–0.287	0.019	0.038*		0.036*	0.32	2.16	4.52	31
	Gap (HP)	(1, 2)	0.000	0.320*		–0.006	0.037	–0.108**	–0.114	0.45	–3.05	3.33	32
	Gap (BK)	(2, 1)	0.000	–0.241*	0.081**	0.004*	–0.415*		0.073**	0.47	2.13	1.97	28
	Gap (QT)	(2, 2)	0.000	0.416	–0.141	–0.019	0.056	–0.146**	–0.152	0.60	2.66	6.36	32
Lebanon	Difference	(2, 1)	0.883	–0.667**	–0.347*	–0.108*	–0.131		–0.119**	0.46	2.36	0.15	20
	Gap (HP)	(0, 0)	–0.000			–0.297**			–0.297**	0.34	2.06	0.27	23
	Gap (BK)	(2, 2)	0.000	–0.327	–0.245	–0.266*	–0.657*	–0.246	–0.382*	0.53	2.51	3.12	17
	Gap (QT)	(0, 0)	–0.000			–0.121*			–0.121*	0.24	1.73	1.02	23
Morocco	Difference	(0, 0)	0.016			–0.060			–0.060	0.02	2.39	0.00	26
	Gap (HP)	(0, 0)	0.000			–0.301			–0.301	0.07	1.53	7.21	27
	Gap (BK)	(2, 0)	–0.000	–0.371	–0.625**	–0.200			–0.1.00	0.41	1.75	2.65	21
	Gap (QT)	(1, 0)	0.001	0.537**		0.024			0.227	0.29	–0.18	2.69	26
Oman	Difference	(2, 1)	0.066	1.361**	–0.669**	–0.002	–0.010*		–0.038	0.82	2.15	0.34	20
	Gap (HP)	(1, 0)	–0.000	0.459*		0.038			0.128	0.25	0.03	0.60	22
	Gap (BK)	(0, 0)	–0.000			0.100			0.100	0.12	2.35	2.32	19
	Gap (QT)	(2, 0)	–0.000	0.540***	–0.196	–0.006			–0.014	0.26	2.12	0.35	21
Qatar	Difference	(2, 2)	0.041	0.609**	–0.333*	0.006	–0.024**	0.015**	–0.005	0.69	1.60	0.34	20
	Gap (HP)	(1, 2)	–0.000	0.252		0.041	–0.094	0.076*	0.046	0.20	None	0.50	22
	Gap (BK)	(0, 1)	–0.000			0.088**	–0.120**		–0.034	0.45	2.54	0.41	19
	Gap (QT)	(2, 2)	0.000	0.011	–0.218	0.021	–0.044	0.019	0.034	0.11	2.10	0.54	21
Saudi Arabia	Difference	(2, 0)	–0.444	–0.157	–0.239	0.138			0.099*	0.22	2.06	6.10	20
	Gap (HP)	(2, 0)	–0.000			0.222*	–0.064	–0.151*	0.202*	0.34	1.76	0.86	23
	Gap (BK)	(0, 0)	–0.000			0.311*			0.311*	0.21	2.16	0.37	19
	Gap (QT)	(2, 1)	0.000	0.285	–0.364	0.186	–0.147		0.092*	0.25	2.20	1.51	21
Sudan	Difference	(0, 0)	–0.516**			0.050*			0.050*	0.08	1.62	1.75	30
	Gap (HP)	(1, 1)	–0.000	0.618**		0.024	–0.150		–0.438	0.40	0.34	4.30	30
	Gap (BK)	(0, 1)	0.000			0.038	–0.116		–0.052	0.11	2.26	0.37	27
	Gap (QT)	(2, 0)	–0.000	0.786**	–0.272*	0.236**			0.442*	0.73	2.21	2.27	29

Table 4 Regression results of the short and long-run coefficients using the ARDL approach (Continued)

