

Original Research Article

The Nexus between Unemployment and Economic Growth in Egypt: Revisiting Okun's Law

ABSTRACT

This paper investigates the validity of Okun's Law to the Egyptian economy through the period 1991 until 2021 using Autoregressive Distributed Lag (ARDL) model technique. The paper applies Augmented Dickey-Fuller (ADF) and Phillips – Perron (PP) to perform the unit root test. It is found that the three variables in the model, natural logarithm of real GDP difference $\text{LN}(\text{RGDPdif})$, natural logarithm of real GDP gap $\text{LN}(\text{RGDPgap})$, and natural logarithm of unemployment rate difference $\text{LN}(\text{UNdif})$, are integrated of order zero $I(0)$. While the other variable, natural logarithm of unemployment rate gap $\text{LN}(\text{UNgap})$, is integrated of order one $I(1)$. Therefore, the paper finds justification to conduct the ARDL bounds test for co-integration for the two Okun's Law versions. However, the paper finds that the results are incompatible with economic theory and contradict most of research papers conducted for other countries. The coefficient of $\text{LN}(\text{UNdif})$ is ($= 0.0004$) and found to be insignificant while the coefficient of $(\text{LN}(\text{RGDPdif}) - 1)$ is the only significant coefficient at 5% significance level ($= -2$). Of course, these results in addition to the ARDL Bounds Tests' results give evidence that there is no relationship between real GDP and unemployment rate in Egypt neither in the long run nor in the short run. Therefore, Okun's Law, with difference model and gap model, is not valid in case of Egypt. These findings can be attributed to the low level of data accuracy and reliability. As a result, it is recommended for the Egyptian government to direct more effort towards collecting and publishing more accurate and reliable data on socio-economic variables.

Keywords: [Unemployment, Economic Growth, Okun's Law, The Difference Model, The Gap Model, Co-integration Analysis, Autoregressive Distributed Lag (ARDL) Approach, Egypt].

1. INTRODUCTION

Unemployment is considered one of the most serious challenges that are facing all categories of economies either developed or developing countries. Several notified economists, such as Shorbaji (2009) and Kreishan (2011), confirmed that the existence of persistent high unemployment rates reflects imbalances in labor market that widen poverty and cause further deterioration of standards of living. From this perspective, it is widely granted by economists that the optimal way to lower unemployment rates is done through boosting economic growth rates. In this regard, "Okun's Law" is considered the theoretical foundation for the relationship between economic growth and unemployment. In his pioneer paper Okun (1962), the famous economist tested this vital relationship statistically and postulated his law concluded "how much of a country's gross domestic product (GDP) may be lost when the unemployment rate is above its natural rate" Okun (1962). In other simple

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words, it is observed that there exists a positive relationship between output and employment according to the fact that the amount of labor used in the production process is the main determinant of output level. Putting in consideration that total employment equals the labor force minus the unemployed; therefore, a negative relationship between output and unemployment can easily be approved.

As a result, economists have been attracted to examine the nexus between unemployment and economic growth due to its importance as one of the most essential macroeconomic dilemmas at any economy. In addition, the importance of lower unemployment rate appeared in being one of the main foundations to achieve macroeconomic stabilization. Consequently, examining such an important nexus has several implications for both policy makers and macroeconomists which are raised when economic authorities are targeting to achieve a specified desirable economic growth rate Mossa (2008), Dahmani (2013). However, limited number of research papers have examined such a nexus in Arab countries in general and in Egypt in specific.

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In Egypt, unemployment rates have been rising dramatically especially during the last decade because of several economic and political problems. Therefore, it is vital for the Egyptian Economy to analyze different types of unemployment and what are the reasons of its presence. In addition, it is required to explain how youth unemployment became a very serious problem in Egypt. In August 2022, the Egyptian Central Agency for Public Mobilization and Statistics (CAPMAS) announced that the unemployment rate reached to 7.2%, around 2.15 million¹.

Also, CAPMAS declared that the Egyptian labor force has reached to 30 million by the end of June 2022. Moreover, it is crucial to highlight the gender inequality between males and females in the labor market. From this perspective, unemployment rate for females is amounted to become 16 percent compared to only 5.6 percent for male by the end of 2021, CAPMAS announced. In addition, another type of discrimination appears in describing the unemployment rate in rural areas compared to urban areas whereas in rural areas it is 4.3 percent compared to 11.2 percent for urban areas by the end of 2021, according to the same monitor².