Country	*Model*	*(p, q)*	μ	γ_1	γ_2	ψ_0	ψ_1	ψ_2	θ_1	R^2	*DW*	*BPG*	*N*
Syria	Difference	(1, 2)	–0.6020	–0.217		–0.130	0.086	0.198	0.082	0.19	–0.91	0.82	20
	Gap (HP)	(2, 2)	0.002	1.905^{**}	$–0.927^{**}$	0.018^{*}	0.004	$–0.017^{*}$	0.198	0.98	1.01	0.84	20
	Gap (BK)	(0, 0)	0.001			–0.416			–0.416	0.03	2.25	0.47	18
	Gap (QT)	(0, 1)	0.001			$–0.579^{*}$	0.324		–0.305	0.19	1.60	0.38	22
Tunisia	Difference	(0, 0)	0.361			–0.067			–0.067	0.02	0.68	0.05	25
	Gap (HP)	(0, 0)	–0.000			–0.264			–0.264	0.13	1.23	0.03	25
	Gap (BK)	(1, 0)	–0.001	$–0.540^{*}$		–0.307			–0.307	0.29	1.96	0.47	20
	Gap (QT)	(0, 0)	–0.000			–0.293			–0.293	0.17	0.84	1.21	25
Turkey	Difference	(0, 0)	0.582^{*}			$–0.114^{**}$			$–0.114^{**}$	0.25	1.86	0.63	33
	Gap (HP)	(1, 0)	–0.000	0.331^{**}		$–0.192^{*}$			$–0.287^{*}$	0.21	4.80	0.17	33
	Gap (BK)	(2, 0)	0.000	–0.088	$–0.471^{**}$	$–0.262^{*}$			$–0.168^{**}$	0.48	2.02	0.47	28
	Gap (QT)	(1, 1)	–0.001	0.695^{**}		–0.190	0.073		$–0.218^{*}$	0.42	2.10	0.15	33
UAE	Difference	(0, 1)	–0.035			$–0.049^{**}$	0.063^{**}		0.014	0.55	2.46	1.19	22
	Gap (HP)	(0, 1)	–0.000			$–0.079^{*}$	0.101^{*}		0.006	0.22	1.93	2.26	23
	Gap (BK)	(0, 0)	–0.000			–0.096			–0.096	0.11	2.27	5.90	19
	Gap (QT)	(1, 0)	–0.002	0.185		0.024			0.018	0.07	1.90	0.51	22
Yemen	Difference	(0, 0)	–0.762	–0.218		0.219^{*}			0.219^{*}	0.15	2.17	6.52	22
	Gap (HP)	(0, 0)	–0.000			0.430^{*}			0.430^{*}	0.09	1.77	0.01	23
	Gap (BK)	(0, 0)	–0.001			0.924^{**}			0.924^{**}	0.28	2.35	0.07	19
	Gap (QT)	(0, 0)	–0.000			0.309^{**}			0.309^{**}	0.06	1.73	0.08	23

DW, *BPG*, and *N* indicate Durbin-Watson Statistics, Breusch-Pagan-Godfrey Statistics and number of observations respectively
* and ** indicate 5 and 1 % confidence levels respectively

nificant in Bahrain, Kuwait, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, UAE and Yemen. Hence, Okun's Law is not valid and growth is jobless in these countries. This implies that cyclical unemployment is not responsive to cyclical output and that unemployment is caused by variables other than cyclical output. This can be attributed to several reasons. First, unemployment rates in these countries are structural and frictional rather than cyclical. Second, cyclical unemployment is not responsive to cyclical output in these economies due to the presence of monopolies and oligopolies that are inhibiting the creation and the development of horizontal and vertical small and medium enterprise networks. Such networks are crucial to ensure sustained job creation, income generation, and poverty eradication. Third, the productivity in these countries is centered on capital intensive industries such as oil, gas, mineral resources ... etc. Changes in the production of such industries have little impact on the labor market. Finally, the public sector in these countries plays a dominant hiring role that distorts the labor markets by inflating wages, increasing rigidities, and contributing to skill mismatches.