Studying unemployment phenomenon in Egypt is characterized to be limited. It is noted that there exists a clear gap in examining the nexus between unemployment and economic growth in the Egyptian economy and the validity of Okun's law. In addition, the literature of this topic is lacking describing, analyzing, and classifying types of unemployment in Egypt. Also, it is required to estimate the loss in economic growth resulted from high and persistent levels of unemployment appeared recently in the Egyptian economy. Therefore, the present study is trying to fill these gaps in the literature of testing the relationship between economic growth and unemployment in Egypt.

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Moreover, this research study could provide awareness to the Egyptian officials who are seen to be responsible for policy making related to unemployment. Also, the study will clarify how negatively unemployment impacts the Egyptian economy by calculating the percentage of loss. Through providing policy recommendations, it could also be essential to solve some problems related to unemployment challenge in Egypt.

The present paper is taking the following structure. Section two presents briefly the literature review. Section three is introducing the methodology and describing the econometric

¹https://www.capmas.gov.eg/Pages/IndicatorsPage.aspx?Ind_id=1117.

²https://www.capmas.gov.eg/Pages/Publications.aspx?page_id=5104&YearID=23462.

modeling and empirical analysis. Section four discusses both short run and long run relationships between unemployment rate and economic growth rate in the Egyptian economy. Finally, section five illustrates conclusion and policy recommendations for the Egyptian policy makers.

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2. LITERATURE REVIEW

Surveying the literature, one can find several research papers which investigated Okun's Law applicability in both developed and developing economies. Of course, the starting paper was the pioneer work Okun (1962) that was the postulation for the law of unemployment – output nexus. In particular, Okun's law, produced in Okun (1962), acts as the rule of thumb for the analysis and explanation of the relationship between economic growth and job creation. Okun concludes that the continuous increase in both size of labor force and productivity enable GDP growth rate to approach the potential GDP growth which is considered the main requirement to hold the unemployment rate steady. Consequently, reducing unemployment rate requires achieving actual GDP growth rate at a pace above its potential.

In a panel of ten industrial countries, Freeman (2001) examined Okun's Law by using new developments in trend cycle decomposition. Freeman (2001) concluded that the law is still valid to make estimations for the impact of unemployment on GDP in both Europe and USA economies.

On the same track, it is found that Lee (2000) examined the Okun's law for all economies of OECD countries. It concluded that there is instability for the relationship over time where it is proved to be varied across different economies. However, it confirmed the existence of the impact of GDP growth on employment. Also, there exists Fuad (2011) that estimated Okun's law to test the unemployment – economic growth nexus in Jordan. It estimated the Okun's coefficient for the Jordanian economy using annual data across the period 1970-2008. It applied time series techniques and employed Augmented Dickey-Fuller (ADF) as a unit root test, co-integration test and a simple regression between unemployment rate and economic growth rate. This paper concluded that Okun's law is not valid for Jordan. Therefore, it can be concluded that the phenomenon of high unemployment rates in Jordan is not attributed to low GDP growth rates.

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For other emerging Arab economies, Dahmani and Mounia (2015) investigates Okun's law in Algeria for the period 1970 to 2014. The paper employs time series analysis where the Autoregressive Distributed Lag (ARDL) model to test the co-integration between economic growth and unemployment. Its results show the existence of long run negative relationship, whereas, no relationship is proved in the short run. In addition, the tremendous paper Mouldi and Mustapha (2017) is observed to provide a strong analysis for examining the validity of Okun's law in Saudi Arabia. The paper estimated the relationship through taking the first difference and employing the gap model with Hodrick-Prescott (HP) filter across the period 1980 until 2015. Also, it uses ARDL approach that reveals a co-integration relationship between the two variables, economic growth and unemployment rate. In the long run, the paper proves the existence of a significant unidirectional causality between the two variables. Moreover, Louail and Ben Haj (2021) tried to provide similar analysis for sixteen Arab countries, Egypt among them. The paper uses annual data during the period 1960-2017 for this group of countries where the dynamic Panel estimation model is employed to estimate Okun's coefficient. Results reveal that the Okun's Law is considered to be in effect. However, the analysis shows a negative relationship between economic growth and unemployment rate in Algeria, Egypt, Jordan, Morocco and Tunisia.

With regard to this literature in Egypt, Elshamy (2013) is found to be one of the most famous and cited papers that test Okun's coefficient in Egypt. It uses co-integration for the long run estimation and Error Correction Mechanism (ECM) for the short run. The paper employed annual data through the period 1970 to 2010 where it ends up with statistically significant estimations for the Okun's coefficient with expected sign. Also, Alhdiy et al. (2015) examined the economic growth – unemployment nexus in Egypt throughout the period 2006 Q1 - 2013 Q2. Its empirical analysis proved that there was no co-integration relationship between the two variables. Therefore, no long-term relationship can be found between them. However, in the short term, the analysis showed the existence of a direct causality relationship between these two variables in the Egyptian economy.

Another literature concentrated more on the youth unemployment problem in Egypt which is often-classified as a structural problem. In both Assaad (2014 and 2008), the analysis showed that the duality of the economy in Arab countries is the main reason for high youth unemployment rates. In Arab economies, there exists a formal economy controlled by the central governments and state-owned enterprises, and a huge informal sector operated by small and micro scale enterprises (SMEs).

3. MATERIAL AND METHODS

The main objective of the present paper is to test the applicability of "Okun's Law" in Egypt. Therefore, based on the methodology proposed by Hany Elshamy (2013), Alhdiy et al. (2015), and Mouldi and Mustapha (2017) that examined the Okun's law as an empirically observed relationship between unemployment and losses in a country's GDP. The present paper employs the Autoregressive Distributed Lag (ARDL) model, proposed by Pesaran (1997) and Pesaran et al. (2001), to examine the short-run and long-run relationships between the real economic growth rate (RGDP) and the unemployment rate (UN).

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Following Okun (1962), the present paper takes the two variables, RGDP and UN, in both difference and gap forms. Therefore, (LNRGDPdif) represents the first difference of the natural logarithm of the real GDP; while (LNRGDPgap) stands for the gap pattern that calculates the difference in natural logarithm between actual GDP growth rate and potential GDP growth rate. Also, (LNUNdif) illustrates the first difference of the natural logarithm of the unemployment rate and (LNUNgap) designates the gap pattern that captures the difference in natural logarithm between observed unemployment rate and natural unemployment rate.

In addition, the Augmented Dickey-Fuller (ADF) and Phillips – Perron (PP) methods are used in order to test for the stationarity of the model of one dependent variable (Real GDP growth rate) and one independent variable (Unemployment rate). Therefore, Unit root tests on both variables will be calculated using both ADF and PP.

Comment [U10]: ADF and PP are unit root tests that test the stationarity of the variables in the model not the model itself. The variables include both the independent and dependent variables.

The motive for this work is clear and straightforward: if the law is valid for Egypt, it will provide information on the type of unemployment in Egypt (periodic or otherwise), implying whether unemployment can be reduced through increased growth or not. Data for economic growth rate, inflation rate, and unemployment rate are the annual data through the period 1991 - 2021. GDP growth rates³, inflation rates⁴, and unemployment rates⁵ are collected from the World Development Indicators (WDI) published by the World Bank through 1991 to 2021.

³<https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2021&locations=EG&start=1991>.

⁴<https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?end=2021&locations=EG&start=1991>

⁵<https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS?end=2021&locations=EG&start=1991>.

3.1 Okun's Law First Difference Model:

The Okun's law first difference version is represented through the following equation;

$$\text{LN}RGDP_t - \text{LN}RGDP_{t-1} = \beta (\text{UN}_t - \text{UN}_{t-1}) + \mu_t \quad (2)$$

Where; $\text{LN}RGDP_t$; is the Natural logarithm of GDP in current time t.

$\text{LN}RGDP_{t-1}$; is the Natural logarithm of GDP in the previous time t – 1.

UN_t ; is the percentage rate of unemployment in the current time t.

UN_{t-1} ; is the percentage rate of unemployment in the previous time t – 1.

μ_t ; is the stochastic error term in current time t.

3.2 Estimating the Natural Rate of Unemployment:

The natural rate of unemployment can be estimated using the augmented Phillips Curve model that can be expressed by the following equation;

$$\pi_t - \pi^e_t = \beta_2 (\text{UN}_t - \text{UN}_{Na}) + \mu_t \quad (3)$$

Where; π_t ; is the actual inflation rate at time t.

π^e_t ; is the expected inflation rate at time t.

UN_t ; is the actual unemployment rate at time t.

UN_{Na} ; is the natural rate of unemployment.

μ_t ; is the stochastic error term.