Table 4 also presents the Durbin-Watson (DW) statistics to test for serial correlation and the Breusch-Pagan-Godfrey (BPG) Statistics to test for heteroscedasticity. To correct for possible serial correlation and heteroscedasticity and to draw more accurate inference for our estimates, we use the Newey-West HAC consistent covariance estimates (Newey-West 1987). The coefficients of determination, R^2, for the six countries where Okun's Law is valid are, in general, satisfactory and their values indicate that variations of the growth components explain a considerable variation in the unemployment components.

The main objective of this study is to estimate the responsiveness of unemployment to output. Measuring the responsiveness of output to unemployment rate or OLC coefficient is beyond the objective of this paper, but it is an equally important issue that can constitute a core of future research study. It is interesting to measure the cost of unemployment rates in terms of output in the country and regional levels, which might provide some clues of why unemployment rates in the region are high compared to other world regions. Our primary measurements of CLSs coefficients in our sample, which are not reported in this study, are either insignificant or of low values. This might indicate that the costs of unemployment in the MENA economies are low, which might explain why the region has tolerated high unemployment rates for a long period of time that lead to the ongoing political crises in the region. The rosy output indicators have been misleading and hiding the gloomy economic realities in the region, especially in the labor markets.

The valid Okun's Law estimations in Algeria, Egypt, Iran, Jordan, Lebanon, and Turkey are tested to check their stabilities over time using the CUSUM of squares test. The

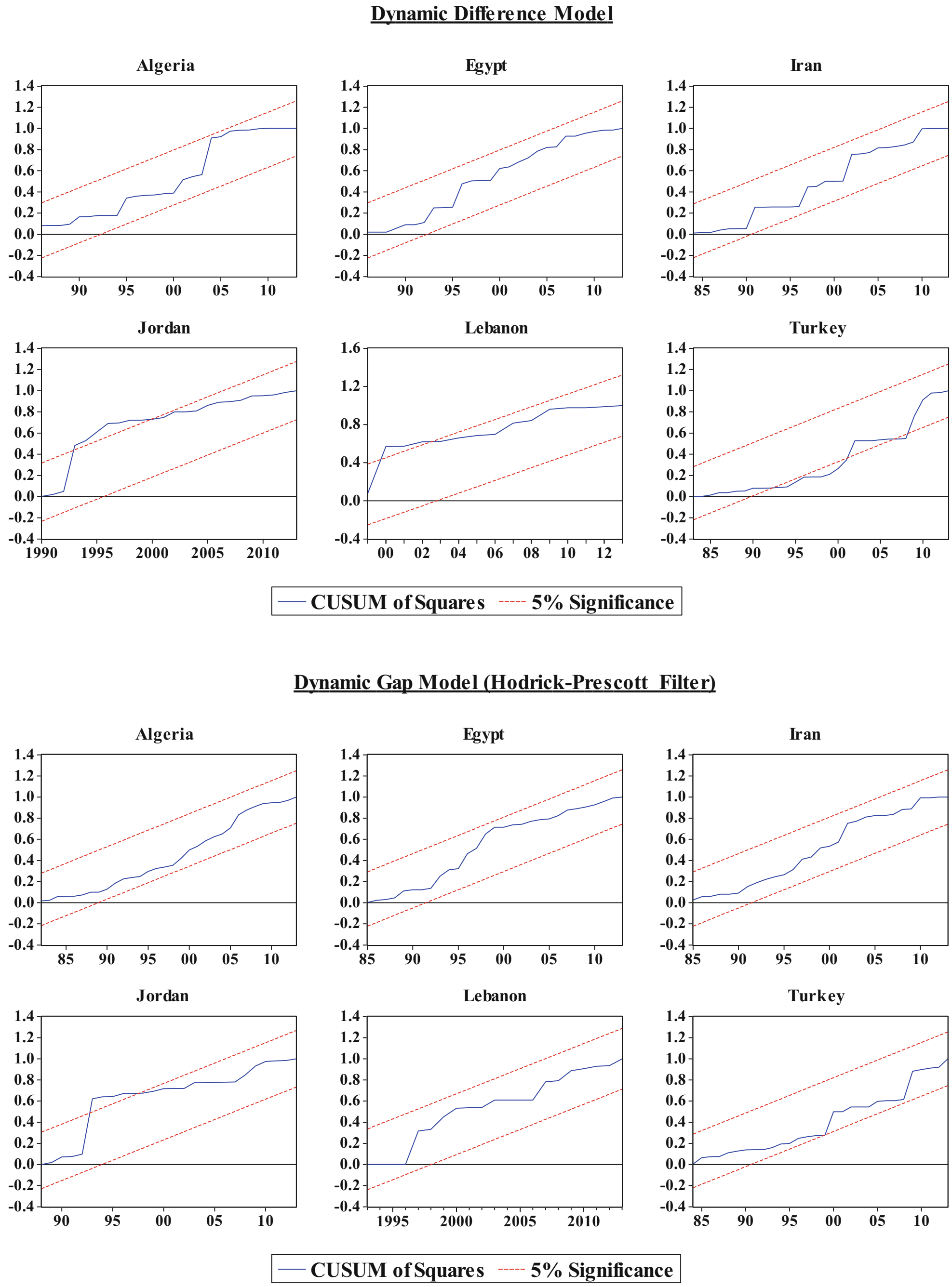
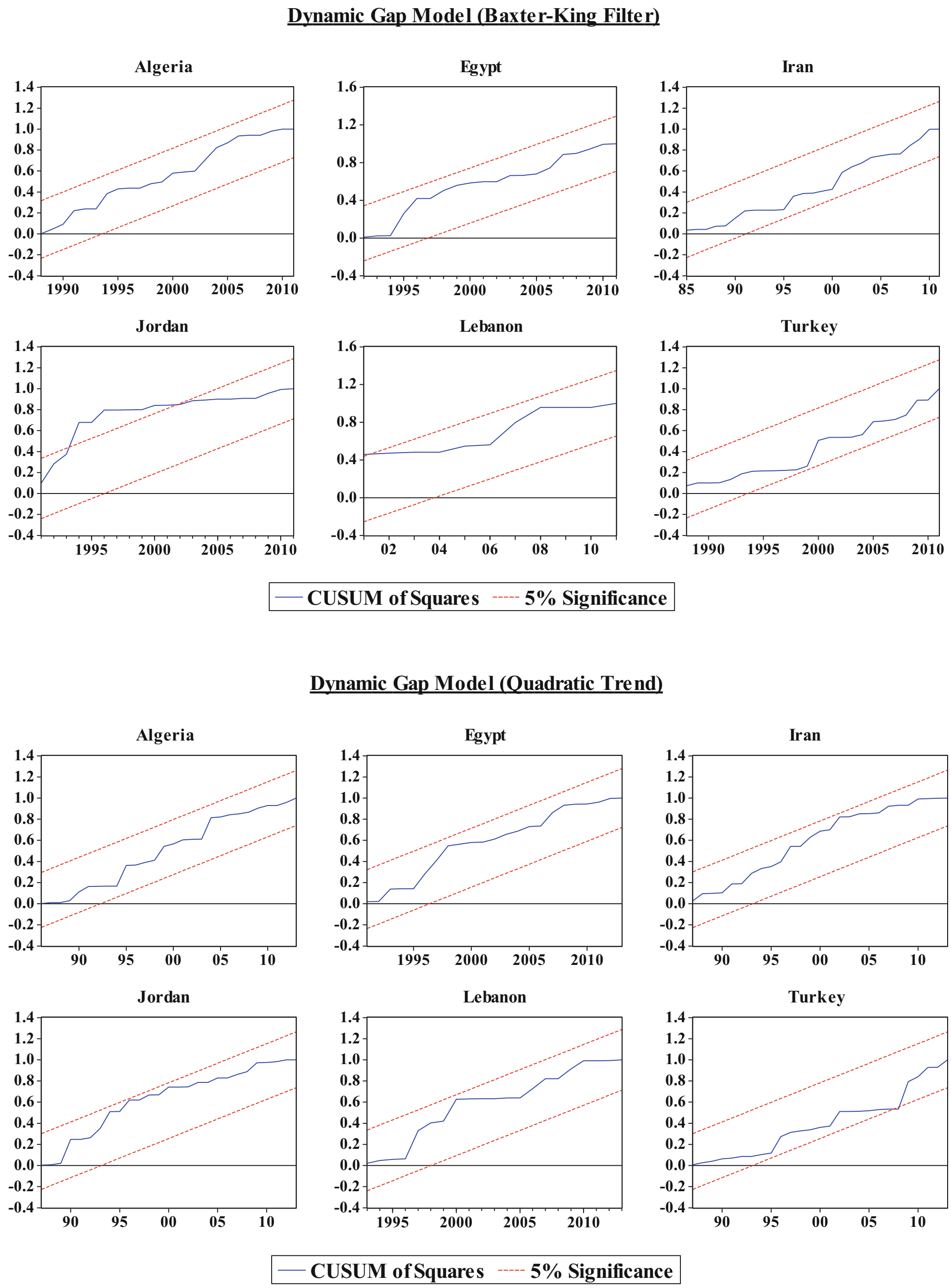