To observe π^e_t , the simple assumption in this literature is that the expected inflation at year t is the inflation rate in year t – 1. Therefore, the present study assumes that $\pi_t = \pi^e_t$. Consequently, following Gujarati (2003), an expectations-augmented Phillips curve is developed through rewriting equation (3) as:

$$\pi_t - \pi_{t-1} = \beta_1 + \beta_2 \text{UN}_t + \mu_t \quad (4)$$

Where the natural rate of unemployment is calculated by $-\beta_1 / \beta_2$. Of course, equation (4), also named as an accelerationist Phillips curve, can easily be estimated using ordinary least squares (OLS) methodology. OLS shows the following estimation;

$$\pi_t - \pi_{t-1} = -9.05 + 0.855 \text{UN}_t + \mu_t$$

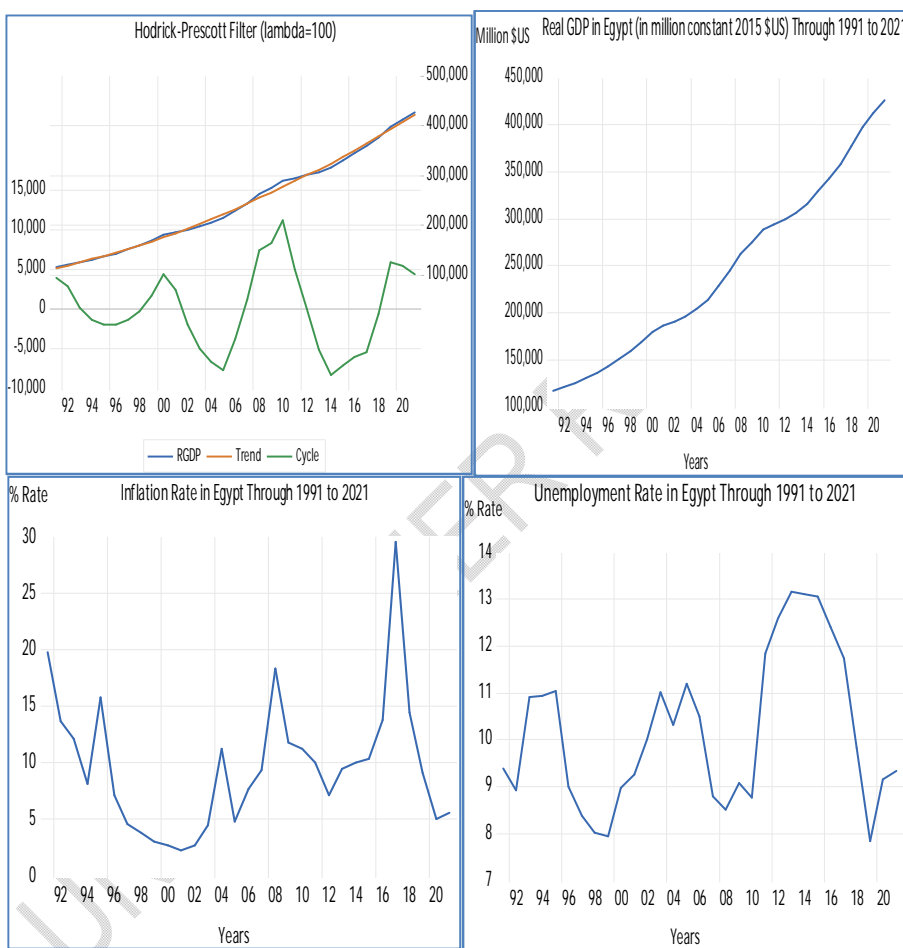
Therefore, the natural rate of unemployment is equal to $(-9.05/0.855) = 10.58\%$. According to Gujarati (2003), estimated natural rate for the developed countries lies in the range 5% to 6%. Of course, it is expected for developing country, such as Egypt, to have a natural rate that exceeds this range for developed economies.

The accelerationist Phillips curve, represented in equation (4), identifies the positive relationship between unemployment rate and inflation rate where an increase of unemployment rate leads to an increase in the inflation rate. It is noted that a higher level of unemployment triggers an acceleration of the price level.

3.3 Estimating Potential GDP in Egypt:

The present paper uses Hodrick-Prescott (HP) filter technique to measure potential output in Egypt through employing E-views 12. The following figure 1 shows the real GDP (RGDP), potential real GDP (RGDPpo) (HP filter technique), Inflation (INF), and Unemployment (UN) in Egypt through 1991 to 2021 (Using E-views 12).