Fig. 1 The CUSUM of Squares Stability Test: The Dynamic Difference and Gap Models

tests are plotted in Fig. 1. The figure includes four sets of graphs. Each set tests the stability of the coefficients obtained from one of the four regressions in Table 4. The four sets of graphs indicate the coefficients of Algeria, Egypt, and Iran are stable as their cumulative squared residuals stayed within the 5 % confidence level corridor throughout the time periods considered in this study. The CUSUM of squares test shows that three out of the four Jordanian coefficients are unstable. The coefficients obtained from the difference model, the gap model based on HP filter, and the gap model based on BK filter are unstable and the CUSUM of squares test suggest parameter instabilities in Jordan taking place in 1993. On the contrary, the Jordanian coefficient of the gap model based on quadratic trend stayed within the 5 % confidence level indicating stable parameter. The Lebanese and the Turkish coefficients obtained from the difference model are also unstable. The CUSUM of squares test applied on the difference models indicates parameter instabilities in 2000 in Lebanon and in 1993 and in 2007 in Turkey. The Lebanese and the Turkish coefficients obtained from the other gap models based on the three filters are stable as their cumulative squared residuals stayed

Fig. 1 *Continued*



within the 5 % confidence level corridor. The unstable relationships between unemployment and growth rates show that Okun's Law is subject to continuous changes and that is why it should be used as a rule of thumb that should be tested for validity from time to time.

Finally, Table 5 shows the panel estimations of the difference and the three gap models as illustrated in Eqs. 1 and 7 respectively using panel SUR method. The estimations of the four coefficients are highly significant with the right positive signs. However, the coefficients are not robust with different versions of Okun's Law. Regardless of the version used, the low values of the four estimations suggest that the impact of GDP growth is weak on creating jobs in the MENA region, which might explain the high unemployment rates despite the resilient growth performance in the region. The coefficients of determination of the four regressions are low, ranging from 0.09 to 0.17, which indicate that the variations of the unemployment rates can be explained by other variables than the variations of the growth rates.