Figure 1: RGDP, RGDPpo, INF, and UN in Egypt 1991 to 2021



3.4 Econometric Modeling:

3.4.1 The ARDL Model Specification:

Within the framework of Pesaran (1997) and Pesaran et al. (2001), ARDL approach is adopted through the following unrestricted Error Correction Model (ECM):

$$\Delta \text{LNUN}_{dijt} = \beta_0 + \beta_1 \text{LNUN}_{dijt-1} + \beta_2 \text{LNRGDP}_{dijt-1} + \sum \alpha_1 \Delta \text{LNRGDP}_{dijt-i} + \sum \alpha_2 \Delta \text{LNUN}_{dijt-i} + \mu_t \quad (5)$$

$$\Delta \text{LNUN}_{gap} = \beta_0 + \beta_1 \text{LNUN}_{gap t-1} + \beta_2 \text{LNRGDP}_{gap t-1} + \sum \alpha_1 \Delta \text{LNRGDP}_{gap t-i} + \sum \alpha_2 \Delta \text{LNUN}_{gap t-i} + \mu_t \quad (6)$$

The ARDL bounds test is started by estimating this model using Ordinary Least Squares (OLS) approach. So, the paper conducts a Wald test (F-Statistic) by imposing restrictions on the estimated long-run coefficients. Therefore, this test will be in the form:

$$H_0: \beta_1 = \beta_2 = 0 \text{ (no long-run relationship).}$$

$$H_1: \beta_1 \neq \beta_2 \neq 0 \text{ (a long-run relationship exists).}$$

Then, the calculated F-statistic value is compared with the critical values tabulated in the Pesaran et al (2001) table in order to take decision.

Once the co-integration is established, the second step is to select the ARDL model lags' orders through either (AIC) or (SBC). Pesaran and Pesaran (1997) proved that the highest value of AIC or SBC determine this optimal lag order. Therefore, the conditional ARDL long-run model can be obtained as follows:

$$LNUN_{dif} = \beta_0 + \sum \beta_1 LNUN_{dif-t} + \sum \beta_2 LNRGDP_{dif-t} + \mu_t \quad (7)$$

$$LNUN_{gap} = \beta_0 + \sum \beta_1 LNUN_{gap-t} + \sum \beta_2 LNRGDP_{gap-t} + \mu_t \quad (8)$$

The final step is to estimate the short-run dynamic parameters through the estimation of ECM associated with the long-run estimates. This estimation can be as follows:

$$\Delta LNUN_{dif} = \beta_0 + \Omega ECM_{t-1} + \sum \alpha_1 \Delta LNRGDP_{dif-t} + \sum \alpha_2 \Delta LNUN_{dif-t} + \mu_t \quad (9)$$

$$\Delta LNUN_{gap} = \beta_0 + \Omega ECM_{t-1} + \sum \alpha_1 \Delta LNRGDP_{gap-t} + \sum \alpha_2 \Delta LNUN_{gap-t} + \mu_t \quad (10)$$

In this model, α_1 and α_2 are the short-run dynamic coefficients and Ω is the speed of adjustment parameter. Also, the error correction term ECM can be derived through the equilibrium relationship forecasted using the equations (5) and (6).

Consequently, before examining long-run relationship, the paper tests the stationarity in order to make sure that integrated order of considered series is suitable for applying the ARDL approach model. Therefore, the paper employs two unit root tests, the Augmented Dickey – Fuller (ADF) and Phillips-Perron (PP) tests. For these two tests, the null hypothesis is the existence of a unit root and the alternative hypothesis is no unit root exists. This procedures of testing are expressed as follows.

4. RESULTS AND DISCUSSION

4.1 AUGMENTED DICKEY-FULLER (ADF) UNIT ROOT TEST RESULTS

The present paper uses the Augmented Dickey – Fuller (ADF) test presented in Dickey and Fuller (1979 and 1981) to investigate the order of integration for a non-stationary time series. The ADF test is expressed by the following equation (11);

$$\Delta Y_t = \phi_0 + \phi_1 Y_{t-1} + \sum_{i=1}^k \phi_i \Delta Y_{t-i} + \varepsilon_t \quad (11)$$

Where k represents the lags' number for ΔY_{t-i} that has to be in a level which saves the degrees of freedom and allow for the presence of autocorrelation in ε_t .