Table 5 Results of the Panel Data Regressions

Method	Model	Θ_{Region}	R^2	N
Panel SUR	Difference	–0.015** (–6.07)	0.15	448
	GAP (HP)	–0.063** (–5.35)	0.16	463
	GAP (BK)	–0.010** (–4.98)	0.09	395
	GAP (QT)	–0.079** (–7.52)	0.17	463

Θ_{Region} represents the slope that measures the total effects of Y^* on U^* *HP*, *BK* and *QT* refer to Hodrick-Prescott, the Baxter and King and the quadratic trend filters
** indicates 99 % confidence levels respectively

5 Conclusion

In this study, we estimated Okun's Law for seventeen MENA countries: Algeria, Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, Turkey, UAE, and Yemen. The subject is an interesting case study since the region has been suffering from one of the highest unemployment rates in the world. The inability of the region to create enough jobs for its growing population, especially its youth, has caused the ongoing turmoil that is threatening to radically change the region socially, economically, and politically. Despite that, very few studies estimated Okun's Law for the MENA region. The time period considered in this study is from 1980 to 2013. The estimation methods used are the ARDL approach for the individual countries and the panel data analysis for the entire sample. To test for results robustness, we obtained four estimations for Okun's Law: an estimation for the difference model and three estimations for the gap model based on three de-trending techniques: the HP filter, the BK filter, and the quadratic trend.

Our findings can be summarized as follows: First, The four estimation results suggest that Okun's Law is only valid in six of the seventeen countries, namely Algeria, Egypt, Iran, Jordan, Lebanon, and Turkey in the long-run. In the short-run, Okun's Law is valid in Iran, Lebanon, and Turkey and the results are decisive in Algeria, Egypt and Jordan. Our estimations indicate that Okun's Law is invalid, and hence growth is jobless in Bahrain, Kuwait, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Tunisia, UAE, and Yemen in the long-run as well as the short-run. Second, the average estimated values of the valid long-run Okun's Law are different from one country to another and they are bigger for the Arab countries than for the non-Arab ones. Such differences are attributed to the economic differences between the countries and the differences of regulations governing their labor markets. The different values can provide policy guidance to decrease unemployment rates in the region. Third, our study tests for the stabilities of the valid coefficients. Based on the CUSUM of squares test, the estimated coefficients of Algeria, Egypt, and Iran are stable over the time periods considered in this study. However, there is strong evidence of structural changes in the relationship between unemployment and output taking place around 1993 in Jordan. The test results for Lebanon and Turkey are ambiguous. Fourth, our panel data analyses suggest that Okun's Law is valid for the entire MENA sample; however, our estimations reveal that the impact of GDP growth is weak on creating jobs in the region. Finally, our individual and panel estimations are not robust as they are sensitive to the choice of the estimation model and to the choice of the de-trending method.

References

Apel, M., Jansson, P.: A theory-consistent system approach for estimating potential output and the NAIRU. Econ Lett **64**, 271–275 (1999)
Attfield, C.L.F., Silverstone, B.: Okun's law, cointegration and gap variables. J Macroecon **20**(3), 625–637 (1998)
Backus, D.K., Patrick, J.K.: International evidence on the historical properties of business cycles. Am Econ Rev **82**(4), 864–888 (1992)
Baxter, M., King, R.G.: Approximate band-pass filters for economic time series. National Bureau for Economic Research working paper 5022 (1995)
Bhalotra, S.R.: The puzzle of jobless growth in indian manufacturing. Oxf Bull Econ Stat **1**(1), 5–32 (1998)
Brown, R.L., Durbin, J., Evans, J.M.: Techniques for testing the constancy of regression relationships over time. J R Stat Soc Series B Stat Methodol **37**(2), 149–192 (1975)
Clark, P.K.: Okun's law and potential GNP. Board of Governors of the Federal Reserve System working paper (1983)
Engle, R.F., Granger, C.W.J.: Co-integration and error-correction: representation, estimation and testing. Econometrica **55**, 251–276 (1987)
Freeman, D.: A regional test of Okun's law. Int Adv Econ Res **6**, 557–570 (2000)
Freeman, D.: Panel test of Okun's law for ten industrial countries. Econ Inq **39**, 511–523 (2001)
Friedman, B.M.: Lessons on monetary policy from the 1980s. J Econ Perspect **2**(3), 51–72 (1988)
Ghatak, S., Siddiki, J.: The use of ARDL approach in estimating virtual exchange rates in India. J Appl Stat **28**, 573–583 (2001)
Grant, A.P.: Time-varying estimates of the natural rate of unemployment: a revisitation of Okun's law. Q Rev Econ Finance **42**, 95–113 (2002)
Hannan, E.J., Quinn, B.G.: The determination of the order of an autoregression. J R Stat Soc Series B Stat Methodol **41**(2), 190–195 (1979)
Hanusch, M.: Jobless growth? Okun's law in East Asia. World Bank policy research working paper WPS6156 (2012)