Also, the autoregressive coefficient (α_0) can be represented as;

$$Y_t = \alpha_0 Y_{t-1} + \varepsilon_t$$

And so it can be modified to;

$$\Delta Y_t = (\alpha_0 - 1) Y_{t-1} + \varepsilon_t$$

If α_0 is less than 1, then Y_t is integrated of order zero. If not, the following test must be conducted;

$$\Delta \Delta Y_t = (\alpha_1 - 1) \Delta Y_{t-1} + \varepsilon_t$$

If α_1 is less than 1, then Y_t is integrated of order one. Consequently, this process is continued until we reach stationarity. Using E-views 12, the present paper proves that there is an evidence of a unit root in all the four variables. Therefore, ADF test indicates that the four variables are all non-stationary. Table 1 provides results for ADF tests where natural logarithm of real GDP difference is ($LNRGDP_{dif}$), natural logarithm of real GDP gap is ($LNRGDP_{gap}$), natural logarithm of unemployment rate difference is ($LNUN_{dif}$), and natural logarithm of unemployment rate gap is ($LNUN_{gap}$).

Table 1. Augmented Dickey-Fuller (ADF) unit root tests results.

ADF (With trend)	LNRGDP _{dif}	LNRGDP _{gap}	LNUN _{dif}	LNUN _{gap}
In Levels	-8.98**	-5.39**	-6.80**	-1.85
In First Differences	N/A	N/A	N/A	-4.43**
Critical Values 5% level	-3.57	-3.57	-3.57	-3.57
Integration Level	I(0)	I(0)	I(0)	I(1)

** Significant at 5% level

Source: Author own estimations using E-views 12 package for the specified time series.

It is clear that three variables in the model, LNRGDP_{dif}, LNRGDP_{gap}, and LNUN_{dif}, are integrated of order zero I(0). While the other variable, LNUN_{gap}, is integrated of order one I(1). Therefore, this unit root test proves that the four variables are found to be of varied orders of integration which gives a sufficient justification for the paper to conduct ARDL approach to this model. In addition, a test for co-integration among these variables has to be conducted to investigate relations among them. Moreover, the paper employs Phillips-Perron (PP) Unit Root Tests to support these findings.

4.2 PHILLIPS-PERRON (PP) UNIT ROOT TESTS

It is important to state that the main difference between The Phillips-Perron (PP) unit root tests and the ADF tests appears in the way that they treat heteroskedasticity and serial correlation in errors. The main advantage of PP tests over the ADF tests can be found in their robust to general forms of heteroskedasticity in the error term. In addition, there is no need to specify a lag length for the PP test regression. So, the PP test regression can take the form;

$$\Delta Y_t = \beta_0 \cdot Dt + \sum \Phi_i \cdot Y_{t-i} + \varepsilon_t \quad (12)$$

Where ε_t is I(0) and may be heteroskedastic. Under the null hypothesis that $\Phi_i = 0$, the PP and ADF tests have the same asymptotic distributions. Employing E-views 12 to conduct PP tests, the study observed that PP test shows the same findings as ADF tests. Table 2 provides findings for PP tests for these variables.

Table 2. Phillips-Perron (PP) unit root tests results.

PP (With trend)	LNRGDP _{dif}	LNRGDP _{gap}	LNUN _{dif}	LNUN _{gap}
In Levels	-29.77**	-5.39**	-7.72**	-2.07
In First Differences	N/A	N/A	N/A	-4.43**
Critical Values 5% level	-3.57	-3.57	-3.57	-3.57
Integration Level	I(0)	I(0)	I(0)	I(1)

** Significant at 5% level

Source: Author own estimations using E-views 12 package for the specified time series.

One can easily find, from table 2, that PP unit root tests assure the results appeared in ADF tests. The variables LNRGDP_{dif}, LNRGDP_{gap}, and LNUN_{dif} are found to be integrated of order zero I(0). On the other hand, LNUN_{gap} is proved to be integrated of order one I(1). Consequently, these results assure the validity of conducting the ARDL approach to model the series' relations and testing co-integration relationship among this system of variables.

4.3 ARDL BOUNDS TEST FOR CO-INTEGRATION TECHNIQUE RESULTS

4.3.1 ARDL Results for First Difference Model

As discussed previously, it is justified to conduct the ARDL bounds test for co-integration. The ARDL approach is applied for the two versions, the first difference and the gap models. The present paper employs E-views 12 to model this time series where the model determines $LNRGDP_{dif}$ to be the dependent variable and $LNUN_{dif}$ to be the independent variable. As a result, the paper proves that the employed model is ARDL (2, 0) which proves significance for the long run relationships at all of 1%, 5%, and 10% significance levels, the following table 3 clarifies this finding. The calculated F-Statistics value (12.58) exceeds both the lower and upper critical bounds at the three levels of significance. Therefore, the paper must reject the null hypothesis of no co-integration. As a result, there exists an evidence of co-integration in the long run at all levels of significance between real GDP and unemployment. Of course, the paper finds that the first difference version of Okun's Law is valid for Egypt.

Table 3. ARDL Bounds Co-integration Test (First Difference Model).

F-statistics		12.58	
Critical value bounds			
Significance levels		I(0)	I(1)
10%		3.02	3.51
5%		3.62	4.16
1%		4.94	5.58

Source: Author own estimations using E-views 12 package for variables' time series.

According to the proved existence of co-integration in this model of variables; the paper has to estimate the long run coefficients of the ARDL model. Consequently, the long run equation for this system is estimated using E-views 12 to be as follows;

$$LNRGDP_{dif} = -2 LNRGDP_{dif}(-1)(13)$$

Although it is found that ARDL bounds test shows co-integration in the model, the long run equation seems insignificant showing no relationship between the two variables. It is clear that the constant term and the coefficient for the independent variable are both insignificant at all levels. Moreover, the coefficient of $LNUN_{dif}$ is found to be positive and tends to zero (= 0.0004). On the other hand, the coefficient of the lagged real GDP difference ($LNRGDP_{dif}(-1)$) is the only significant coefficient at 5% significance level (= -2); therefore, it is the only term to be included in equation (13). Consequently, it means that real GDP in Egypt is self-explanatory where it is not impacted by unemployment's fluctuations. However, this coefficient is -2 that reflects an inverse relationship between $LNRGDP_{dif}$ and $LNRGDP_{dif}$ which does not make any economic sense. Table 4 presents both the insignificance and coefficients of this long run equation.

Table 4. The Estimated ARDL Long Run Coefficients (First Difference Model).

The Dependent Variable $LNRGDP_{dif}$

Variables	Coefficients	Std. error	t-statistics	P-value
LNRGDP_{dif}(-1)	-2.001*	0.333	-6.016	0.000
C	0.087	0.099	0.867	0.394
LNUN_{dif}	0.0004	0.018	0.023	0.982
DLNRGDP_{dif}(-1)	0.335***	0.197	1.704	0.101

Source: Author own estimations using E-views 12 package for variables' time series.
*, **, *** indicate significance at 1 , 5 and 10 per cent level, respectively.

Results presented in table 4 assures that there is no relationship between real GDP growth and unemployment in the Egyptian economy. However, the paper must test the relationship in the short run as well in the following using the Error Correction Model (ECM) technique. The following table 5 presents the results for ECM between these two variables.

Table 5. The Estimated ARDL Short Run Coefficients (First Difference Model).

The Dependent Variable LNRGDP _{dif}				
Variables	Coefficients	Std. error	t-statistics	P-value
CoIntEq(-1)	-2.001*	0.313	-6.385	0.000
DLNRGDP_{dif}(-1)	0.335***	0.181	1.853	0.08

Source: Author own estimations using E-views 12 package for variables' time series.
*, **, *** indicate significance at 1 , 5 and 10 per cent level, respectively.

Results presented in table 5 also proves that there is no relationship between real GDP growth and unemployment in the Egyptian economy even in the short run. Of course, the results are consistent with the long run results and analysis. In addition, results show that the estimated error correction coefficient (= - 2) is negative and significant 1% significance level ensuring that the adjustment process from the short-run deviation is very fast.

Moreover, the estimated model stability is checked using several diagnostic tests such as ARCH test, LM

Test and Jarque-Bera test. Results clarify that residuals are normally distributed and there is no sign of heteroskedasticity and serial correlation in this forecasted model. These results are presented in the following table 6.

Table 6. The Results for the Three Diagnostic Tests.