Hodrick, R.J., Prescott, E.C.: Postwar U.S. business cycles: an empirical investigation. J Money Credit Bank **29**, 1–16 (1997)
Johansen, S.: Statistical analysis of co-integration vectors. J Econ Dyn Control **12**, 231–254 (1988)
Johansen, S.: Estimation and hypothesis testing of co-integration vectors in Gaussian vector autoregressive models. Econometrica **59**(6), 1551–1580 (1991)
Johansen, S., Juselius, K.: Maximum likelihood estimation and inference on co-integration with applications to the demand for money. Oxf Bull Econ Stat **51**, 169–210 (1990)
Keller, J., Nabil, M.K.: The macroeconomics of labour market outcomes in MENA over the 1990s: How growth has failed to keep pace with a burgeoning labour market. Egyptian Center for Economic Studies working paper (2002)
Lal, I., Muhammad, S.D., Jalil, M.A., Hussain, A.: Test of Okun's law in some asian countries: co-integration approach. Eur J Sci Res **1**, 73–80 (2010)
Lee, J.: The robustness of Okun's law: evidence from OECD countries. J Macroecon **22**(2), 331–356 (2000)
Mankiw, N.G.: Macroeconomics, 2nd edn. Worth Publishers, New York (1994)
Marinkov, M., Geldenhuys, J.: Cyclical unemployment and cyclical output: as estimation of Okun's coefficient for south africa. South Afr J Econ **75**(3), 373–390 (2007)
Moazzami, B., Dadgostar, B.: Okun's law revisited: evidence from OECD countries. Int Bus Econ Res J **8**(8), 21–24 (2009)
Moosa, I.A.: A cross-country comparison of Okun's coefficient. J Comp Econ **24**, 335–356 (1997)
Moosa, I.A.: Cyclical output, cyclical unemployment, and Okun's coefficient: a structural time series approach. Int Rev Econ Finance **8**, 293–304 (1999)
Moosa, I.A.: Economic growth and unemployment in arab countries: is Okun's law valid? International conference on the unemployment crisis in the Arab Countries, Cairo. (2008)
Newey, K., West, D.: A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica **55**(3), 703–708 (1987)
Okun, A.M.: Potential GNP: its measurement and significance. Proceedings of the Business and Economic Statistics Section of the American Statistical Association, 98–104 (1962)
Perman, R., Tavera, C.: A cross-country analysis of the Okun's law coefficient convergence in Europe. J Appl Econ **37**, 2501–2513 (2005)
Pesaran, M.H., Shin, Y.: An autoregressive distributed lag modeling approach to co-integration analysis. University of Cambridge working paper 9514 (1999)
Prachowny, M.F.J.: Okun's law: theoretical foundations and revised estimates. Rev Econ Stat **75**(2), 331–335 (1993)
Soegner, L., Stiassny, A.: An analysis on the structural stability of Okun's law – a cross-country study. Appl Econ **14**, 1775–1787 (2002)
United Nations, Department of Economic and Social Affairs: World Youth Report: youth employment: youth perspectives on the pursuit of decent work in changing times (2011)
Villaverde, J., Maza, A.: The robustness of Okun's law in Spain, 1980–2004 regional evidence. J Policy Model **31**, 289–297 (2009)
Weber, C.E.: Cyclical output, cyclical unemployment, and Okun's coefficient: a new approach. J Appl Econom **10**(4), 433–445 (1995)

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