Test	Test Statistics	P-value
Normality	1.7655	0.5121
Serial correlation	0.0298	0.6987
Heteroscedasticity	0.4894	0.7855

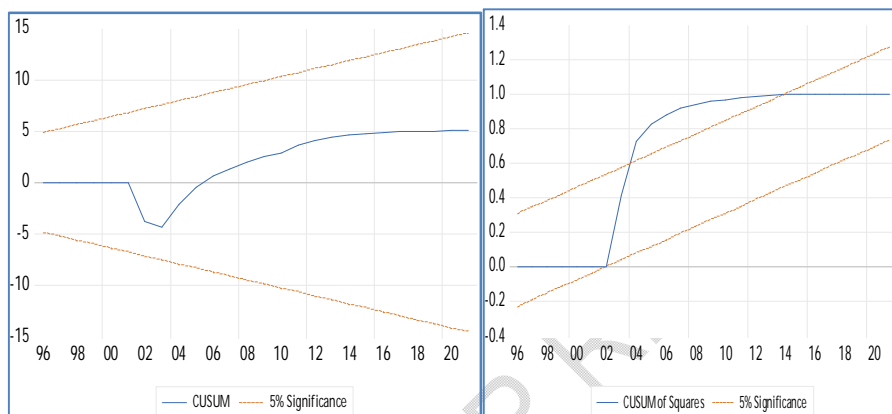
Source: Author own estimations using E-views 12 package for the specified time series.

4.3.2 Testing the Stability and Reliability of the Model

To test stability and reliability, the cumulative sum of recursive residual (CUSUM) and cumulative sum of squares of recursive residual (CUSUMQ) are tested and presented in

Figure 2. The CUSUM test shows a shock through the period 2002 to 2004, that reflects the instability of the model during this time. Of course, it was the time of deep recession in the Egyptian economy that witnessed continuous increase of unemployment rates. In addition, the (CUSUMQ) test assures this shock where the estimated model and parameters are instable at 5% significance level since the recursive error line provides the sharp shock appeared in the unemployment rate during the period 2002 until 2013 when it returned back again to the path between the two critical lines.

Figure 2. Graphing CUSUM and CUSUMSQ



4.3.3 ARDL Results for Gap Model

As discussed previously, in this part the paper examines the Okun's Law Gap Version. In this version, LNRGDPgap is employed to be the dependent variable and DLNUNgap to be the independent variable. The paper takes DLNUNgap as an independent variable because LNUNgap is proved to be integrated of degree one $I(1)$, see table 1. Therefore, the paper clarifies that the employed model is ARDL (2, 4) which does not prove any significance for the long run relationships at all of 1%, 5%, and 10% significance levels. Table 7 illustrates this finding. The calculated F-Statistics value (6.41) which lies in between of both the lower and upper critical bounds at the three levels of significance. Therefore, ARDL test is inconclusive and the paper cannot reject the null hypothesis of no co-integration. As a result, there is no evidence of co-integration in the long run at all levels of significance between real GDP and unemployment. Of course, the paper investigates that the gap version of Okun's Law is not valid for the case of Egypt.

Table 7. ARDL Bounds Co-integration Test (Gap Model).

	F-statistics	
	6.41	
Critical value bounds		
Significance levels	I(0)	I(1)
10%	3.303	3.797
5%	4.09	4.66
1%	6.03	6.76

Source: Author own estimations using E-views 12 package for variables' time series.

According to this finding, the paper could not find an evidence for the Okun's gap version to state a long run relationship. However, it does not necessarily mean that there is no correlation between these two variables in Egypt. Moreover, it does not mean that there is

no long run co-integration in this model of variables but rather it reflects the need for more accurate data to verify such a relationship.

To sum, the paper does not find an evidence to validate Okun's Law, in both of its versions, in Egypt due to the available data. In addition, the paper sheds light on the reliability of data in developing countries and the need to use this data with more cautious.

5. CONCLUSION

The present paper employed data for the Egyptian economy through 1991 until 2021 with objective to examine the two versions of Okun's Law, the difference and the gap models. This time series of data is investigated with unit root tests, ADF and PP, then is used to estimate the two targeted models. Upon the estimation of models, the paper finds the results are inconsistent with economic theory and go in the opposite direction of most of studies for other countries. Inflation rate is shown to be highly volatile causing similar sharp volatility and instability in unemployment rate, due to their heavy interactions. As a result, the paper is not able to find any evidence for the validity of Okun's Law in Egyptian case, neither for the difference version nor for the gap version. Moreover, it is found that there is no relationship between real GDP and unemployment rate in Egypt neither in the long run nor in the short run. In Egypt, real GDP is self-explanatory and totally independent of fluctuations of unemployment. The paper attributes these findings to the lack of reliable data, a phenomenon that most of developing countries suffer from. As a result, economists must use macroeconomic data for developing countries with severe cautious before using it to recommend policies. Finally, Egypt is required to gather and publish more accurate and reliable data regarding socio-economic variables to conduct such an important research.

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